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Investigations of Attitudes towards Offshore Wind Farm Development in Ireland: Their Implication towards Future Development of the Industry.

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INVESTIGATIONS OF ATTITUDES TOWARDS OFFSHORE WIND FARM DEVELOPMENT IN IRELAND: THEIR IMPLICATIONS TOWARDS FUTURE DEVELOPMENT OF THE INDUSTRY

A Thesis

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of

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I would like to dedicate this to my parents Ann and Martin for their continued and unquestioning support of my academic progression.

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ABSTRACT

Melia, Aidan. M.S., Purdue University, May 2013. Investigations of Attitudes towards Offshore Wind Farm Development in Ireland: Their Implication towards Future Development of the Industry. Major Professor: Robert Herrick.

This current research investigates what the attitudes of Irish people are towards the development of offshore wind farms in Ireland. Using a qualitative approach, a questionnaire is carefully designed and distributed among a sample population from three coastal communities. One is located on the west coast and two on the east coast. The two locations on the east coast have an involvement in offshore wind farms. One of the locations plays host to Ireland's only offshore wind farm, while there are plans in place for an offshore wind farm at the other location. The results from the questionnaires are analyzed with regard to the respondent's proximity to the coast, their age, their gender and their educational levels. This analysis results in a number of conclusions being generated. Overall, it is found that there is a strong support amongst the respondents for the development of offshore wind farms in Ireland.

CHAPTER 1. INTRODUCTION

This chapter provides a general overview of the research topic. The introduction is aimed at providing the scope or breadth of the research as well as the general significance of the topic. Definitions which are crucial to understanding the area of research are provided, and assumptions, limitations and delimitations of the research are also addressed.

1.1. Scope

It is clear from the energy policies of a number of countries, namely Denmark and Germany, that renewable energy is now taking center stage with relation to the development of the future energy strategies for such countries. In the case of Denmark, there is an aim to fully remove the need for coal, oil and gas by the year 2050 (Danish Energy Agency, 2011). With regard to Germany, the government there has led the way in relation to feed-in tariffs for renewable energy. Feed-in tariffs guarantee grid connection for renewable technologies while also providing a premium rate for technology developers to guarantee a profit (Rickerson, Bennhold, & Bradbury, 2008).

Such policy directions prove the importance that renewable energy is now playing for future energy provision. Ireland has set about creating its own targets for generating electricity from renewable sources (see section 2.2) and there has been much talk in recent times of the country becoming an exporter of renewable electricity (Denny, Touhy, Meibom, Keane, Flynn, Mullane, & O' Malley, 2010) and the recently signed Memorandum of Understanding between Ireland and the UK allows Irish wind farms to export to the UK (Irish Times, 2013). As a subject in its entirety, renewable energy development is extremely broad and represents much more work than is possible to include in this thesis. With this taken into consideration, the thesis will focus on wind energy, as this is an area which has seen significant development in recent years in Ireland. In 2009 wind accounted for 10% of all electricity generation (Sustainable Energy Authority of Ireland, 2010).

There will be a more specific focus however on the area of offshore wind energy, as compared to its onshore counterpart. The offshore wind sector has not been developed to its full potential in Ireland. The study will center primarily on Ireland, however reference will be made to international examples, especially from continental Europe and the USA.

1.2. Significance

Fossil fuels have usually been the core component for generating electricity worldwide since the foundation of the industry. The use of coal in particular has been paramount to this. Since large-scale electricity production became the norm at the

beginning of the 20th Century, coal-fired power stations have emerged in many countries, particularly those which have experienced an industrial revolution of some description. The UK, the United States, Russia and China have all delved into the world of coal produced electricity, and have been heavily reliant on it. The United States relies on 829,477 kilotons of coal annually for use in coal burning power plants (International Energy Agency, 2009). This equates to 49% of the total electricity generated there. Other countries however, such as South Africa and Poland have an even higher dependence on coal for electricity generation; 93% and 92% respectively (International Energy Agency, 2011). It is only relatively recently that other fossil fuels, namely oil and natural gas, have taken over as key players in electricity generation.

This heavy reliance on fossil fuels to generate electricity, regardless in what form, cannot continue at its current level. There are three basic reasons for this; climate change, air quality and security of supply (International Energy Agency, 2012). Climate change and air quality have been key drivers in realizing the need for changing our habits with relation to energy production. Security of supply issues have traditionally been drivers in exploring alternative methods of producing energy from renewable means. Renewable electricity can play a key role in the overall solution to these issues.

Another important issue to address however is the fact that the world's population is steadily increasing, particularly in areas where electricity may not be readily available. According to a report by the United Nations (UN), the population of the world is expected to rise by 37%, from 6.5 billion in 2007 to 9.2 billion by 2050 (UN

2007a). It will be difficult to sustain such population increases without considerable energy resources, particularly electricity, and particularly renewable electricity.

There are a number of different methods used to generate renewable electricity. Wind energy is a common choice, however it is only one of many. Traditional forms of generation include the use of hydropower, and biomass such as wood and peat. More recently, solar energy and landfill gases have been harnessed to generate electricity (Malik, Lerner, & MacLean, 1987). As renewable resources are often restricted due to location and climatic conditions, there is no single source which can be deemed all encompassing. In the case of wind energy, it is often location specific with regards to where the highest resources can be found. Some countries have resources which vary significantly within their own borders. The United States is a prime example of this. There are relatively strong wind resources in certain states such as Montana and Wyoming compared with Georgia or Alabama. As can be seen in Figure 1.1 Ireland is no different, with higher wind speeds located along the west and north-west of the country. This location specific nature of the resource is clearly a significant disadvantage of wind energy.

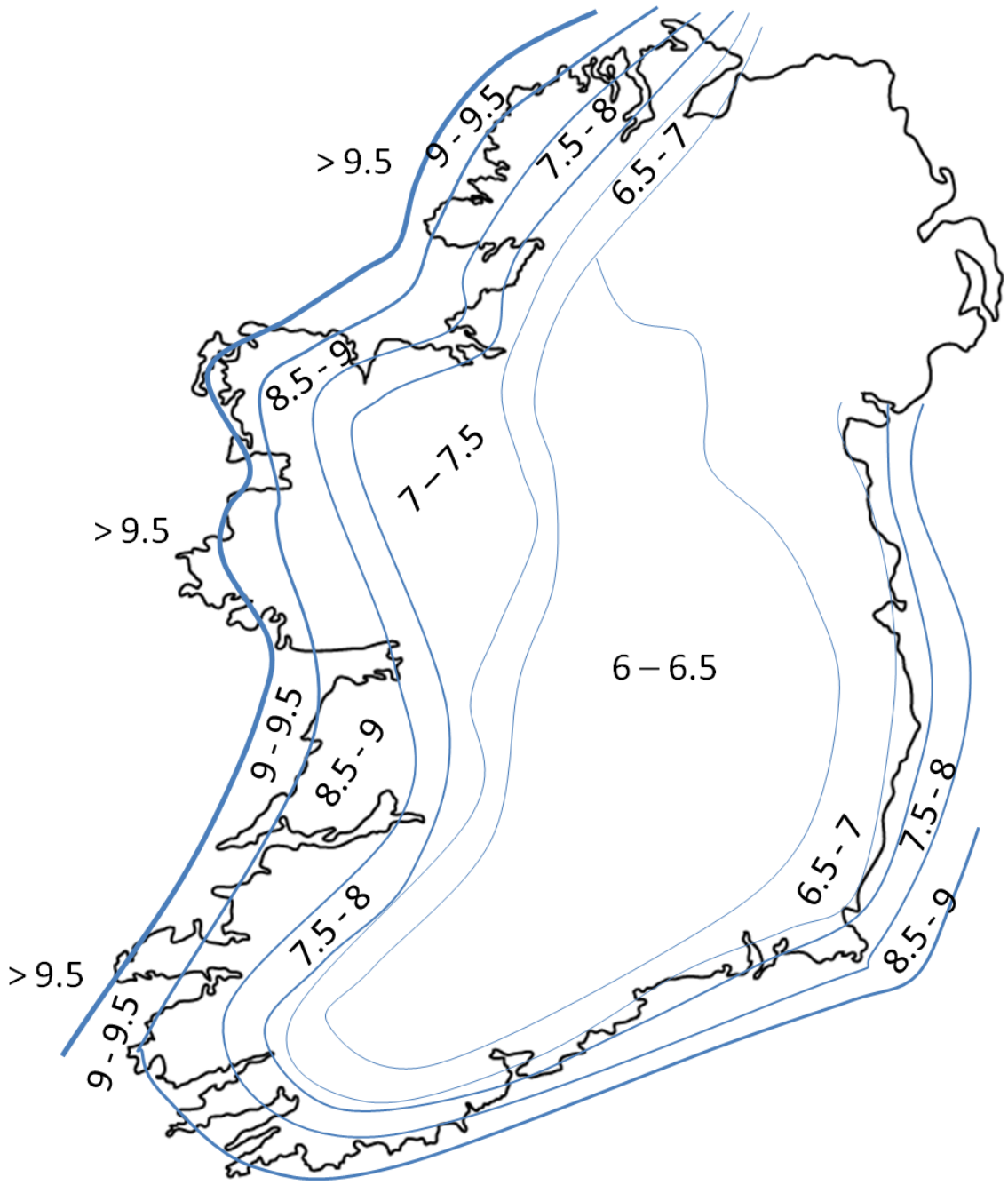


Figure 1.1. **Wind resources in meters per second in the Republic of Ireland (Retscreen, 2012)**

Using turbines to harness the winds energy (as explained in more detail in Chapter 2) is a well developed technological innovation. Erecting offshore turbines

(Figure 1.2) is a more recent phenomenon. Due to higher and more constant wind speeds, offshore wind turbines have proven themselves capable of producing higher quantities of electricity in comparison to their onshore counterpart, and other forms of electricity production (Bigili et al., 2011). One study by the British Wind Energy Association (BWEA) has estimated that in certain areas, wind speeds can be as high as 9 m/s in relatively close proximity to the shore line (BWEA, 2004). Taking this into account, it is clear that offshore wind is significant with respect to the renewable energy sector as a whole.

Figure 1.2. **A typical offshore wind farm (PM Generators, 2012)**

1.3. Research Questions

The formulation of the research questions is a central step in the research process. According to Flick (1998) this is a step which essentially determines whether

the overall research will be a success. Formulating concrete research questions is therefore vital to having a streamlined research process. The questions central to this research were:

1. What are Irish people's attitudes towards the development of offshore wind farms in Ireland?
2. Do these attitudes have any implications towards the future development of offshore wind farms in Ireland?

The reasons for these questions are outlined below in section 1.4.

1.4. Objectives of Research

Research related to attitudes towards wind power development in Ireland has been carried out in the past. In 2003, the Sustainable Energy Authority of Ireland (SEAI) completed research entitled; "*Attitudes towards the development of wind farms in Ireland".* The results from that study indicated a generally positive attitude towards wind turbines and the development of the wind industry. No research has been carried out however on the attitudes towards offshore wind farms in Ireland. This represents a significant gap in research considering other such research has been conducted in a number of countries such as Denmark and the United States.

The research was designed with the intention of providing a comprehensive set of results regarding people's attitudes towards offshore wind farms in Ireland. The information compiled could be of particular interest to investors, developers and government officials who carry an interest in the offshore wind sector. In the case of

investors, the information compiled could give an indication as to whether there is an appetite amongst the public for further development of the offshore wind sector in the country. In the case of developers, the information compiled could give an indication as to whether there would be any significant opposition to the development of offshore wind farms. In the case of government officials, the information compiled could inform policy direction with respect to planning future offshore wind farm developments. This research has been influenced by other similar research. Results generated from this could therefore be used in other countries that are in the process of developing offshore wind farms.

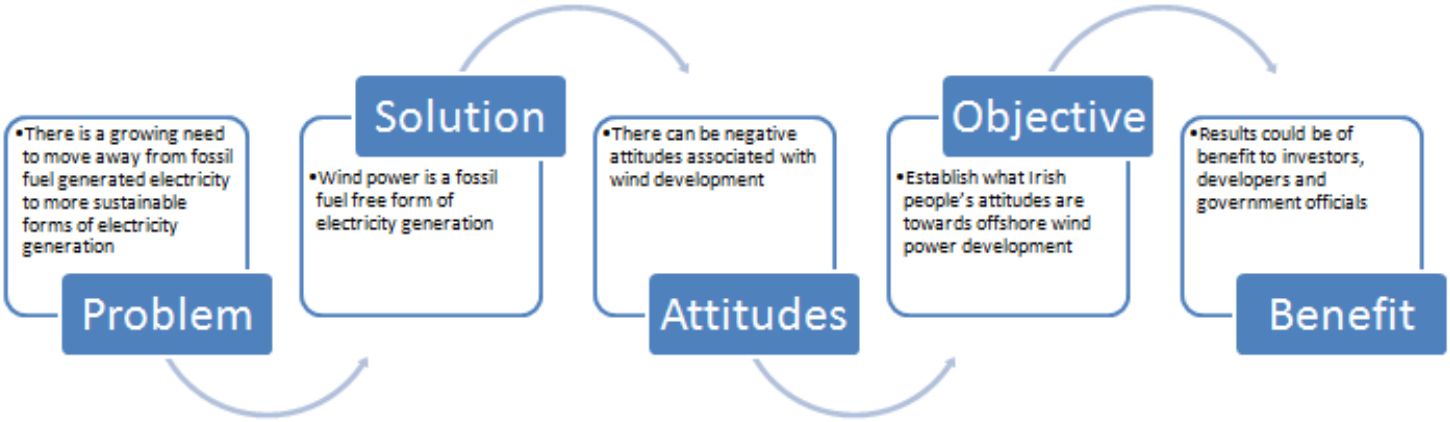


Figure 1.3. **Channels of this research**

As a piece of research, this work would not be complete until all the data (in the form of questionnaire results) was gathered. Only then could the results be adequately analyzed and conclusions drawn.

1.5. Definitions of Key Terms

There were a number of definitions which were deemed important to this study. These are not categorized in alphabetical order but rather in their significance to each other.

Attitude – a psychological inclination that is expressed by evaluating a particular object with some degree of favor or disfavor (Eagly and Chaiken, 1998).

Wind Farms – this is the placement of multiple turbines in a concentrated strategic location in order to generate electricity from the power of the wind (Brown, 2011).

Wind Turbines – wind turbines are devices which convert kinetic energy from the wind into electrical energy (Wind Energy Development Program, 2012).

Offshore Wind Turbines – these are turbines which are located off the coast and harness the energy of moving air over the oceans and convert it to electrical energy (OSC Energy, n.d.)

Horizontal Axis Wind Turbine (HAWT) – these are the most common type of wind turbines with respect to offshore wind power. With this type of turbine, the axis of the rotor's rotation is parallel to the wind direction. (Bureau of Ocean Energy Management, n.d.).

National Renewable Energy Action Plan (NREAP) – the national plan of Ireland which sets out national targets with respect to renewable energy under the duress of the European Union (Department of Communications, Energy and Natural Resources, 2010).

Single Energy Market (SEM) – the creation of a single market for gas and electricity for Northern Ireland and the Republic of Ireland. The SEM is a joint initiative by the Commission for Energy Regulation in the Republic and the Northern Ireland Authority for Energy Regulation (Commission for Energy Regulation, n.d.)

European Supergrid - this is a high voltage direct current network connecting offshore and onshore renewable energy clusters and deliver electricity to the existing high voltage grid on land (Mainstream Renewable Power, 2012).

1.6. Assumptions

There were a number of assumptions central to the research which included the following:

- Wind power is now a well established industry in Ireland. With this taken into consideration, it was assumed that questionnaire respondents already had some general knowledge of the use of wind power to generate electricity.
- It was assumed that the questionnaire respondents could answer all of the questions.
- It was assumed that any questionnaire respondents were answering questions in a truthful manner.
- It was assumed that the research method selected in this study would adequately address the research questions posed.

1.7. Limitations

The following limitations were inherent to the pursuit of this research:

- The research was limited by the number of completed questionnaires received.
- Due to an imbalance in the age profile of the respondents from one of the locations, the results were affected for that area.
- Weather conditions played an important role in the distribution of questionnaires. In one of the locations, heavy intermittent rain showers restricted number of possible respondents.

1.8. Delimitations

Delimitations dealing with the research included:

- The research being limited to three specific towns in Ireland.
- A certain period of time designated for the distribution of questionnaires. In this instance, one day was spent at each study location.
- The questionnaire being designed around the attitudes of respondents towards offshore wind farms, as opposed to their knowledge of the technical workings of wind turbines.

1.9. Organization

There are six primary chapters in this thesis. After this introductory chapter, Chapter 2 provides an overview of literature pertaining to the topic. It begins by giving an overview of the energy sector in Ireland and provides a history of wind energy development as well as information related to offshore wind energy.

Chapter 3 provides an overview of the methodology which was employed in this study. It gives a description of the study locations as well as the merits for choosing the particular research strategy.

Chapter 4 gives an overview of the questionnaire, a presentation of the results, and also provides some interesting correlations associated with them.

Chapter 5 is an analysis of these results. This analysis helps to formulate some conclusions for the overall study.

Chapter 6 provides a summary of the whole study, conclusions which emerged from it and also recommendations for future research.

1.10. Summary

Fossil fuels have been usually been the core component for generating electricity worldwide since the foundation of the industry, however issues such as climate change, air quality and security of supply have led to a rethinking of the situation. Other options

for electricity generation include the use of renewable energies, and wind energy is one of the most commonly used. This comes in the form of turbines erected on land or more recently out to sea in order to harness the power of the wind. At no stage in Ireland has research of note been carried out on the attitudes of people towards offshore wind development. Definitions, assumptions, limitations and delimitations relevant to the study are included in this chapter and an overview of the entire document has been provided in this chapter. The next chapter provides an overview of literature to the study.

CHAPTER 2. REVIEW OF RELEVANT LITERATURE

2.1. Approach to this Review

Dealing with the energy sector, and in particular renewable energy, is quite an onerous task given the large volume of material that relates to it. The scope of this study helped to define the depth and breadth required in the current literature review. Much of the review centered on Ireland and Europe, with some references made to the United States. Limiting the scope of the geographical area where possible, considerably reduced the level of work involved without necessarily hampering the quality. Wind energy is now an expansive area in terms of research volume; therefore, this review focused on the basic principles of wind energy and also incorporated offshore wind, the topic that forms the core of this thesis. The literature search methodology involved using databases such as *Science Direct* to obtain and research journal articles. Together with this, books, papers and websites were used to gather information. The information is presented in sequence, firstly examining the energy sector in Ireland, followed thereafter by a background to the wind energy sector in both continental Europe and Ireland. The offshore wind sector is dealt with extensively together with public opinions towards the sector. The review concludes with the ecological impacts associated with offshore wind farms.

2.2. Energy in Ireland

There appears to be a need for significant investment in the renewable energy industry in Ireland. Consumption of energy has increased significantly since 1990 to coincide with a major period of growth in the economy. The major areas of energy consumption are in electricity generation, heating and transport. Ireland is heavily reliant on imported fossil fuels for all three sectors. The figure for imported fossil fuels in 2008 stood at 88%, which is higher than the 2008 EU average which was 55% (SEAI, 2011a). Due to this high figure of imported fuels, this over-reliance is not sustainable in terms of security of supply for Ireland. However there is a significant opportunity for a reduction in the country's dependence on fossil fuels, especially with regard to electricity generation.

Gross electricity consumption doubled in the period from 1990 to 2010. In 2009, it accounted for 32% of the total primary energy consumption (O' Rourke, Boyle & Renyolds, 2009). Natural gas played a central role in this growth with its share in electricity generation increasing from 28% in 1990 to 55% in 2009 (SEAI, 2010). However the recent economic downturn has resulted in an overall reduction in the consumption of energy. Since 2007, the economy has contracted by 10% and energy consumption has declined by 9% (SEAI, 2011b). Despite this, consumption of electricity increased by 2.9%, accounting for less than one fifth of the 2010 energy demand (SEAI, 2011b). This indicates that despite a difficult period for the economy, there is still a strong demand for electricity and that the sector can grow.

The *National Renewable Energy Action Plan* (NREAP) was a plan devised by every member state of the European Union under the EU directive 2009/28/EC. The aim was to establish each nation's energy targets up to the year 2020. The NREAP sets out Ireland's strategy to deliver on the country's 16% overall renewable energy target for 2020. This target covers all sectors, namely, electricity generation, heating and transport. The specific target for renewable electricity is 40%. Achieving this target will have certain difficulties, the primary one being the upgrading of the grid to cope with increased capacity from renewable sources. Certain initiatives, however, like the establishment of the Single Energy Market (SEM) in 2007, has spurred development of a more structured approach to the delivery of electricity across the island of Ireland. This joint initiative by the Commission for Energy Regulation in the Republic and the Northern Ireland Authority for Energy Regulation is evolving continuously to take into account the growth in the renewable energy sector (DCENR, 2010).

2.3. History of Wind Energy

Harnessing the wind's energy is by no means a new idea. The first turbines date back as far as 200 BC with the remains of vertical axis turbines found close to the Persian-Afghan borders (Kaldellis & Zafirakis, 2011). The primary use for turbines at the time was to grind grain. Throughout the 19th Century, turbines were very common in the United States as a means of pumping water. One of the most important events to aid the development of wind power was the oil crisis in 1973. This prompted a serious review of energy production in many countries, with the United States leading the way

in terms of research and development in wind energy (Kaldellis & Zafirakis, 2011). The first commercial farms for generating electricity were built in California in the 1980's. The market soon shifted to Europe with high levels of development throughout the 1990's. This was fuelled by the higher costs for electricity along with reliable and strong wind resources in countries such as Denmark (Kaldellis & Zafirakis, 2011).

The development of offshore farms is more recent. The first turbine erected offshore was in Nogersund, in Northern Sweden in 1990. It is located 250 m offshore with a power rating of 220 kW (Nikolaos, 2004). In 1991, the first large scale offshore wind farm was built in Vindeby in Denmark. Consisting of 11 turbines rated at 450 kW each, and with a total power output of 4.95 MW, this farm represented a new departure in wind energy (Bilgili, Yasar, & Simsek, 2010).

2.4. Characteristics of Wind Turbines

Wind Turbines are divided into two categories, Horizontal Axis Wind Turbines (HAWT) and Vertical Axis Wind Turbines (VAWT). The horizontal axis wind turbine is the most recognizable type. They typically consist of three lift style blades pointed into the wind stream. HAWT are usually referred to as low solidity, meaning that the spinning blades have a high speed and low torque making them more productive (Gipe, 2004). However there are HAWT with multiple blades which appear to be a solid disc. These are referred to as high solidity as the blades have a reduced turning speed (Boyle, 2004).

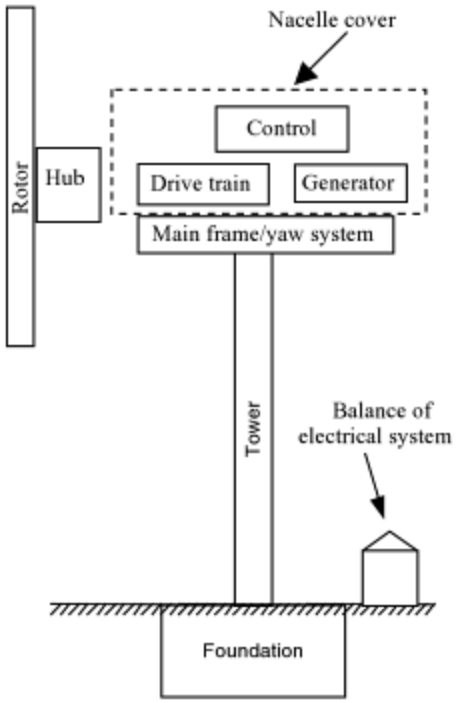


Figure 2.1. **Layout of a typical horizontal axis wind turbine (Manwell, McGowan & Rogers, 2010)**

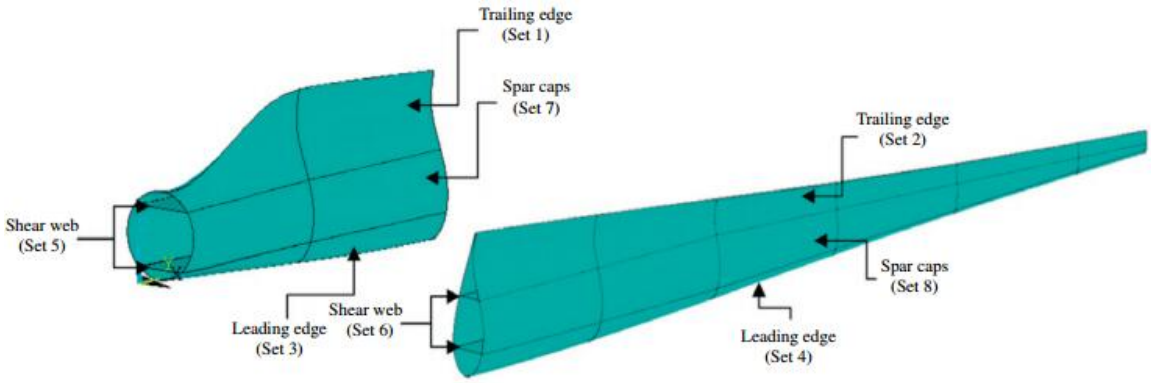


Figure 2.2. **Cross-section of a turbine blade (Chou, Chien, Huang & Chi, 2012)**

The shape of the blades is very important for increasing efficiency, and for most HAWT the blades have a cross section, which has a streamlined asymmetrical shape. The flattest side should face the oncoming wind. The blade itself consists of the leading

edge, the trailing edge, the blade tip and the blade root. Figures 2.1 and 2.2 give an overview of a typical HAWT and blade design respectively.

Unlike HAWT, most modern VAWT (Figure 2.3) are cross flow devices. This means the direction from which the undisturbed wind flow comes is at right angles to the axis of rotation. The blades on a VAWT can be drag or lift driven and sweep a three dimensional surface, usually cylindrical or conical, unlike the circular plane swept by most HAWT. The VAWT extracts most of the power from the wind passing from front to rear of the swept surface. They can function with wind blowing in any direction without the need of a yaw motor. There are many variations on blade shape and configuration in VAWT and they usually have greater solidity than HAWT. This can result in a heavier more expensive rotor (Boyle, 2004). By-and-large, VAWT have not penetrated the offshore market.

Figure 2.3. **Vertical axis wind turbine (Sandia National Laboratory, 2012)**

2.5. Wind Energy in Europe

Wind energy plays a major role in the renewable energy sector in Europe. Germany and Denmark have successfully managed to develop the industry to play an important role in their respective economies. Over 60,000 new permanent jobs were created in the wind energy sector in Europe over the past number of years (Bilgili et al., 2010). The European Wind Energy Association (EWEA) expects this figure to increase to

375,000 by 2030 – 160,000 onshore related jobs and 215,000 offshore related jobs (EWEA, 2009).

With relation to onshore wind, 8,750 MW was installed in Europe in 2011, bringing the total onshore capacity to 90,147 MW (EWEA, 2012). With the exception of Slovenia and Malta, all the other 25 members of the European Union produce wind generated electricity. Germany is producing by far the largest portion of electricity from wind, with a total of 29.1 MW followed closely by Spain with 21.6 MW[1]. Denmark has the highest share of electricity consumption from wind with a total of 29.5%, followed by Spain at 15.9%. Ireland's figure stands at 12% (EWEA, 2012).

In terms of offshore wind, the development potential is huge. There are already significant offshore wind farms in the North Sea. The sector has seen a dramatic increase in capacity since 2000 when only 50 MW was installed. The figure in 2011 stood at 3,810 MW, which represents over a 70 fold increase (EWEA, 2011). The United Kingdom, Denmark, and the Netherlands have significantly developed this area of the renewable energy market. In 2008, these three countries accounted for 85% of the total capacity of the 27 member states of the European Union (Green & Vasilakos, 2010). The European Wind Energy Association expects to see a degree in saturation in the onshore wind market by 2023, for reasons such as higher wind resources offshore and a lack of availability of land onshore. With this expected to happen, there should be a significant rise in interest in offshore wind, particularly from an investors point of view.

[1]This includes offshore capacity.

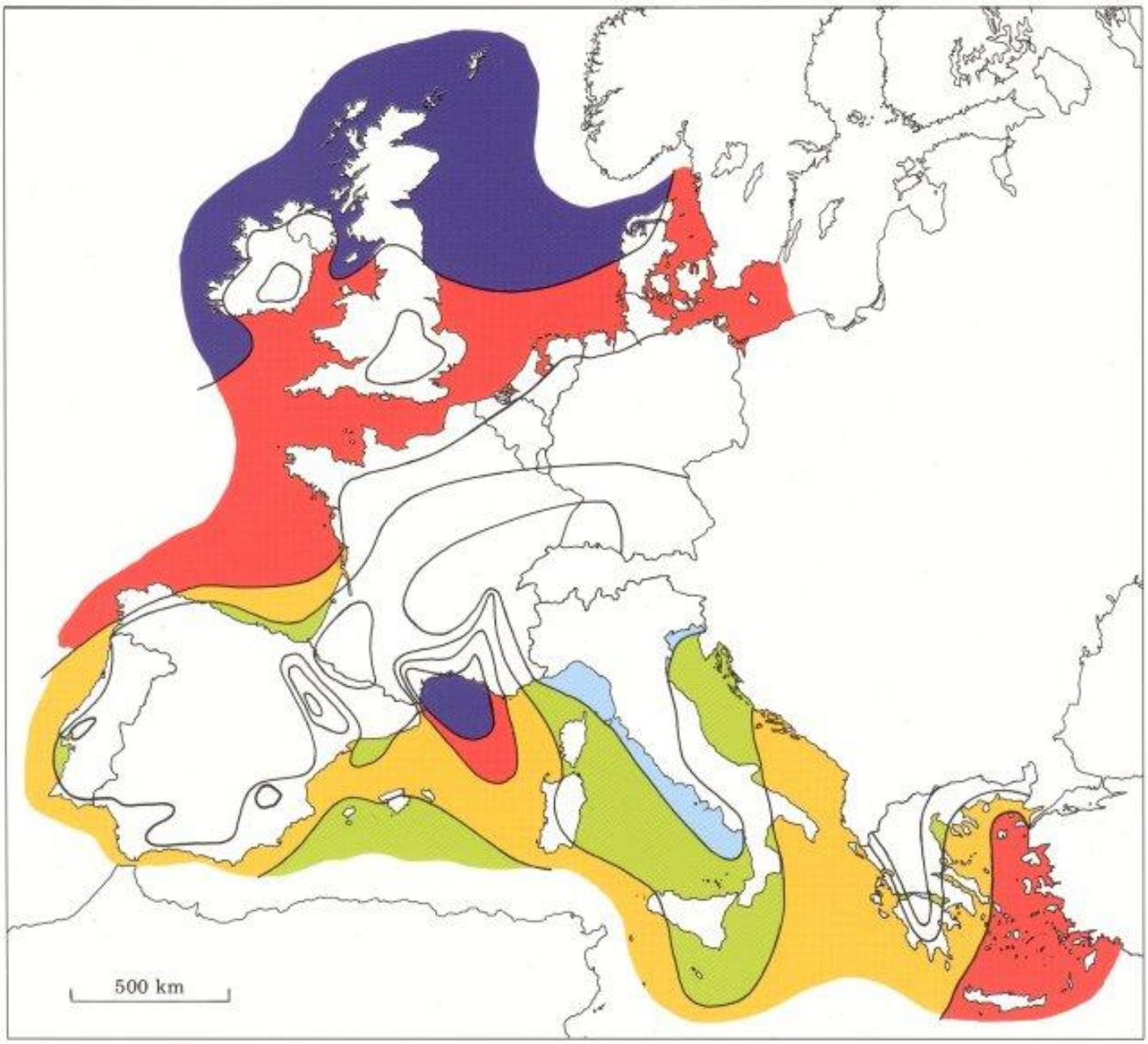
Figure 2.4. **The location of offshore wind farms in North West Europe (Courtesy: Mads Krohmann-Larsen, LORC)**

Europe's current target for wind energy capacity is 230 GW, a figure that includes 40 GW of offshore wind energy. To achieve this target, there will need to be a drastic increase in the annual growth of capacity. The growth of wind farms was 28% in 2008 or 366 MW. This will need to increase annually to 6900 MW by 2020 (EWEA, 2009). However given existing increases in the wind sector, this is not an unattainable target. There is at present 100 GW of offshore wind projects proposed in addition to the farms that are already in operation (Figure 2.4). Therefore meeting the target of 40 GW by 2020 should not present a significant problem. Having 100 GW of installed offshore capacity will result in between 8.7% and 11% of the EU's electricity demand being met. This could simultaneously avoid 202 million tons of CO_2 each year (EWEA, 2009).

The key to the expansion of Europe's wind resource is the planned development of a European "super grid". This grid is aimed at providing a comprehensive and structured link between different countries, especially those involved in offshore wind projects in the North Sea. The grid should contribute significantly to Europe's security of supply by reducing the potential for large-scale black outs and shortages due to the greater ability to trade electricity (EWEA, 2009). The implementation of such a project is likely to play an important role in alleviating the waste of any excess electricity produced.

2.6. Wind Energy in Ireland

Due to Ireland's location on the western periphery of Europe (Figure 2.5), it is well positioned to benefit from the large wind resource available to it which can be seen in Figure 1.1. There is an estimated energy resource of 613 terawatt hours (TWh) available per year, which is approximately four times the European average (SEAI, 2004). Ireland utilizes 2.8 TWh of this for electricity generation with a significant potential to increase this figure. At present there are over 1600 MW installed in Ireland (EWEA, 2012). Wind speeds in certain areas can reach over 9 m/s (Figure 2.5). The cut-in speed of a turbine, which is the speed at which the turbine will start generating power, is typically less than 5 m/s.



Wind resources over open sea (more than 10 km offshore) for five standard heights										
	10 m		25 m		50 m		100 m		200 m	
	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}
	> 8.0	> 600	> 8.5	> 700	> 9.0	> 800	> 10.0	> 1100	> 11.0	> 1500
	7.0-8.0	350-600	7.5-8.5	450-700	8.0-9.0	600-800	8.5-10.0	650-1100	9.5-11.0	900-1500
	6.0-7.0	250-300	6.5-7.5	300-450	7.0-8.0	400-600	7.5- 8.5	450- 650	8.0- 9.5	600- 900
	4.5-6.0	100-250	5.0-6.5	150-300	5.5-7.0	200-400	6.0- 7.5	250- 450	6.5- 8.0	300- 600
	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 6.0	< 250	< 6.5	< 300

Figure 2.5. **Offshore wind resources in Europe (Wind Atlas, 2011)**

For Ireland to achieve its 40% target of gross electricity consumption from renewable sources, an installed capacity of 3100 MW will be required (SEAI, 2010). At present there is only one offshore wind farm in Ireland (see section 3.2.1). To meet the 40% target, it is expected that there will be further expansion of this particular farm and the development of others.

2.7. Offshore Wind

The development of offshore wind farms is significantly different to that of onshore farms. As the majority of turbines are located about 20 km from the coast, there are a number of different considerations which need to be taken into account, the primary one being the support structure required for the foundations of the turbines. Figure 2.6 highlights various different support structures that have been applied to offshore wind projects with respect to water depth. These include traditional monopole structures and more ambitious floating structures. Other considerations are; strengthening the turbine tower to deal with the harsher maritime climate, protecting the nacelle against the sea air, and providing appropriate access points for maintenance vessels (Bilgili et al., 2010). Another major consideration is the laying of submarine cables, which adds significantly to the capital costs of an offshore project over an onshore project (Zhixin, Chuanwen, Oian, & Chengmin, 2009).

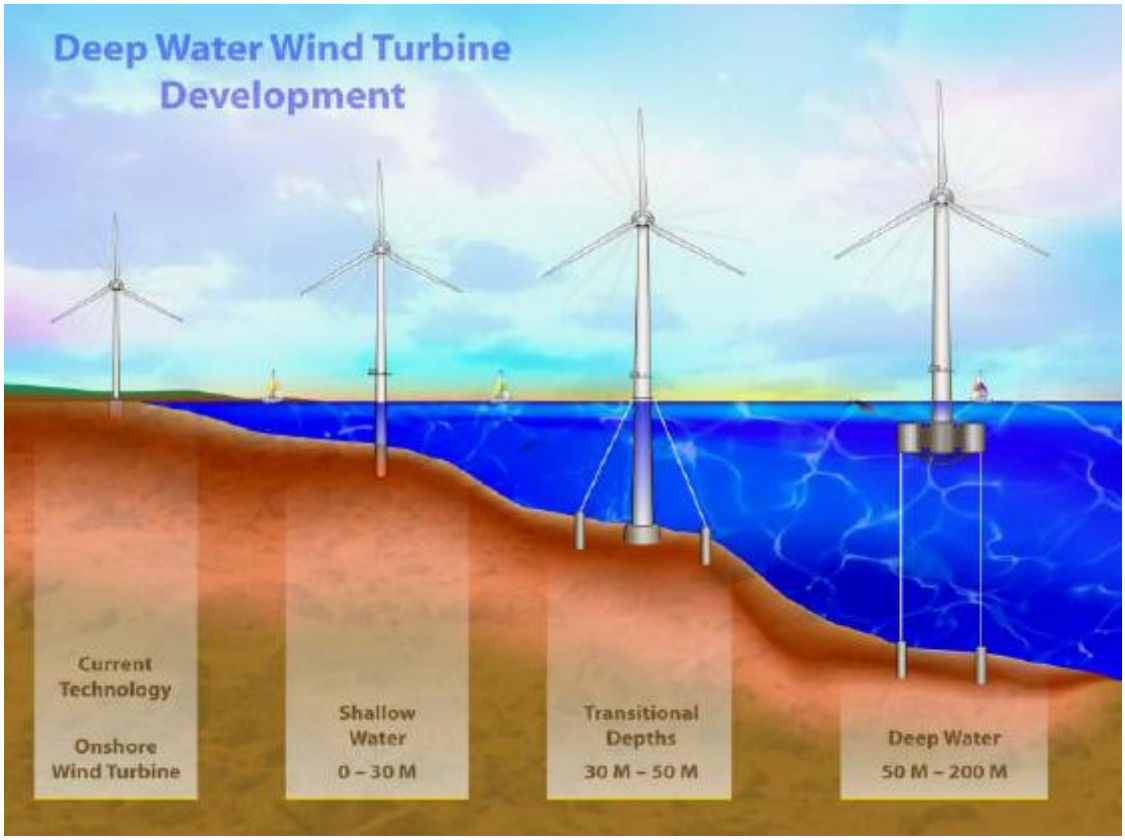


Figure 2.6. **Types of offshore turbine support structures (International Energy Agency Wind, 2011)**

There are a number of advantages and disadvantages as summarized by Bilgili et al. (2010), which can be associated with offshore farm development. Table 2.1 shows these advantages and disadvantages.

Table 2.1.
Advantages and disadvantages of offshore wind (Bigili et al. 2010)

Advantages	Disadvantages
Greater availability of larger areas to facilitate the development of large projects.	Access for operating and maintenance is considerably more difficult than onshore installations.
A reduction in noise impacts and the	Grid networks are often weaker along

impacts on onshore visual amenity.	shorelines adding significantly to costs.
Greater wind speeds, which results in a higher level of generation.	Installation is often hampered by weather conditions.
Lower wind shear which results in the possibility of using shorter towers.	Foundations for turbines are generally more expensive than onshore turbines.
Less wind turbulence which results in more effective harvesting of energy.	

Due to the more complex nature of developing offshore wind farms, associated costs are significantly higher. Installing turbine foundations, for example, often represents a significant portion of the costs for the entire project. Green and Vasilakos (2010) claim that foundations represent 21% of the construction cost for the project, while another study has estimated an even higher cost of over 36% (Nikolaos, 2004). An article by Blanco (2008) describes the primary cost factors of offshore wind development. Construction and installation is generally less developed and more complicated than the onshore equivalent. Operating and management costs are also substantially higher due to difficulties in accessing the site. Electrical cabling linking the turbines to the mainland as well as providing a connection to each other can be expensive. Due to higher perceived negative impacts on the environment, there tends to be more preliminary environmental analysis carried out, as well as ongoing research and development programs to monitor the situation once the wind farm is operational.

There are higher risks associated with offshore wind projects compared to onshore ones. For investors this equates to higher interest rates and premiums. Other factors such as fluctuating steel prices can also have an impact on overall costs (Green & Vasilakos, 2010).

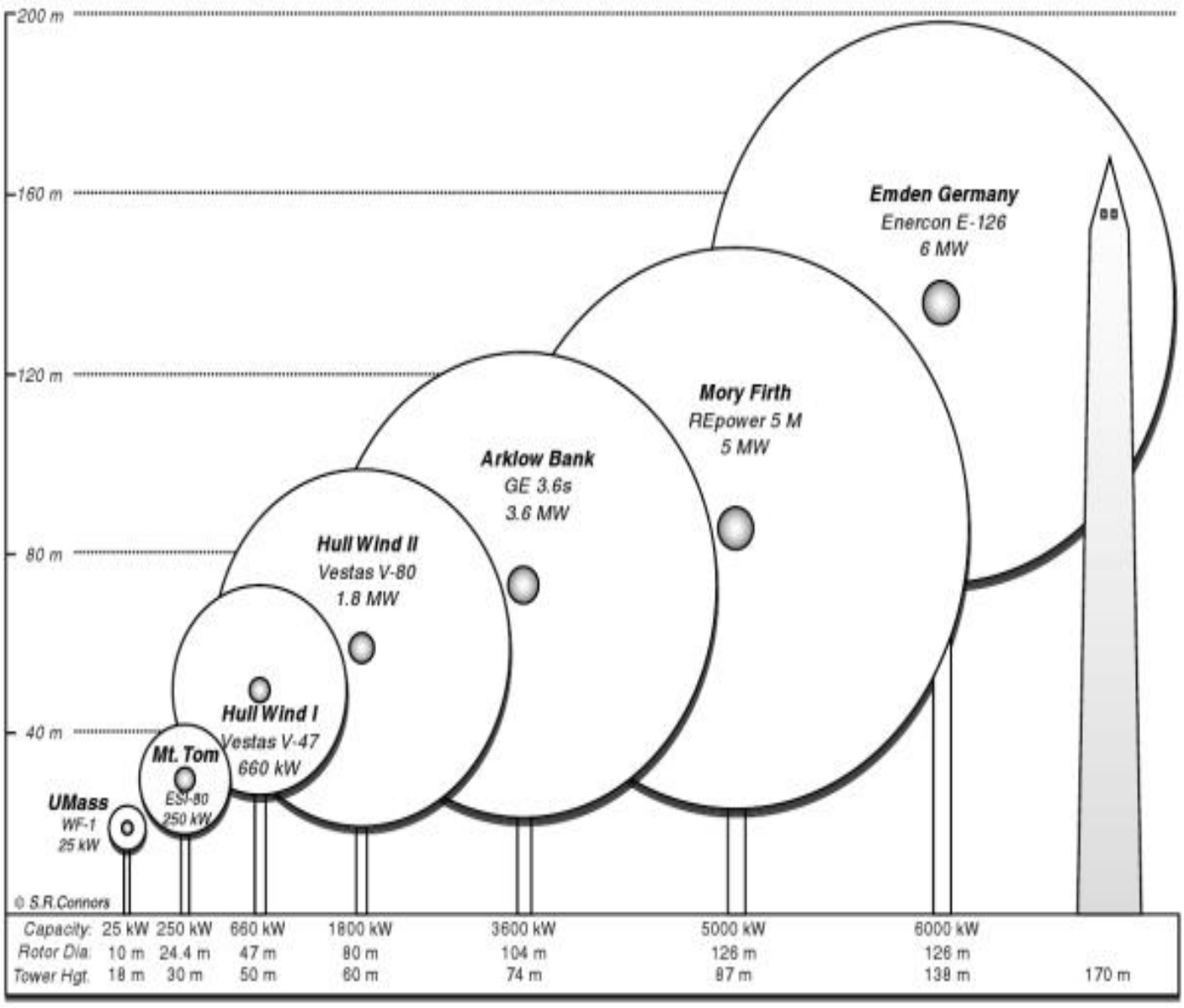


Figure 2.7. **Development of offshore turbines (Courtesy: Steve Connors, MIT)**

Despite these issues however, the size and output capacity of offshore turbines has continued to increase (Figure 2.7).

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2.8. Public Opinion

To date, there has been no substantial research published with relation to public attitudes towards offshore wind turbines in Ireland. In 2003, the Sustainable Energy Authority of Ireland carried out significant research into people's views about onshore turbines. The results were found to be quite favorable towards turbines and the industry in general, with eight out of ten respondents in favor of further construction of wind turbines (SEAI, 2003). In the same study, the development of power stations and mobile phone masts were seen as being far more controversial than the development of wind farms. 40% of respondents felt that five-turbine wind farms had a positive impact on the landscape, this figure decreased however as the number of turbines increased (SEAI, 2003).

The development of wind farms can constitute a prime element of NIMBYism (Not in My Back Yard). This situation is often prevalent in strategic infrastructure projects, i.e., projects that are for the good of the population but that few want to live near. Energy projects in general usually fall under this category as well as other projects such as airports and waste disposal facilities. With relation to wind energy and the NIMBY effect, "the basic theory is that people support wind energy on an abstract level but object to specific local projects because of suspected consequences concerning primary noise and visual impact" (Krohn & Damborg, 1999: 957). Some studies such as

Bell, Grey and Haggett (2005) and Wolsink (2006), claim that the NIMBY factor should not be held solely accountable for the non-acceptance of wind farms. There are a number of studies which focus on the area of offshore wind farm acceptance.

Some studies favor offshore development over onshore for a number of reasons. These include reduced visual impact (Ladenburg, 2010), reduced NIMBYism (Farrier, 1997), less direct impact with humans (Jones and Eiser, 2010), strong ethical values such as increased renewable energy, and material values such as job creation (Waldo, 2011). Studies by Ladenburg (2008, 2009) examined people's attitudes towards offshore wind farms extensively, using respondents from Denmark. His studies supported the view that onshore turbines can represent a major imposition on people's everyday lives, as the majority of respondents favored offshore turbines over onshore turbines. The reduced NIMBY factor (as highlighted by Farrier above) is a prime reason for this. Much of the reaction was related to the proximity in which people lived to offshore turbines. In this study, respondents who could see offshore turbines on a daily basis from their homes did not have a negative attitude towards them. In general, they were the preferred choice over onshore turbines. This more negative view towards onshore turbines is supported by Swofford and Slattery (2010), whose research in Texas found that the lowest levels of support for wind energy came from those living closest to turbines. However other studies found the opposite effect. Warren, Lumsden, O' Down and Birnie (2005: 866) discovered "an 'inverse NIMBY' syndrome". This is where people living in close proximity to turbines were found to be the most supportive of them.

However there are also negative views towards offshore development. A study carried out by Firestone and Kempton in Cape Cod found that "the overwhelming majority of the public expects negative impacts from the project, and can name many expected negatives" (2007: 1596). These negatives included impacts on aesthetics, the local fishing industry, community harmony and recreational fishing and yachting. The idea that the impact on visual amenity is alleviated once turbines are located offshore is dealt with by Devine-Wright and Howes when suggesting that "offshore wind farms may be just as controversial as onshore projects, since the places affected by change do not cease at the water's edge and include the view of the horizon" (2010: 278). Haggett (2011) points out that intrusions to coasts and coastal views are unlikely to be welcome and she uses Henderson (2002) as an example in saying that the visual impact of turbines are difficult to solve with increased distance given the fact that the cliffs of Dover (England) are visible from Calais (France); 30 km away.

The difference between local impacts from turbines and the wider positive impacts are highlighted in a number of studies. As wind energy is a major contributor to alleviating carbon dioxide emissions and tackling climate change, this positive benefit is often not felt immediately at a local level where the turbines are located. As described by Haggett (2011), the perceived damage from the installation of turbines is immediate and tangible, but the benefits such as carbon dioxide reduction can often be invisible in a local context. However if local residents were to receive more tangible benefits from an offshore farm such as cheaper electricity, then they might be more open to accepting it (Firestone and Kempton, 2007).

It is interesting to note the importance that age played in a number of studies. In Ladenburg (2008, 2009) it was noted how the relevance of the age of the respondents related to the results. People over the 49 to 54 age category generally had a negative attitude towards both onshore and offshore wind turbines, whereas younger people had a more positive reaction to wind turbines. However in certain respects, this is reflective of the overall attitude of the public towards renewable energy as a whole. Age is clearly important with regards to attitudes towards wind power and with this in mind, it played an important role in the methodology for this thesis.

2.9. Ecological Impacts

Besides perceived problems with visual amenity, there are also perceived ecological problems associated with the construction and operation of offshore turbines. One of the primary concerns is that turbines will cause excessive avian mortality through collisions. Snyder and Kaiser (2008) conducted research into the area of the effects of turbines on bird populations and particularly their risk of collision. The research was carried out on onshore turbines and the mortality rate was found to be between 0.01 and 23 per turbine per year. Measuring the mortality rate for onshore turbines can be done simply by counting carcasses in the vicinity of the turbines. This is considerably more difficult to measure however for offshore turbines. One solution used at the Nysted wind farm off the coast of Denmark was to use a thermal imaging system placed on top of one of the turbines – this would give a general average of bird collisions. It was found that there was a collision rate of 0.02%.

One of the primary mitigation measures to avoid collisions, as discovered by Parkinson (2001) is suitable location of turbines. Ideally, wind farms should be located away from areas of ornithological interest and migratory routes. The primary difficulty in this though is that often the most suitable locations for turbines are coastal areas where birds often naturally tend to gather.

The construction phase poses significant difficulties to mammals. As they are highly sensitive to sound, the increased noise levels emitted during construction can pose issues of sensitivity for them. The pile driving of a monopole foundation, the most common in offshore construction, have been found to create noise levels of 205 decibels (dB) (Bailey, Senior, Simmons, Rusin, Picken & Thompson, 2010) in some cases, and even as much as 228 dB (Synder & Kaiser, 2008). This can cause hearing loss for seals in the immediate area and hearing loss for porpoises would likely extend 1.8 km away from the source. It would be audible for porpoises 80 km away (Snyder & Kaiser, 2008). When the farm is operational, the movement of the turbine blades can pass vibrations through the tower and into the water. This can have a negative effect for mammals given their requirement to communicate via acoustic signals. Despite this however, porpoises and seals will generally leave the area temporarily while construction is on-going. Studies have shown that their numbers usually re-establish overtime (DONG, Vattenfall, DEA, & DFNA, 2006).

The effects of turbines on fish can be both positive and negative. It will naturally vary depending on the species of fish. Tests were carried out by Abbott and Bing-Sawyer (2002) on fish placed in cages close to where pile driving operations were

ongoing. The study conducted on Sacramento blackfish found that fish placed close to the source of sound (45 m or less) experienced more damage than those further away. Damage was only caused to fish exposed to 193 dB or more. There was no evidence to suggest that fish actually died during the work. Another study by the California Department of Transport (2004) compared the effects on fish that were exposed to pile driving and fish that were transported to the site and exposed to no noise. Results showed that fish which were exposed to the pile driving experienced more damage than those not exposed to the noise.

Another significant impact of offshore turbines is the electromagnetic effect that underwater cables can have on fish. Many species contain magnetic substances as an aid for navigation and this can be hampered by the electromagnetic field emitted by the cables. Such species include yellow fin tuna and sockeye salmon. Research carried out at the Nysted site in Denmark concluded that there were differences in the number of fish caught on both sides of the cables suggesting that there are effects on the migratory pattern of fish (DONG et al. 2006).

There are positive effects on fish as a result of turbines in the fact that wind farms provide a natural sheltered area from fishing boats (Parkinson, 2001). There is also evidence to suggest that they make good breeding grounds. Research in Sweden found that there were increased numbers of fish in the vicinity of the Yttre, Stengrund and Utgrunden farms (Wilhelmsson, Malm, & Ohman, 2006).

2.10. Summary

This chapter has provided an overview of literature pertaining to the energy sector in Ireland. It has highlighted that there is a need for significant investment in the renewable energy industry in Ireland. This is primarily due to the country's heavy reliance on imported fossil fuels, which is close to 90%. This chapter also provided a history of wind energy development as well as the characteristics of wind turbines, particularly those most applicable to offshore wind energy. With Ireland having a 40% target for renewable electricity by the year 2020, it is clear that offshore wind can play a significant role in achieving this. This is especially true given Ireland's unique position on the periphery of North West Europe, where wind speeds are generally quite high. Positive attributes of offshore wind include higher generating capacities than onshore and also less conflict with landowners. Negative attributes include higher costs and impacts on marine mammals. The review has confirmed that there is a basis for the research questions posed, as there is no literature pertaining to the attitudes of offshore wind farms in Ireland. The next chapter will discuss the methodology and research framework that was used in this study.

CHAPTER 3. METHODOLOGY

The purpose of this research was to obtain and analyze the attitudes of Irish people towards offshore wind farm development. In research, there are two primary methods used to gather data. These are:

- Quantitative research methods.
- Qualitative research methods.

3.1. Quantitative versus Qualitative Research

Distinguishing between these two methods was important when setting out a research framework. Quantitative research is defined as research which is used to "quantify the variation in a phenomenon, situation, problem or issue" (Kumar, 2011: 13). It is generally measured with numbers, and analysed with the use of statistics in order to determine whether the hypothesis or the theory holds true (Creswell, 1994). As Naoum (2007) describes, this type of research is used when:

- It is necessary to find facts about a concept, a question or an attribute.
- It is necessary to collect factual evidence and study the relationship between these facts in order to test a particular theory or hypothesis.

Qualitative research on the other hand is defined as research which is used to "describe a situation, phenomenon, problem or event" (Kumar, 2011: 13). Unlike quantitative type research, it is "subjective in nature. It emphasises meanings, experiences (often verbally described) and so on" (Naoum, 2007: 39). In this regard, qualitative research methods formed the best mechanism to gather initial data for this study, as "qualitative methods attempt to capture and understand individual definitions, descriptions and meanings of events" (Burns, 2000: 388). Table 3.1 gives an overview of the differences between quantitative and qualitative research.

Table 3.1.
Differences between quantitative and qualitative research (Kumar, 2011: 20)

Difference with respect to:	Quantitative	Qualitative
Approach to enquiry	Structured/rigid/ predetermined methodology	Unstructured/flexible/open methodology
Purpose	Quantify extent of variation in a phenomenon, situation, issue etc.	Describe variation in a phenomenon, situation, issue etc.
Sample sizes	Emphasis on greater sample size	Fewer classes
Analysis of data	Subject variables to frequency distributions, cross-tabulations or other statistical procedures	Subjects responses, narratives or observational data to identification of themes and describes these
Communication of findings	Organization more analytical in nature, drawing inferences and	Organization more descriptive and narrative in nature

conclusions, and testing
magnitude and strength of
a relationship

3.2. Research Framework

The research was set out in three sections. First, it was felt imperative to conduct a desktop study as covered in the literature review, in order to assess what information is available through journals, books, papers and websites. Second, a visit to the three study areas was conducted with the intention of viewing the turbines in person (where in situ in Arklow), taking photographs, and making notes. Third, questionnaires were distributed to members of the public in order to gauge their reaction towards offshore turbines.

Previous research had been carried out on the visual impacts of offshore wind turbines in countries such as Denmark and the United States. This research aimed to build upon those findings and transplant them to an Irish setting in order to establish whether these results held true, or indeed establish whether they were completely different. Similar research which was carried out in Sweden by Waldo (2012) has provided a structure to this research. In that study, a qualitative analysis of attitudes towards offshore wind power in Sweden was measured. The use of interviews and questionnaires there provided the researcher with the majority of the results generated.

This study focused on three locations. They are all popular scenic residential seaside areas. It was deemed important to gather data from these locations, as they could act as a good representative sample of the country as a whole. Having locations from the east and west of the country was important in maintaining a sense of balance in the research. The three locations were Arklow, Blackrock and Enniscrone (Figure 3.1).

Figure 3.1. **Locations for survey distribution**

3.2.1. Arklow, County Wicklow

Arklow is located on Ireland's east coast approximately 80 km south of Dublin. The 2011 census recorded the population at 12,779 inhabitants of which 6,214 were male and 6,565 were female (Census, 2011). Ireland's only offshore wind farm is located 10 km off the coast from Arklow. It is a 25 MW wind farm consisting of seven 3.6 MW turbines. Figure 3.3 shows two of these turbines. The turbines have a 70.5 m hub height with a blade diameter of 50 m (University of Delaware, 2004).

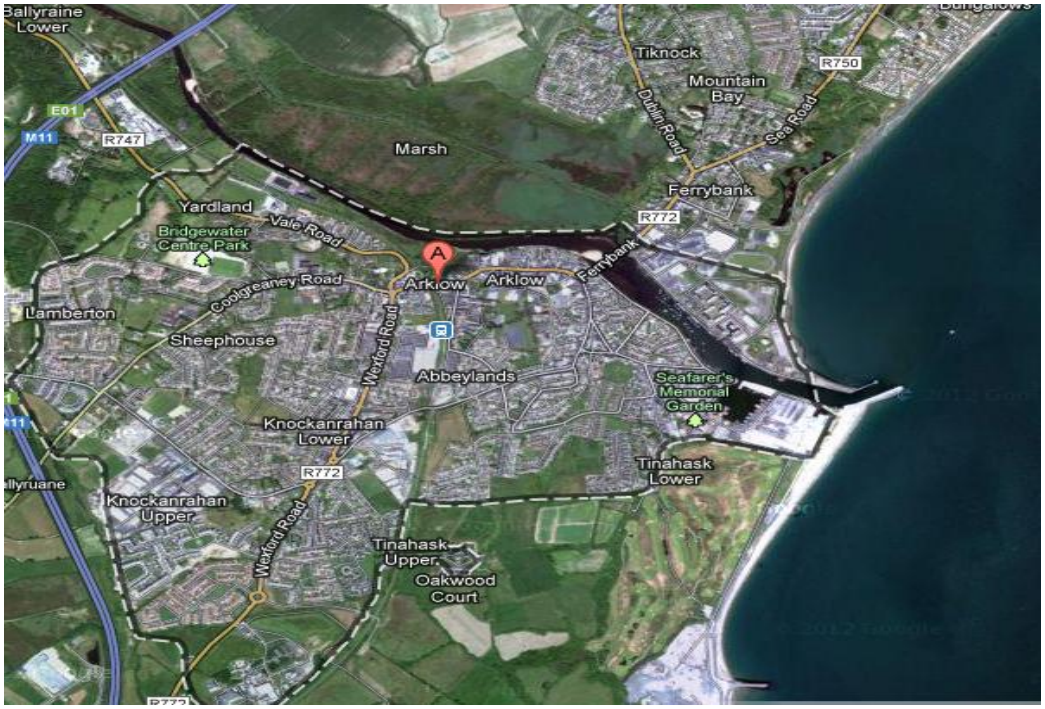


Figure 3.2. **Aerial view of Arklow (© 2011 Google)**

Figure 3.3. **View of two of the turbines at the Arklow site (Courtesy: National Renewable Energy Lab)**

3.2.2. Blackrock, County Louth

Blackrock is also located on Ireland's east coast, approximately 85 km north of Dublin. The 2011 census recorded the population at 6,310 inhabitants of which 3,049 were male and 3,261 were female (Census, 2011). There are plans to locate a 330 MW offshore farm 22 km from the coast in Dundalk Bay. The farm will consist of 55 six MW turbines (Oriel Wind, 2012).

Figure *3.4.* Aerial view of Blackrock (© 2011 Google)

3.2.3. Enniscrone, Co. Sligo

Enniscrone is located on Ireland's west coast. There are no immediate plans for any offshore development. There are however three turbines located in close proximity to the shore line. These are 60 m in height with a blade diameter of 80 m. The population in the 2011 census was recorded at 1,641 people of which 811 were male and 830 were female (Census, 2011).

Figure 3.5. **Aerial view of Enniscrone (© 2011 Google)**

One thing that all three locations had in common is that there was not a great disparity between the number of males and females living in each location. In this regard, the distribution of questionnaires (as discussed in section 3.10) had a relatively even spread between males and females. Many studies, such as Firestone and Kempton (2007) have indicated that the gender of questionnaire respondents can have an impact on attitudes towards offshore wind power.

3.3. Data Collection

The primary method of data collection for this study was the distribution of surveys in the form of questionnaires. The use of interviews was considered, however it

was believed that questionnaires would be a quicker way of obtaining the required information from a larger range of respondents.

3.4. Surveys

Surveys, most commonly through the use of questionnaires, "provide broad coverage of populations enabling us to explore spatial and social variations in people's attributes, attitudes, and actions" (Preston, 2009: 46). Through the use of internet survey programs or through traditional face-to-face distribution methods, the researcher is able to compile a sizeable amount of data from a population in a relatively short space of time. There are a number of advantages and disadvantages associated with surveys, as highlighted in the following three tables.

Table 3.2.
Advantages and disadvantages of face-to-face surveys (Sekaran & Bougie, 2010)

Advantages	Disadvantages
Face-to-face surveys can establish a rapport with the respondent.	Organizations may not be willing to give up company time for employees to fill out surveys.
High response rates are ensured.	
Any doubts regarding questions can be clarified immediately.	
Anonymity of respondents is high.	
No major expenses when administered to groups of respondents.	

Table 3.3.

Advantages and disadvantages of electronic surveys (Sekaran & Bougie, 2010)

Advantages	Disadvantages
Easy to administer. Can reach a global population. No major expense incurred. Fast delivery. Respondents can answer at their convenience.	Computer literacy is a must. Respondents must have access to a computer. Respondents must be willing to complete the questionnaire.

Table 3.4.

Advantages and disadvantages of postal surveys (Sekaran & Bougie, 2010)

Advantages	Disadvantages
Anonymity is high. Can reach a global population. Token gifts can be enclosed to seek compliance. Respondents can answer at their convenience.	Response rate is almost always low. Cannot clarify questions.

3.5. Credibility of Research

When conducting the questionnaire research, ensuring its quality was vitally important. The quality of quantitative research is generally measured through reliability and validity. Reliability is regarded as being the level at which the results of a study can be repeated, and validity is regarded as being whether those results measure what they are supposed to measure (Bryman & Bell, 2007). The quality of qualitative research however, is measured through what Patten (2002) describes as being credibility.

3.5.1. Triangulation

Triangulation is the most common method of establishing credibility in qualitative research. In this instance, research is approached from different perspectives. There are four major types of triangulation used, as defined by Sekaran and Bougie (2010: 385). These are:

- Method triangulation which uses multiple methods of data collection and analysis.
- Data triangulation where data is collected from several sources and/or at different times.
- Researcher triangulation where multiple researchers are used to collect and analyze data.
- Theory triangulation which uses multiple perspectives to interpret data.

Although this study was primarily a qualitative based one, the principles of validity and reliability were still important however. The initial drafting of the questionnaire came from examples of questionnaires used in previous similar studies (as seen in section 3.6). After an initial questionnaire draft was developed, this was viewed by thesis committee member Dr. Michael Dyrenfurth (Purdue University). This initial face validity resulted in some modifications being made and a recommendation for a pilot test of the questionnaire to be conducted to further enhance the validity of it.

3.5.2. Pilot Test of Questionnaire

The pilot test of the questionnaire was conducted with the assistance of a number of people. It was initially distributed amongst students and staff members at Purdue University, Indiana. A group of Ph.D. students based in the National University of Ireland, Galway (NUIG), also worked with the questionnaire to improve upon the initial draft. In total, 18 questionnaires were completed. Respondents were asked to complete the questionnaire and were encouraged to make recommendations as to how they felt it could be improved. With the help of these external people completing the trial questionnaires, it was possible to know the exact areas where improvements could be made.

3.5.3. Results from the Pilot Test

Some important results emanated from the pilot test. First, a number of changes were made to the language used in certain questions. Having test respondents

from Ireland and the USA resulted in a closer examination of the language used and from that, a more neutral tone was applied to certain questions. Second, the structure and sequence of certain questions was altered. Third, the length was adjusted to take into consideration these changes. Initially, the questionnaire was designed to be short (one page) however this was changed to accommodate the structure of certain questions, namely questions 12 and 13.

These changes helped to increase the validity of the questionnaire. Its reliability was determined through the actual wording of the questions. In many instances, the questions used would be transferrable to other similar attitudinal studies, particularly those related to renewable energy infrastructure. The results of the questionnaire would be transferrable to other countries, much in the same way that the results from other studies were transferrable to this research.

3.5.4. Statistical Analysis

Statistical analysis of the questionnaire was also utilized to enhance its validity. The reason behind this was to see if the results from statistical tests of the questionnaire matched the results already produced from the questionnaire. Linear regression and Chi-Square analysis was used to establish results. These results, as presented in Chapter 4 and discussed in Chapter 5, broadly matched the results extracted from the questionnaire.

3.6. Participant Population and Sample

The sample for this study was selected from people who were present in the three study locations at the time of the questionnaire distribution. It was aimed that a minimum total of 90 questionnaires (30 per location) would be successfully completed. Due to population differences between the three locations, it was highly plausible that there may be a variance in the rate of survey completions in the different locations.

It has already been recognized in studies such as Ladenburg (2008, 2009) the importance in which age can play in results. Therefore it was important to attempt to reach as broad a range of respondents as possible with regard to age. Also important to note, as highlighted by Firestone and Kempton (2007), is that the demographic background of respondents in the case of education can have an impact on results. Age and education were therefore clearly important and were factored into the questionnaire design.

3.7. Questionnaire Design

The questionnaire itself was initially intended to be short (one page long) so as to be convenient to the respondents and not take up too much of their time. The results from the pilot test however confirmed that one page might be too restrictive due to the nature of certain questions. The questions were split up into three sections. The first addressed the background of the respondent by categorizing their age, gender and educational level attained. These were categories which, from previous studies such as Ladenburg (2008, 2009), and Firestone and Kempton (2007) have played important roles

in attitudinal surveys about wind turbines. The second section dealt with attitudes and background knowledge of renewable energy. The final section addressed the most important aspect of the study. Here enquiries were made into the respondent's attitudes towards offshore wind power.

The questionnaire contained a mixture of both open and closed ended questions. Some literature recommends using only closed ended questions as this makes it easier to quantitatively analyze the results (Czaja & Blair, 2005). For this research though, certain questions remained open ended because if they were close ended, the response categories provided might not reflect the opinions of the respondents. In the case of some of the closed ended questions, a scale very similar to a Likert scale was utilized, with the primary difference being that the scales related to questions and not statements. The results from these scale type questions led to some interesting conclusions as can be seen in section 5.4. As outlined in Table 3.4 there are a number of advantages and disadvantages associated with this method of attitudinal research.

Table 3.5.
Advantages and disadvantages of the Likert scale (Burns, 2000)

Advantages	Disadvantages
Easier to prepare. This method is based on empirical data regarding subjects' responses rather than subjective opinions of judges. This method increased the probability that a unitary attitude is being measured which ensures high validity and reliability.	This method does not provide a basis for saying how much more favorable one attitude is over another. Many patterns of response to the various items may produce the same score.

The language used in the questions was also important. It was necessary to keep the question style simple, neutral and easy to understand for the respondent. The questions needed to be unambiguous, so as not to put the respondents into a position where they required further clarification. The consistency of the data gathered relied in a large part on "the uniform administration of questions and their uniform interpretation by respondents" (Czaja & Blair, 2005: 73). Again, this suggested that the language should be kept clear of vagueness so that all questions could be easily interpreted.

3.8. Questionnaire Construction

The questionnaire was designed from information obtained from previous similar studies, many of which are outlined in section 2.8. Question one was to ascertain whether the respondents lived within 10 km from the coast. The reasoning behind this as discovered by Firestone and Kempton (2007), was that people who would routinely see turbines on a daily basis might have a different opinion to those who lived further away or indeed were on holidays in the study areas. Questions two, three and four, addressed age, gender and educational levels respectively. Ladenburg (2009) highlighted the importance of these variables.

The next section of the questionnaire dealt with the respondents attitudes towards renewable energy in general. Question five was to determine whether the respondent was in favor of renewable energy development in Ireland. Question six

focused in on their knowledge of wind generated electricity giving five possible responses. Question seven was to discover what the respondents felt were the biggest impacts of wind generated electricity (either positive or negative). This was an open ended question in order to give a degree of flexibility to the responses.

The final eight questions made up the last and most important section of the questionnaire. Question eight assessed whether the respondents were in favor of offshore wind power development in Ireland. Question nine assessed their knowledge of the workings of offshore wind turbines and was designed in a similar fashion to question six with a set number of responses provided. Questions 10 and 11 were open ended and asked respondent whether he or she knew of any positive or negative impacts associated with the erection of offshore wind turbines.

Questions 12 and 13 attempted to assess whether the views of the respondents were similar or different with respect to onshore and offshore wind turbines. The importance of making this comparison originated from Ladenburg (2008) when determining whether there was any specific preference between onshore and offshore wind farms. Four pieces of criteria were common to both questions. These were visual impact, noise impact, impact on bird life and impact on carbon dioxide reduction. Impact on fish/marine mammals and impact on fishing were included for question 13 on offshore wind turbines. Respondents picked from a Likert scale style response ranging from very negative to neutral to very positive.

Questions 14 and 15 attempted to assess how acceptable offshore wind turbines would be, within viewing distance from respondent's homes, if they resulted in reduced

electricity bills and reduced carbon dioxide emissions. Question 14 originated from a study by Firestone and Kempton (2007). Here, the idea of offshore wind turbines would be more acceptable in the minds of people if there was a financial benefit attached, such as cheaper electricity. Question 15 stemmed from a study by Hagget (2011), which discovered that benefits such as reduced carbon dioxide emissions were often invisible in the mind of local people.

3.9. Questionnaire Employed

Attitudes towards Offshore Wind Turbines in Ireland

This questionnaire relates to research being conducted as part of a Master's Thesis examining Irish people's attitudes towards offshore wind power development. (Offshore Wind Turbines refers to turbines located off the coast)

1. Do you live within 10km from the coast (please circle)? Yes No
2. Age : 18-21 22-30 31-40 41-50 51-65 66+
3. Gender: Male Female
4. Educational background: Primary Secondary Third Level- Bachelor Masters Ph.D.
5. Are you in favour of renewable energy development in Ireland? Yes No Don't Know
6. To what extent do you understand wind generated electricity?

1	2	3	4	5
Not at all	Vaguely	Moderately	Fairly Well	Expert in the field

7. What would you consider to be the biggest impacts of wind generated electricity?

   _____

8. Are you in favor of offshore wind power development in Ireland? Yes No Don't Know

9. To what extent do you understand offshore wind turbines?

1	2	3	4	5
Not at all	Vaguely	Moderately	Fairly Well	Expert in the field

10. What would you consider to be positive impacts associated with offshore wind power, if any?

_____

11. Would you consider there to be any negative impacts associated with the erection of offshore wind turbines? If yes, please specify.

_____

12. With regard to **ONSHORE** wind turbines, what are your feelings towards the following (please tick)?

	1 - Very Negative	2 - Negative	3 - Neutral	4 - Positive	5 - Very Positive	6 - Don't Know
Visual Impact						
Noise Impact						
Impact on Bird Life						
Impact on Carbon Dioxide Reduction						

13. With regard to **OFFSHORE** wind turbines, what are your feelings towards the following (please tick)?

	1 - Very Negative	2 - Negative	3 - Neutral	4 - Positive	5 - Very Positive	6 - Don't Know
Visual Impact						
Noise Impact						
Impact on Bird Life						
Impact on Fish/Marine Mammals						
Impact on Fishing						
Impact on Carbon Dioxide Reduction						

14. Would you be willing to accept more offshore wind turbines, within viewing distance from your home if it resulted in reduced electricity bills? Yes No Don't Know

15. Would you be willing to accept more offshore wind turbines, within viewing distance from your home if it resulted in reduced Carbon Dioxide emissions? Yes No Don't Know

3.10. Questionnaire Distribution

Questionnaires were distributed to persons over the age of 18. The Institutional Review Board at Purdue University stipulated that any research carried out on minors must be accompanied with parental consent. It was deemed that having to obtain parental consent for every questionnaire completed by a minor would create an impractical working environment for the researcher.

Questionnaires were distributed randomly on the street and in other public locations. In all three study locations, it was important when using random street distribution, to do so in areas which were close to the coastline. In Ladenburg (2010) it was found that proximity by respondents to, and the number of visits to a beach where offshore turbines were visible, had an impact on attitudes. In locations where there were no turbines, it was sometimes necessary to describe to respondents where they would be located, and this was made easier if the respondents were answering questions while in view of the sea.

During the distribution process, potential respondents were approached and a conversation was initiated. During this initial exchange it was explained who the author was and what the study was all about. Developing this initial rapport with the respondents no doubt helped to achieve a positive response rate, as once they

understood the nature and importance of the study, they were more willing to respond. Potential respondents were then given a stamped addressed envelope in which they could return their responses which increased the ease in which they could do so. When approaching potential respondents, it was important to bear in mind that obtaining opinions from a broad range of respondents was necessary in order to create a sense of balance in the study. Therefore, at times when, for instance, younger people were being approached, it was necessary to then proceed to older respondents.

3.11. Sample Size

There was much literature available regarding the exact sample size to use when researching a population. Some authors such as Israel (2009) recommended using a similar population sample to that used in a similar study. In this instance, comparisons were made to Firestone and Kempton (2007) regarding their study of attitudes towards offshore wind in Cape Cod. In that study the researchers completed a pilot test of their 62 question survey using 100 respondents. The survey was then modified based on the outcomes of the pilot test. It was then posted to 1500 adult residents of the area. There was a 38.5% response rate. The method used in this study, as discussed in section 3.10, was based primarily on random distribution of questionnaires on the street. However, given the fact that there were three locations which required survey distribution, and only one researcher, there was inadequate time or resources available to distribute a similar number of questionnaires to that of the Firestone and Kempton

study. Table 3.6. is a pre-calculated chart determining suitable sample sizes for a population, where *N* is the population size and *S* is the sample size.

Table 3.6.
Determining sample size from a given population (Krejcie & Morgan, 1970: 608)

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

If distributing surveys in Enniscrone, Co. Sligo, for example, to meet the requirements set out above to cover a population of over 1600 people, 310 questionnaires would need to be distributed. The corresponding figure for Blackrock, Co. Louth would be in the region of 361 and for Arklow, Co. Wicklow, 375. This was deemed to be too excessive in terms of time availability and resources available to the researcher. However some authors such as Roscoe (1975), proposed that as a general

rule, sample sizes larger than 30 and less than 500 were appropriate for most research. This reasoning was applied to this study.

3.12. Summary

This chapter provided an overview of the methodology employed for this research. The reason why a qualitative research approach was adopted to gather data was addressed as well as the benefit of using questionnaires. A breakdown of the questionnaire and the reason why certain questions were chosen was also provided. The method of questionnaire distribution and how the sample was determined was also addressed. The next chapter will provide a presentation of the data obtained from the study locations.

CHAPTER 4. PRESENTATION OF DATA

The aim of this chapter is to present the results of the findings from the field research, namely, the questionnaires which were distributed. At this point it is beneficial to remind ourselves of the two research questions central to this thesis.

1. What are Irish people's attitudes towards the development of offshore wind farms in Ireland?
2. Do these attitudes have any implications towards the future development of offshore wind farms in Ireland?

4.1. Questionnaire Results

The results from the questionnaires were analyzed using the online *Qualtrics* questionnaire statistics program. This allowed for a clear picture of the results to be deciphered as well as producing the relevant graphs to aid in the presentation of the data. All graphs outlined below were retrieved from the *Qualtrics* program after all the necessary information was inputted from the questionnaires.

4.1.1. Arklow, County Wicklow

The questionnaire was distributed in Arklow, Co. Wicklow on 11th August 2012. The questionnaire was distributed in three locations. These were on the main street, outside the Bridgewater shopping centre, and also along the beach front. Potential respondents were approached by the author and asked if they would mind filling out the questionnaire at a time that suited them and returning it to the author in a stamped addressed envelope provided. A total of 120 questionnaires were distributed throughout the day, with a response rate of 28%.

4.1.1.1. Personal Background

1. *Do you live within 10 km from the coast?*

#	Answer		Response	%
1	Yes		29	85%
2	No		5	15%
	Total		34	100%

Of the 34 respondents in Arklow, 85% of them lived within 10 km from the coast.

2. *Age?*

#	Answer		Response	%
1	18-21		4	11%
2	22-30		10	29%
3	31-40		5	15%
4	41-50		8	24%
5	51-65		5	15%
6	66+		2	6%
	Total		34	100%

There was relatively broad age range among the respondents in Arklow, with the 22 to 30 category having the most respondents at 29% followed by the 41 to 50 category with 24%.

3. *Gender?*

#	Answer		Response	%
1	Male		15	44%
2	Female		19	56%
	Total		34	100%

With regard to gender, there was a relatively even spread between males and females. As highlighted earlier, gender can play an important role in such results. Of the respondents surveyed in Arklow, 44% were male and 56% were female.

4. *Educational Background?*

#	Answer		Response	%
1	Primary		0	0%
2	Secondary		13	38%
3	Third Level - Bachelor		14	41%
4	Third Level - Masters		5	15%
5	Third Level - Ph.D.		2	6%
	Total		34	100%

The majority of respondents had either a secondary education or third level bachelor. 6% of the respondents had obtained a Ph.D.

4.1.1.2. Attitudes towards Renewable Energy

5. *Are you in favor of renewable energy development in Ireland?*

#	Answer		Response	%
1	Yes		32	97%
2	No		0	0%
3	Don't Know		1	3%
	Total		33	100%

There were 33 responses for question five. An overwhelming majority of respondents, 97%, were in favor of renewable energy development in Ireland. One respondent was not entirely sure.

6. *To what extent do you understand wind generated electricity?*

#	Answer		Response	%
1	1 - Not at all		0	0%
2	2 - Vaguely		3	9%
3	3 - Moderately		13	38%
4	4 - Fairly Well		17	50%
5	5 - Expert in the field		1	3%
	Total		34	100%

50% of respondents understood the concept of wind generated electricity fairly well, with 38% having a moderate understanding. There were no respondents in Arklow who had no understanding at all of wind generated electricity.

7. *What would you consider to be the biggest impacts, either positive or negative, of wind generated electricity?*

Question seven was left open-ended in order to give the respondents a degree of flexibility with their responses. There was a variety of responses. These ranged from job creation, to reducing carbon emissions, and reducing dependence on fossil fuels. Some of the responses are outlined below. These are quoted directly from the responses received.

Table 4.1.
Attitudes towards wind generated electricity (Arklow)

Negative Impacts
• Natural replacement for other forms of electricity.
• Landscapes could be destroyed with larger wind farms but if they are out at sea I can see them being an attraction rather than inland.
• Noise and visual impacts.
• Reduction in use of fossil fuels.
• Positive impact would hopefully reduce reliance on fossil fuels. A negative would be the impact on scenery and wildlife.
• Energy security and being able to export energy once full infrastructure is in place.
• Clean. Renewable. Job creation.
• Reduced carbon emissions.
• Replacement of fossil fuels.
• Lessen dependency on fossil fuels. No waste. No consistent outputs.

Table 4.1 (continued).

- Local employment, clean renewable electricity.
- Noise pollution and visual pollution.
- Increase the use of clean energy.
- Reduced Fossil fuel dependency and reduced cost.

4.1.1.3. Attitudes towards Offshore Wind Power

8. Are you in favor of offshore wind farm development in Ireland?

#	Answer		Response	%
1	Yes		31	94%
2	No		0	0%
3	Don't Know		2	6%
	Total		33	100%

Similar to question six, the overwhelming majority of those who responded, 94%, were in favor of offshore wind farm development in Ireland.

9. To what extent do you understand offshore wind turbines?

#	Answer		Response	%
1	1 - Not at all		1	3%
2	2 - Vaguely		7	21%
3	3 - Moderately		12	35%
4	4 - Fairly Well		14	41%
5	5 - Expert in the field		0	0%
	Total		34	100%

76% of the respondents understood offshore wind turbines either moderately or fairly well. 41% of the respondents understood offshore wind turbines fairly well, with 35% having a moderate understanding of them.

10. Would you consider there to be any positive impacts associated with the erection of offshore wind turbines? If yes, please specify.

Some of the responses here were similar to those obtained from question seven however the greater part of responses were more specific to the actual erection of turbines as opposed to any far reaching environmental consequences. Some of the responses are outlined below. All of the responses are quoted directly from those received in Arklow.

Table 4.2.
Positive impacts associated with the erection of offshore wind turbines (Arklow)

Positive impacts
• Less noise pollution.
• They look cool sitting out in the sea. We don't have a summer anymore so there's plenty of wind around that should be harnessed in this way.
• Renewable energy with very little impact on the environment.
• Less impact on scenery and tourism.
• Fewer planning issues and large number of turbines in a single area.
• Renewable and clean.
• Reduced carbon emissions.

Table 4.2 (continued).

- Noise factors associated with turbines would not be an issue. Environmental impact of building turbines on land would be avoided.
- Possibility of new marine ecosystems around turbines bases similar to those around ship wrecks. Sites could be developed as marine resorts with turbines appearing as an extra.
- It's not a matter of siting, but how quickly we can be self sufficient in power supplies.
- Local employment, tourism and beneficial for the environment.
- They are visually less impacting and nobody hears them.
- It's the way forward for clean power.
- Less impact on land, easier to get approval.
- Give more power.

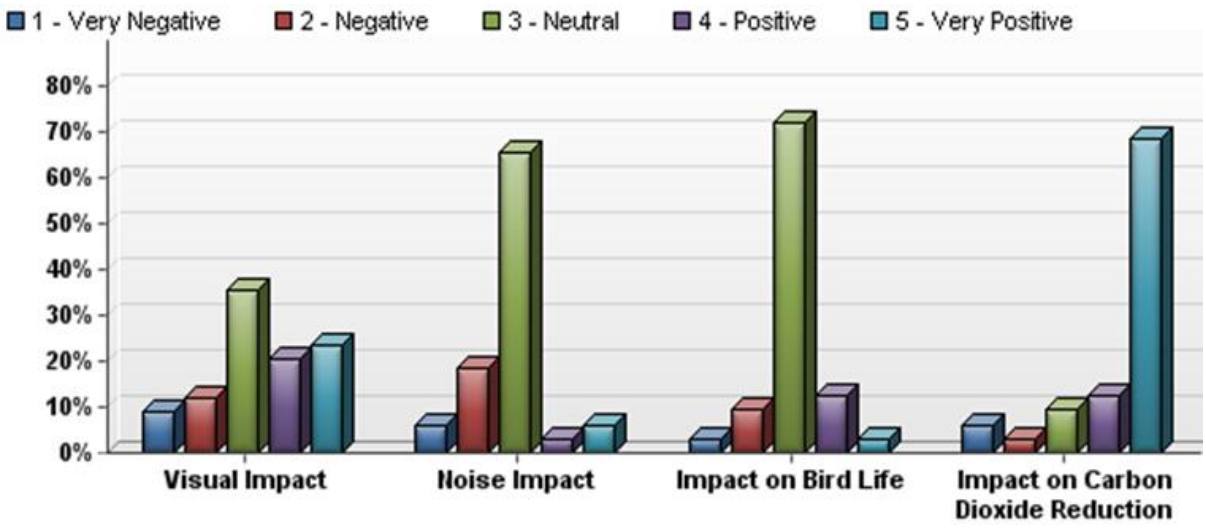
11. Would you consider there to be any negative impacts associated with the erection of offshore wind turbines?

Some of the negative responses related to impact on bird life, cost, and an impact on shipping and fishing. However, the majority of respondents felt there were no negative impacts associated with the erection of offshore turbines. Some of the responses are outlined below. All of the responses are quoted directly from those received in Arklow.

Table 4.3.
Negative impacts associated with the erection of offshore wind turbines (Arklow)

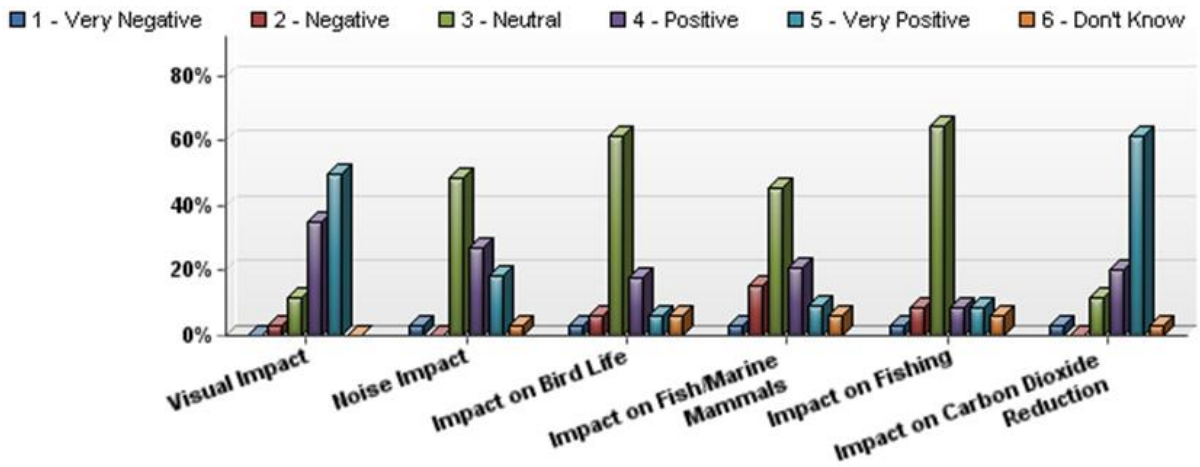
Negative Impacts
• Spoils the vista - i.e. looks out of place in natural beauty of coastline.
• Impact on bird and sea life.
• Yes, I would fear there would be environmental impacts due to poor placement or bad construction.
• Costly?
• No.
• Cost of building and cost of maintenance could be prohibitive.
• Location could interfere with existing marine activities, both human and wildlife.
• No.
• No.
• The installation can impact currents and change sediment erosion patterns.
• Shipping, fishing but unknown to what extent.
• Don't know.
• No. They are very impressive on the skyline.
• Cost.
• None.

12. With regard to ONSHORE turbines, what are your feelings towards the following?



With regard to visual impact, the majority of respondents; 44% had a positive or very positive opinion towards the turbines. With regard to noise impact, 18% felt that the turbines had a negative impact, however the majority; 65%, had a neutral view when it came to noise impact. With regard to impact on bird life, 72% felt there would be neither a positive or negative impact associated with the erection of onshore turbines. With regard to carbon dioxide reduction, 68% of respondents felt that onshore turbines had a very positive impact in reducing carbon dioxide emissions.

13. With regard to OFFSHORE turbines, what are your feelings towards the following?



Similar to question 12, the majority of respondents, 86%, felt that offshore turbines had a positive or very positive visual impact, with only 2% of respondents feeling that they had a negative impact. With regard to noise impact, a large portion of the respondents felt that offshore turbines had a positive, 26%, or very positive, 18%, noise impact. With regard to the impact on bird life of offshore turbines, 62% of respondents felt that they had a neutral impact. The additional variables of "impact on fish/marine mammals" and "impact on fishing" were added to this question. 45% of respondents felt that the turbines had a neutral impact on fish/marine mammals, with 21% feeling that they had a positive impact. 64% of respondents felt that offshore turbines had a neutral impact on fishing. 18% of respondents felt that offshore turbines had both a positive and very positive impact on fishing. 62% of respondents felt that there was a very positive impact on carbon dioxide reduction.

14. Would you be willing to accept more offshore wind turbines, within viewing distance from your home, if it resulted in reduced electricity bills in your home?

#	Answer		Response	%
1	Yes		31	91%
2	No		0	0%
3	Don't Know		3	9%
	Total		34	100%

91% of the respondents in Arklow would accept more offshore turbines in exchange for cheaper electricity.

15. Would you be willing to accept more offshore wind turbines, within viewing distance from your home, if it resulted in reduced carbon dioxide emissions?

#	Answer		Response	%
1	Yes		33	97%
2	No		0	0%
3	Don't Know		1	3%
	Total		34	100%

There was a similar result there with 97% of respondents willing to accept more turbines in viewing distance from their homes if it resulted in reduced carbon dioxide emissions.

4.1.2. Correlations with Arklow Results

There are a number of interesting correlations which can be witnessed within the results that came from the Arklow questionnaires. These relate to the age of the

respondents, their gender, their educational background, and how far they lived from the coast. These four responses were correlated with five other responses which were given. These were:

- Whether the respondents were in favor of renewable energy development in Ireland.
- Whether they were in favor of offshore wind energy development in Ireland.
- How well they understood offshore wind turbines.
- Whether they would accept more offshore turbines within viewing distance from their homes in exchange for cheaper electricity.
- Whether they would accept more offshore turbines within viewing distance from their homes in exchange for reduced carbon dioxide emissions.

4.1.2.1. Location from Coastline

As discovered in section 4.3.1.1., 85% of respondents lived within 10 km from the coastline, with 15% living outside this 10 km zone. Of the 85% of residents who lived within the 10km zone, all of them were in favor of renewable energy development in Ireland. 96% of these respondents were in favor of offshore wind farm development in Ireland and the majority of them understood offshore wind turbines either moderately or fairly well, 41% and 44% respectively. The large majority of these respondents were in favor of further development of offshore wind turbines if it

resulted in reduced electricity prices and reduced carbon dioxide emissions, 96% and 100% respectively.

From the 15% of residents who lived outside the 10 km zone, 80% of them were in favor of renewable energy development in Ireland with 20% unsure. The same result was obtained when these respondents were asked whether they were in favor of offshore wind farm development in Ireland. When asked how well they understood offshore wind turbines, 50% replied vaguely, 17% moderately and 33% fairly well. When asked whether they would be willing to accept more offshore turbines in exchange for reduced electricity bills, 67% said yes while 33% were unsure. When asked whether they would be willing to accept more offshore turbines for reduced carbon dioxide emissions, 83% said yes while 17% were unsure.

4.1.2.2. Age

97% of respondents in Arklow were in favor of renewable energy development in Ireland. Of these, 13% fell into the 18 to 21 age category, 31% into the 31 to 40 age category, 22% into the 41 to 50 age category, 13% into the 51 to 65 age category and 6% were over the age of 66. The respondents who were unsure of this question were in the 41-50 age category. The results were relatively similar when the respondents were asked whether they were in favor of offshore wind farm development. The only difference is that there was an additional respondent who was unsure and this respondent was in the 31-40 age category.

Most of the respondents understood offshore turbines either moderately, 36%, or fairly well, 41%. Of those that understood offshore turbines fairly well, the majority were in the 41 to 50 and 51 to 65 age categories, 29% in each instance. Of those that understood offshore turbines moderately, the majority were in the 22 to 30 and 31 to 40 age categories, 33% and 25% respectively. Of those who had a vague understanding, the 22 to 30 and 41 to 50 age categories were best represented at 43% each.

There was a relatively even spread among the age groups of those that would be willing to accept the erection of offshore turbines in exchange for cheaper electricity. 13% were in the 18 to 21 age category, 29% were in the 22 to 40 age category, 13% were in the 31 to 40 age category, 23% were in the 41 to 50 age category, 16% were in the 51 to 65 age category and 6% were over the age of 66. Those that were unsure were in the 18 to 21, 31 to 40 and 41 to 50 age categories. The results were similar when the respondents were asked if they would be willing to accept the erection of offshore turbines in exchange for reduced carbon dioxide emissions. There were less people unsure with this number made up in the 22 to 30 and 41 to 50 age categories.

4.1.2.3. Gender

44% of the respondents in Arklow were male and 56% were female. When asked if they were in favor of renewable energy development in Ireland, all of the male respondents answered yes with 94% of female respondents answering yes. One female respondent was unsure of her response to this question. When asked if they were in

favor of offshore wind farm development in Ireland, again, all the male respondents answered yes while 89% of the female respondents answered yes.

When asked how well they understood offshore wind turbines, the male respondents had a better understanding in comparison to their female counterparts. Of the male respondents, the combined sum of those that understood offshore turbines either moderately or fairly well was 87%. The corresponding figure for females was 68%. 13% of male respondents had a vague understanding of offshore turbines. The corresponding figure for females was 26%.

When asked whether the respondents would be willing to accept more offshore turbines for reduced electricity bills, all the male respondents answered yes. The majority of female respondents, 86% answered yes with 14% unsure. When asked whether they would accept more offshore turbines in exchange for reduced carbon dioxide emissions, the results were very similar to the previous question. All of the male respondents answered yes while 95% of females responded yes with one respondent being unsure.

4.1.2.4. Educational Background

The educational background of the respondents was split up into five different categories. These were: primary education, secondary education, a third level bachelor, a third level masters and a Ph.D. There were no respondents who had just a primary education. When asked whether they were in favor of renewable energy development in Ireland, of those that gave positive responses, 38% had a secondary education, 41%

had a bachelor, 16% had a master and 6% had a Ph.D. When asked whether they were in favor of offshore wind farm development in Ireland, there was a similar trend in the results. Of the positive responses given, 39% had a secondary education, 42% had a bachelor, 13% had a master and 6% had Ph.D.

When asked about their knowledge of offshore wind turbines, 41%, understood turbines fairly well followed closely by moderately at 35%. Of those that answered "fairly well", 43% had a secondary education, 36% had a bachelor, 14% a masters and 7% a Ph.D.

91% of respondents would accept of further development of offshore turbines within viewing distance from their homes, if it resulted in reduced electricity bills. Of these, 42% had a secondary education and a further 42% had a bachelor. 13% had master and 3% had a Ph.D. 97% would accept further development of offshore turbines within viewing distance from their home if it resulted in reduced carbon dioxide emissions. Of these respondents, 40% had a secondary education, 42% had a bachelor, 12% had a master and 6% had a Ph.D.

4.1.3. Blackrock, County Louth

The questionnaire was distributed in Blackrock, Co. Louth on 21st July 2012. The questionnaire was distributed primarily on Main Street. This street runs adjacent to the beach and has a good view of where the offshore turbines are to be located in Dundalk Bay. Similar to Arklow, the respondents were asked to return the completed

questionnaires to the author in a stamped addressed envelope provided. There were 80 questionnaires handed out over the course of the day. The response rate was 31%.

4.1.3.1. Personal Background

1. Do you live within 10km from the coast?

#	Answer		Response	%
1	Yes		20	80%
2	No		5	20%
	Total		25	100%

Of the 25 respondents, 80% of them lived within 10km form the coast.

2. Age?

#	Answer		Response	%
1	18-21		4	16%
2	22-30		4	16%
3	31-40		5	20%
4	41-50		4	16%
5	51-65		5	20%
6	66+		3	12%
	Total		25	100%

There was a very even spread of age categories in Blackrock with the 31 to 40 and 51 to 65 age categories having the largest representation at 20% each.

3. Gender?

#	Answer		Response	%
1	Male		11	44%
2	Female		14	56%
	Total		25	100%

There were a relatively even number of males and females, with 44% of respondents being male and 56% being female.

4. Educational background?

#	Answer		Response	%
1	Primary		1	4%
2	Secondary		11	44%
3	Third Level - Bachelor		8	32%
4	Third Level - Masters		3	12%
5	Third Level - Ph.D.		2	8%
	Total		25	100%

44% of respondents had a secondary education with 32% of respondents having a bachelor degree.

4.1.3.2. Attitudes towards Renewable Energy

5. Are you in favor of renewable energy development in Ireland?

#	Answer		Response	%
1	Yes		25	100%
2	No		0	0%
3	Don't Know		0	0%
	Total		25	100%

All of the respondents were in favor of renewable energy development in Ireland.

6. To what extent do you understand wind generated electricity?

#	Answer		Response	%
1	1 - Not at all		0	0%
2	2 - Vaguely		4	16%
3	3 - Moderately		6	24%
4	4 - Fairly Well		15	60%
5	5 - Expert in the field		0	0%
	Total		25	100%

Among the respondents in Blackrock, 60%, understood the concept of wind generated electricity fairly well.

7. What would you consider to be the biggest impacts, either positive or negative, of wind generated electricity?

Just as in Arklow, the respondents in Blackrock had a degree of flexibility when answering question seven. The responses ranged from having a positive impact on the environment, to helping Ireland's economy. Some of the responses are outlined below.

Table 4.4.
Attitude towards wind generated electricity (Blackrock)

Attitudes
• Positive for environment and natural resources.
• Don't know.
• Aid the economy.

Table 4.4 (continued).

- Less dependence on foreign oil.
- Cheaper electricity.
- Job creation.
- Huge poles.
- Positive impact on the environment. Job creation.
- Relatively poor lifespan of turbines, however wind is a clean source of energy.
- Wind is a renewable source of energy with plenty available in Ireland.
- Not as dependent on foreign countries.
- Cleaner source of electricity generation.
- Creation of new jobs. Green economic development. Indigenous source of energy.
- More secure method of producing electricity.
- Wind generated electricity will play a major role in reducing CO_2 emissions.
- Cheaper for the consumer.
- Reduce dependence on coal plants.
- Helping to reduce CO_2 emissions.

4.1.3.3. Attitudes towards Offshore Wind Power

8. Are you in favour of offshore wind farm development in Ireland?

#	Answer		Response	%
1	Yes		23	92%
2	No		0	0%
3	Don't Know		2	8%
	Total		25	100%

92% of the respondents in Blackrock were in favor of offshore wind farm development in Ireland with 92% responding positively to question eight.

9. To what extent do you understand offshore wind turbines?

#	Answer		Response	%
1	1 - Not at all		3	12%
2	2 - Vaguely		5	20%
3	3 - Moderately		4	16%
4	4 - Fairly Well		13	52%
5	5 - Expert in the field		0	0%
	Total		25	100%

A significant majority of the respondents in Blackrock understood offshore turbines fairly well.

10. Would you consider there to be any positive impacts associated with the erection of offshore wind turbines? If yes, please specify.

The majority of responses in question ten related to the positive environmental impacts associated with offshore turbines and also how they can assist in meeting renewable energy targets. Some of the responses are outlined below.

Table 4.5.
Positive impacts associated with the erection of offshore wind turbines (Blackrock)

Positive impacts
• Cheaper, using natural resource.
• Out of sight.
• Less impact/struggles with landowners and residents compared with onshore.
• High wind speeds offshore.
• Turbines can be larger than onshore equivalent.
• It would be our own energy supply.
• Less of a NIMBY issue.
• Larger areas to work with. They will help to meet our CO_2 reduction targets.
• Security of electricity supply.
• Reducing CO_2 emissions. More attractive than onshore turbines.
• Wind generated electricity will help to offset Ireland's carbon emissions.
• More availability of space for turbines.
• Not sure.
• A well developed offshore strategy can result in the export of electricity and hence generate income for the country.

11. Would you consider there to be any negative impacts associated with the erection of offshore wind turbines?

The majority of respondents to question 11 felt that there were no negative impacts associated with the erection of offshore wind turbines. Of those that answered who felt that were negative impacts associated with offshore turbines, the majority of these responses related to impacts on fishing, shipping and vistas. The following are some of the responses which were received.

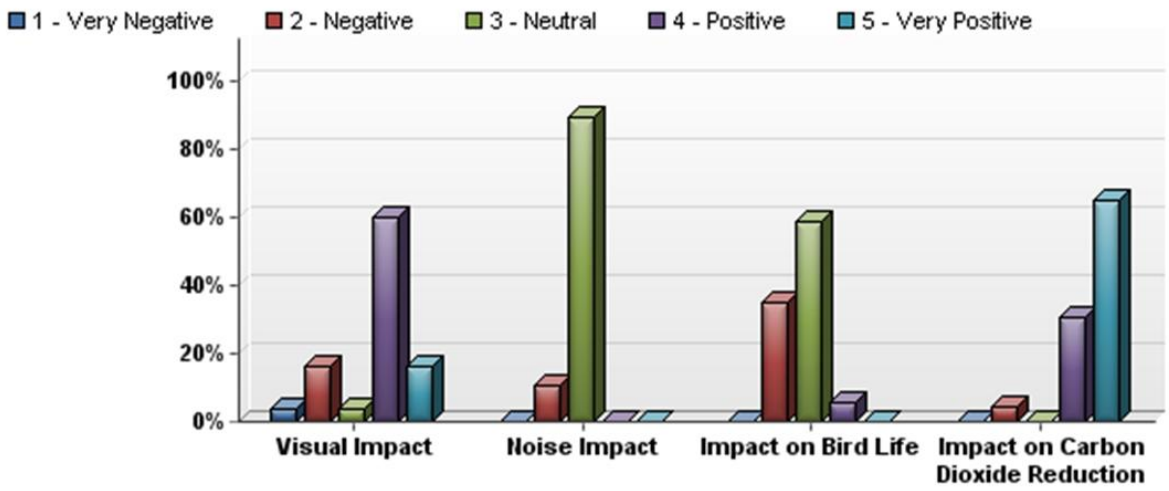
Table 4.6.
Negative impacts associated with the erection of offshore wind turbines (Blackrock)

Negative Impacts
• Impact on views.
• Impact on fishing.
• No.
• No, we need more.
• No.
• They are ugly.
• No. Higher costs than onshore.
• Difficulty with shipping lanes.
• Not too sure.
• Not that I can think of.
• Impact on local fishermen.
• Too many might be visually obtrusive.

Table 4.6 (continued).

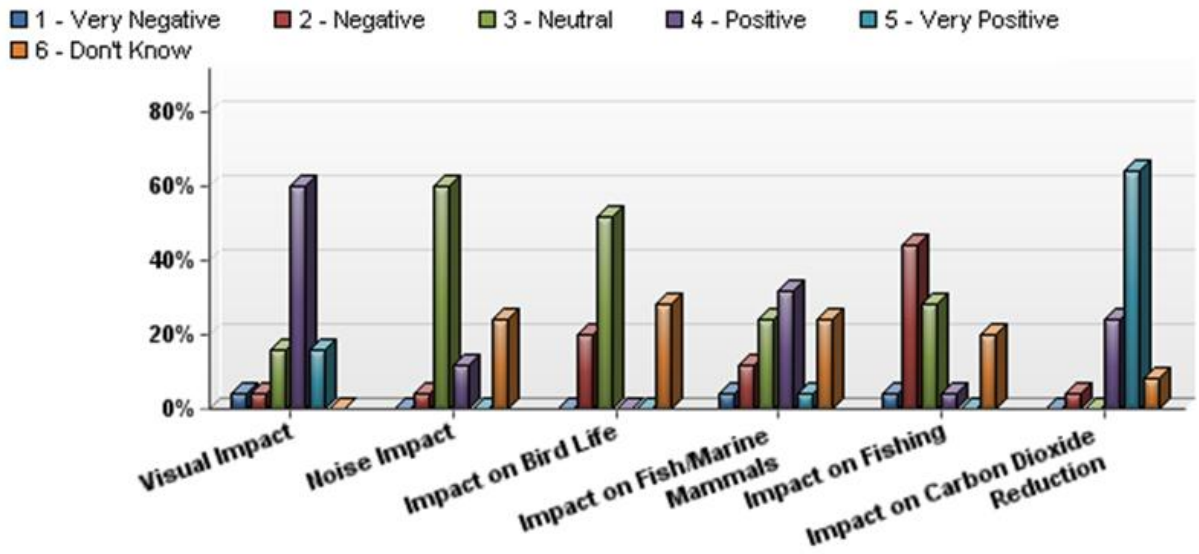
- No.
- No.

12. With regard to ONSHORE turbines, what are your feelings towards the following?



With regard to visual impact, 60% of respondents had a positive opinion towards onshore turbines. The overwhelming majority of respondents; 89% had a neutral view with regards to any noise impacts associated with onshore turbines. 35% of respondents were of the opinion that onshore turbines had a negative impact on bird life, while 59% had a neutral view on the matter. An accumulated total of 96% of respondents felt that onshore wind turbines had either a positive or very positive impact on carbon dioxide reduction. 4% of the respondents felt that onshore turbines had a negative impact on carbon dioxide reduction.

13. With regard to OFFSHORE turbines, what are your feelings towards the following?



Similar to the result with the onshore turbines, 60% of respondents felt that offshore turbines had a positive visual impact, with a further 16% having the opinion that they had a very positive effect. 60% of respondents had a neutral view towards the noise impact of offshore turbines. When asked about impact on bird life, 20% felt that offshore turbines would have a negative impact. 52% had a neutral view on the matter and 28% did not know. 32% of respondents felt that offshore turbines would have a positive impact on fish/marine mammals. 44% felt that they would have a negative impact on fishing with 20% of respondents unsure as to the impact turbines would cause on fishing. 64% of responents felt that offshore turbines would have a very positive impact on the reduction of carbon dioxide emissions, with 24% feeling that they would have a positive impact.

14. Would you be willing to accept offshore wind turbines, within viewing distance from your home, if it resulted in reduced electricity bills? (Altered slightly from Arklow questions by the fact that there is no offshore farm located there)

#	Answer		Response	%
1	Yes		22	92%
2	No		1	4%
3	Don't Know		1	4%
	Total		24	100%

There were 24 responses to question 14. 92% of the respondents in Blackrock would accept offshore wind turbines, within viewing distance from their homes if it resulted in reduced electricity bills.

15. Would you be willing to accept offshore wind turbines, within viewing distance from your home, if it resulted in reduced carbon dioxide emissions? (Altered slightly from Arklow questions by the fact that there is no offshore farm located there)

#	Answer		Response	%
1	Yes		22	88%
2	No		3	12%
3	Don't Know		0	0%
	Total		25	100%

88% of respondents would be willing to accept offshore wind turbines, within viewing distance from their homes, if it resulted in reduced carbon dioxide emissions.

4.1.4. Correlations with Blackrock Results

Similar to the Arklow results, there were a number of interesting correlations which can be examined from the Blackrock results. The same correlations were examined.

4.1.4.1. Location from Coastline

80% of the respondents in Blackrock lived within 10km from the coast. Of this 80%, all of the respondents were in favor of renewable energy development in Ireland and 95% were in favor of offshore wind farm development. 60% of those living within 10 km of the coast understood offshore wind turbines fairly well with 15% understanding them moderately. The large majority of respondents, who were living within 10 km from the coast, would accept the development of offshore wind turbines if it resulted in reduced electricity bills and carbon dioxide emissions. These figures stood at 95% and 90% respectively.

From the 20% of respondents who lived further than 10 km from the coast, all of the respondents were in favor or renewable energy development in Ireland. 80% were in favor of offshore wind farm development with 20% being unsure. When asked how well they understood offshore wind turbines, 40% replied not at all, 20% replied vaguely, 20% moderately and 20% fairly well. 80% of respondents would be willing to accept offshore wind turbines if it resulted in reduced electricity bills and reduced carbon dioxide emission with 20% being unsure.

4.1.4.2. Age

All of the respondents were in favor of renewable energy development in Ireland. Of these, 16% represented both the 18 to 21 and 22 to 30 age categories. 20% were aged between 31 and 40, 16% were aged between 41 and 50, 20% were aged 51 to 65 and 12% were over the age of 66. The majority of respondents were in favor of offshore wind farm development, with those being unsure falling into the 18 to 21 age category and the 51 to 65 age category.

51%, of respondents understood offshore wind turbines fairly well. Of these, 15% were aged between 18 and 21 whilst 23% represented the 22 to 30, 31 to 40 and 41 to 50 age categories. 8% represented both the 51 to 65 and the over 66 age groups. Of those that vaguely understood, or had no understanding at all of offshore wind turbines, the majority were aged over 51, 40% and 67% respectively.

Of those that would be willing to accept the erection of offshore turbines in exchange for cheaper electricity, there was a relatively even spread among the age groups. 14% were aged between 18 and 21, 18% were aged between 22 and 30, 23% were aged between 31 and 40, 15% were aged between 41 and 50, 18% were aged between 51 and 65 and finally 14% were aged over 66. These results were the same when asked if the respondents would be willing to accept the erection of offshore turbines in exchange for reduced carbon dioxide emissions.

4.1.4.3. Gender

Of the respondents in Blackrock, 44% were male and 56% were female. All of the male and female respondents were in favor of renewable energy development in Ireland. All of the male respondents were in favor of offshore wind farm development in Ireland, with 86% of female respondents in favor and 14% of female respondents unsure.

When asked how well they understood offshore wind turbines, 55% of males and 50% of females had a fairly good understanding of them. 18% of males had a moderate understanding compared to 14% of females. 9% of males did not understand offshore wind turbines at all, compared to 14% of females.

All of the male respondents would accept the development of offshore wind turbines within viewing distance from their homes, if it resulted in reduced electricity bills compared to 86% of females. 7% of females would not accept them and 7% were unsure. 91% of males would accept the development of offshore wind turbines within viewing distance from their homes, if it resulted in reduced carbon dioxide emissions. The corresponding figure for females was 86%. 9% of males would not accept them compared with 14% of females.

4.1.4.4. Educational Background

Similar to the Arklow results, the educational background was split up into five different categories. These were: primary education, secondary education, a third level bachelor, a third level masters and a Ph.D. 44% of respondents had a secondary level

education, while 32% had a bachelor, 12% had a master, and 8% had a Ph.D. A small percentage, 4%, of the respondents reached an educational level no higher than primary. All of the respondents were in favor of renewable energy development in Ireland, regardless of their educational level. The result was somewhat similar when asked whether they were in favor of offshore wind farm development. All respondents were in favor except for 18% of those from the secondary education category who were not sure.

When asked how well they understood offshore wind turbines, 52% had a good understanding of the general concept of offshore turbines. Of this 52% of respondents, 8% had a primary level of education, 23% had a secondary level of education, 31% had a bachelor, 23% had a master and finally 15% had Ph.D.

The majority of respondents, 92% would accept the development of offshore wind turbines within viewing distance from their homes if it resulted in cheaper electricity. Of this 92%, the majority of respondents had a secondary level of education or a bachelor, 36% in each instance. 9% of respondents had a Ph.D. and 6% had a primary level of education. The results were the same when the respondents were asked whether they accept further development of offshore turbines within viewing distance from their home if it resulted in reduced carbon dioxide emissions.

4.1.5. Enniscrone, County Sligo

The questionnaire was distributed in Enniscrone, Co. Sligo on 21st June 2012. The questionnaire was distributed on the local beach which offered a good view over

Killala Bay. There have been no plans to erect any offshore wind farms in this location. It was however, deemed important by the author to obtain the views of those who live on the coast but have no immediate connection to an offshore wind farm. There were 105 questionnaires distributed with a response rate of 30%.

4.1.5.1. Personal Background

1. Do you live within 10km from the coast?

#	Answer		Response	%
1	Yes		27	87%
2	No		4	13%
	Total		31	100%

Of the 31 respondents, 87% of them lived within 10km from the coast.

2. Age?

#	Answer		Response	%
1	18-21		3	10%
2	22-30		22	71%
3	31-40		1	3%
4	41-50		1	3%
5	51-65		4	13%
6	66+		0	0%
	Total		31	100%

Unlike the results in Arklow and Blackrock, the range of ages in Enniscrone was not as diverse as those locations. The majority of respondents, 71%, were in the 22 to 30 age category.

3. Gender?

#	Answer		Response	%
1	Male		16	52%
2	Female		15	48%
	Total		31	100%

In terms of gender, there was quite an even spread among the respondents in Enniscrone. 52% were male and 48% were female.

4. Educational background?

#	Answer		Response	%
1	Primary		0	0%
2	Secondary		8	26%
3	Third Level - Bachelor		12	39%
4	Third Level - Masters		9	29%
5	Third Level - Ph.D.		2	6%
	Total		31	100%

The respondents in Enniscrone were quite well educated with no participants having just a primary level of education. 39% of participants had bachelor, 29% had a master and 6% had a Ph.D.

4.1.5.2. Attitudes towards Renewable Energy

5. Are you in favor of renewable energy development in Ireland?

#	Answer		Response	%
1	Yes		30	100%
2	No		0	0%
3	Don't Know		0	0%
	Total		30	100%

Of those who responded to question five, all were in favor of renewable energy development in Ireland.

6. To what extent to you understand wind generated electricity?

#	Answer		Response	%
1	1 - Not at all		0	0%
2	2 - Vaguely		8	26%
3	3 - Moderately		11	35%
4	4 - Fairly Well		11	35%
5	5 - Expert in the field		1	3%
	Total		31	100%

There was generally a good understanding of wind generated electricity among the sample population in Enniscrone. 35% had a moderated understanding while 35% understood wind generated electricity fairly well.

7. What would you consider to be the biggest impacts, either positive or negative of wind generated electricity?

The responses to question seven ranged from the environmental benefits which can arise from wind energy, to more negative opinionated aspects such as noise pollution and visual impacts. The following are a sample of the responses received from question seven.

Table 4.7.
Attitudes towards wind generated electricity (Enniscrone)

Attitudes
• Renewable, clean energy.
• It had implications for birds. You need to generate a lot of energy to offset the CO_2 used to build and implement them. Planning restrictions.
• Reduced carbon emissions. They can be unsightly.
• Noise pollution. Lower cost electricity.
• Not being able to store the energy generated for use at a later time, or to be directed for local use.
• Optimum use of natural resources has to be positive. I think there is a color issue with turbines, they could blend in much more if they were not white.
• Noise issues, infrasound, associated health issues, threat to wildlife, impact on real estate value, inefficiency, decommissioning, expensive form of energy.
• Excessive time needed to develop wind farms.
• Reduced cost on households.
• Makes making electricity cheaper.
• Negative to look at, positive because they are cheaper.
• Negative: ecology, visual. Positive: sustainable renewable energy.

Table 4.7 (continued).

- Negative: clean renewable energy and we have an abundance of wind in Ireland.

  Negative: eyesore.

- Reducing the use of fossil fuels. Cost.

- Environmentally friendly way of generating electricity, they don't need any fuel to run which is good also.

4.1.5.3. Attitudes towards Offshore Wind Power

8. Are you in favor of offshore wind farm development in Ireland?

#	Answer		Response	%
1	Yes		28	90%
2	No		1	3%
3	Don't Know		2	6%
	Total		31	100%

In Enniscrone, 90% of the population was in favor of offshore wind farm development with 3% not in favor and 6% unsure.

9. To what extent do you understand offshore wind turbines?

#	Answer		Response	%
1	1 - Not at all		2	6%
2	2 - Vaguely		16	52%
3	3 - Moderately		9	29%
4	4 - Fairly Well		4	13%
5	5 - Expert in the field		0	0%
	Total		31	100%

52% of respondents had a vague understanding of offshore wind turbines. 29% of respondents understood them moderately while 13% had a fairly good knowledge of offshore wind turbines.

10. Would you consider there to be any positive impacts associated with the erection of offshore wind turbines? If yes, please specify.

The majority of responses to question ten related to the reduced visual impact of turbines if they were located offshore, and also, the environmental benefits which may arise from them. The following is a sample of the responses received.

Table 4.8.
Positive impacts associated with the erection of offshore wind turbines (Enniscrone)

Positive impacts
• They can generate large amounts of power as larger turbines can be used as there are no planning restrictions. They also help create artificial reefs for marine environment.
• Offshore is where there is most wind.
• Wouldn't see or hear them.
• Less of an eyesore than in your back garden, also more exposure for the turbines.
• Offshore wind farms would be safer – not as much impact on humans.
• Potential for lots of energy to be generated by Irish wind turbines.
• Reduced cost for households.
• Yes. Ireland is a great place for these.

Table 4.8 (continued).

- Offshore wind turbines generate more electricity due to higher wind volumes.
- Yes. Clean renewable energy and after initial set up costs I would imagine in would be a very cheap source of energy.
- If energy can be generated from a renewable resource, then we should be embracing it. Economies rely far too much on fossil fuels and they will run out.
- Some people complain about wind turbines being an eyesore, offshore wind turbines would prevent this. Also no noise pollution.
- Yes. They would not alter the look of the landscape.
- Yes. Less noise pollution to the surrounding areas. Less bird deaths etc.

11. Would you consider there to be any negative impacts associated with the erection of offshore wind turbines?

The responses to question 11 centered on negative effects towards marine and wildlife, and also the associated costs of erecting the turbines. The following are some of the responses which were received.

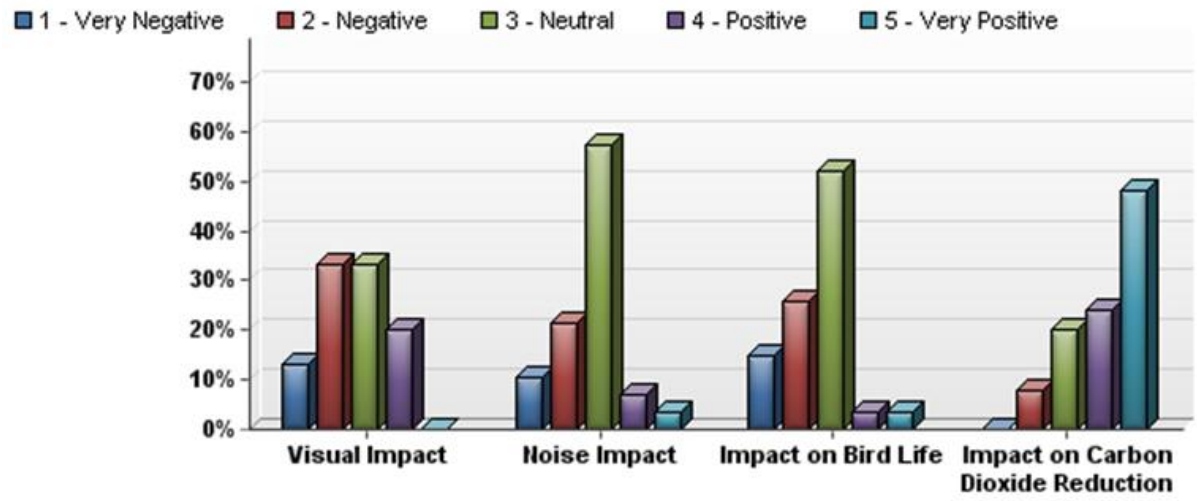
Table 4.9.
Negative impacts associated with the erection of offshore wind turbines (Enniscrone)

Negative impacts
• Could affect fishing and marine life.
• Wildlife.
• Still unsure of the efficiency and added cost to electricity consumers. Decommissioning of old turbines.

Table 4.9 (continued).

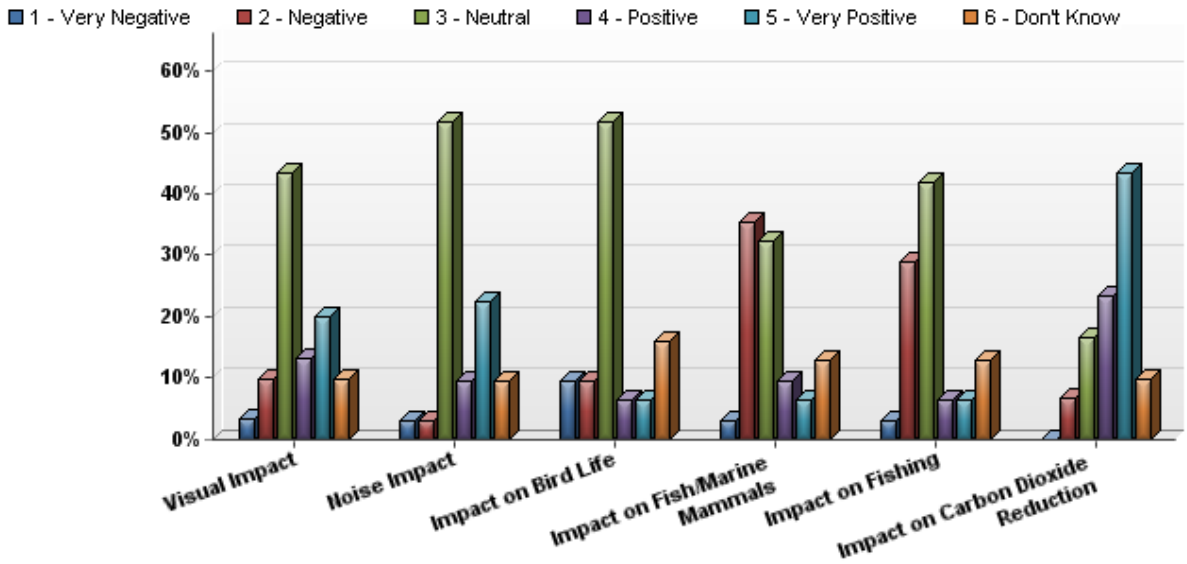
- Cost of installation.
- No.
- No.
- Higher costs.
- Personally no, I am all for it.
- No.
- They may have a negative impact on sea life, I'm not so sure.
- Effect marine life due to the construction of the turbines and transporting the electricity to shore.
- No.
- Visual impact, but that negates itself when you are forced to witness flammable oil rigs or gas rigs or gas pipes running through communities.
- Bird life. They might have some impact on the movement of water.

12. With regards to ONSHORE turbines, what are your feelings towards the following?



There was a somewhat even breakdown of the results with regard to visual impact of onshore wind turbines. 33% of respondents felt that they had a negative impact, 33% felt that they had a neutral visual impact while 20% felt that they had a positive visual impact. In terms of noise impact, the majority of respondents, 57% had a neutral view towards any noise impact of turbines. It was a similar picture with relation to the impact the turbines might have on bird life. 52% of respondents had a neutral view in this regard with 26% of respondents feeling that they had a negative impact on bird life. Finally, the majority of respondents agreed that onshore wind turbies had either a positive or very postive imact on carbon dioxide reduction. The figures here were 24% and 48% respectively.

13. With regard to OFFSHORE wind turbines, what are your feelings towards the following?



From the results received for visual impact, 43% of respondents had a neutral view whilst 20% felt that they had a very positive visual impact. With relation to noise impact, there was a broadly similar result to question 12 with 52% of respondents having a neutral view. The situation was the same when asked about impact on bird life. 52% of respondents had a neutral view while 16% did not know. The view with regard to the impact on fish or marine mammals was that offshore turbines would have a negative effect. 36% of respondents were of this belief. The majority of respondents felt that offshore turbines would have either a neutral or negative effect on fishing with the figures being 42% and 29% respectively. The majority of respondents were of the belief that offshore turbines would have either a positive or very positive effect on carbon dioxide reduction. The figures here were 23% and 43% respectively.

14. Would you be willing to accept offshore wind turbines, within viewing distance from your home, if it resulted in reduced electricity bills? (Altered slightly from Arklow questions by the fact that there is no offshore farm located there)

#	Answer		Response	%
1	Yes		23	74%
2	No		7	23%
3	Don't Know		1	3%
	Total		31	100%

Of the respondents in Enniscrone, 74% answered yes to question 14 with 23% not willing to accept offshore turbines within viewing distance from their homes in exchange for reduced electricity bills.

15. Would you be willing to accept offshore wind turbines, within viewing distance from your home, if it resulted in reduced carbon dioxide emissions? (Altered slightly from Arklow questions by the fact that there is no offshore farm located there)

#	Answer		Response	%
1	Yes		25	81%
2	No		6	19%
3	Don't Know		0	0%
	Total		31	100%

From the responses received for question 15, 81% of respondents would be willing to accept offshore wind turbines within viewing distance from their homes in exchange for reduced carbon dioxide emissions.

4.1.6. Correlations with Enniscrone Results

Similar to the correlations witnessed in sections 4.1.2 and 4.1.4 there are also correlations with the results received in Enniscrone. These relate to the age of the respondents, their gender, their educational background, and how far they live from the coast.

4.1.6.1. Location from Coastline

87% of the respondents lived within 10 km from the coast. Of this 87%, all of the respondents were in favor of renewable energy development whilst 89% were in favor of offshore wind farm development. The majority of respondents, 52%, had only a vague understanding of the concept of offshore wind turbines with 15% understanding them fairly well. Of the respondents living within 10km from the coast, 74% would accept offshore turbines within viewing distance from their homes if it resulted in reduced electricity bills. 22% of respondents would not accept them. 81% would accept offshore turbines within viewing distance from their homes if it resulted in reduced carbon dioxide emissions.

Of the 13% of respondents who lived further than 10km form the coast, all were in favor of both renewable energy development and offshore wind energy development. When asked how well they understood offshore wind turbines, 50% had a vague understanding and 50% had a moderate understanding. 75% of this group of respondents would be willing to accept offshore turbines if it resulted in reduced

electricity bills with 25% answering no. The result was the same when asked if they would accept offshore turbines in exchange for reduced carbon dioxide emissions.

4.1.6.2. Age

All of the respondents in Enniscrone were in favor of renewable energy development in Ireland. 70% of these were aged between 22 and 30 with 13% in the 51 to 65 age category and 10% in the 18 to 22 category. There were 3% each in the 31 to 40 and 41 to 50 age categories. It is important to bear in mind that 71% of the respondents were aged between 22 and 30 which obviously had a bearing on these results. 90% of the respondents were in favor of offshore farm energy development. The majority of these respondents, 71%, were aged between 22 and 30.

52% of respondents had a vague understanding of offshore wind turbines. 29% of respondents understood them moderately while 13% had a fairly good knowledge of offshore wind turbines. Of those who had a vague understanding of offshore turbines, 6% were aged between 18 and 21. 81% were aged between 22 and 30 and 13% were aged between 51 and 65. Of those who had a moderate understanding, 11% were aged between 18 and 21, 67% were aged between 22 and 30 whilst 22% were aged between 51 and 65.

Of those that would be willing to accept the erection of offshore turbines in exchange for cheaper electricity, the majority, 74%, were aged between 22 and 30. Of those that would be willing to accept the erection of offshore turbines in exchange for

reduced carbon dioxide emissions, again a vast majority of 76% were aged between 22 and 30.

4.1.6.3. Gender

From the respondents in Enniscrone, 52% were male and 48% were female. All of the male and female respondents were in favor of renewable energy development in Ireland. All of the female respondents were in favor of offshore wind farm development with 94% of male respondents in favor and 6% not in favor.

The majority of the respondents in Enniscrone, 52% had a vague understanding of offshore turbines. When broken down, 31% of these were male and 69% were female. Of those who had a moderate understand of offshore turbines, 67% were male and 33% were female. Of those who understood offshore turbines fairly well, all of the respondents were male.

Of the 74% of respondents who would be willing to accept offshore turbines within viewing distance from their homes, if it resulted in reduced electricity bills, 57% were male and 43% were female. Of those who would not be willing to accept offshore turbines in exchange for reduced electricity bills, 43% were male and 57% were female. Of the 81% of respondents who would be willing to accept offshore turbines within viewing distance from their homes, if it resulted in reduced carbon dioxide emissions, 56% were male and 44% were female. Of those who would not be willing to accept offshore turbines in exchange for reduced carbon dioxide emissions, 33% were male and 67% were female.

4.1.6.4. Educational Background

Of the respondents in Enniscrone, 26% had a secondary level education, 39% had bachelor, 29% had master and 6% had a Ph.D. All of the respondents were in favor of renewable energy development in Ireland. 90% of the respondents were in favor of offshore wind farm development in Ireland. Of these respondents, 29% had a secondary level education, 32% had a bachelor, 32% had a master and 7% had a Ph.D. The respondents, who were not in favor or did not know, had bachelor degrees.

Of the 52% of respondents who had a vague understanding of offshore turbines, 31% had a secondary level education, 25% had a bachelor, 31% had a master and 13% had Ph.D. Of the 29% who had a moderate understanding of offshore turbines, 22% had a secondary level education, 56% had a bachelor and 22% had a master. Of the respondents who understood offshore turbines fairly well, 75% had a bachelor with 25% having a master.

Of the 74% of respondents who would accept offshore turbines within viewing distance from their homes in exchange for cheaper electricity, 26% had secondary level education, 35% had a bachelor, 30% had a master and 9% had Ph.D. Of those who would not accept offshore turbines in exchange for cheaper electricity, 29% had a secondary level education, 42% had a bachelor and 29% had master. Of the 81% of respondents who would accept offshore turbines within viewing distance from their homes in exchange for reduced carbon dioxide emissions, 24% had a secondary level education, 40% had a bachelor, 28% had a master and 8% had a Ph.D.

4.1.7. Overall National Result

The results from Arklow, Blackrock and Enniscrone were then combined and compiled into a single set of results. The idea behind this was to provide an overall representation of the three study locations.

4.1.7.1. Personal Background

1. Do you live within 10km from the coast?

#	Answer		Response	%
1	Yes		75	83%
2	No		15	17%
	Total		90	100%

Of the 90 respondents, 83% of them lived within 10 km from the coast.

2. Age?

#	Answer		Response	%
1	18-21		11	12%
2	22-30		36	41%
3	31-40		11	12%
4	41-50		13	14%
5	51-65		14	16%
6	66+		5	5%
	Total		90	100%

41% of the respondents were aged between 22 and 30 with there being a relatively even spread of respondents among the other age categories.

3. Gender?

#	Answer		Response	%
1	Male		42	47%
2	Female		48	53%
	Total		90	100%

There was quite an even spread between male and female respondents. 47% of respondents were male with 53% being female.

4. Educational background?

#	Answer		Response	%
1	Primary		1	1%
2	Secondary		32	35%
3	Third Level - Bachelor		34	38%
4	Third Level - Masters		17	19%
5	Third Level - Ph.D.		6	7%
	Total		90	100%

Of the respondents from the three locations, 35% had a secondary level education, 38% had a bachelor, and 19% had a master while 7% had a Ph.D.

4.1.7.2. Attitudes towards Renewable Energy

5. Are you in favor of renewable energy development in Ireland?

#	Answer		Response	%
1	Yes		88	99%
2	No		0	0%
3	Don't Know		1	1%
	Total		89	100%

99% of the respondents were in favor of renewable energy development.

6. To what extent do you understand wind generated electricity?

#	Answer		Response	%
1	1 - Not at all		0	0%
2	2 - Vaguely		15	17%
3	3 - Moderately		30	33%
4	4 - Fairly Well		43	48%
5	5 - Expert in the field		2	2%
	Total		90	100%

In general, there was quite a good understanding of wind generated electricity. 48% of respondents understood wind fairly well.

4.1.7.3. Attitudes towards Offshore Wind Power

8. Are you in favor of offshore wind farm development in Ireland?

#	Answer		Response	%
1	Yes		82	92%
2	No		1	1%
3	Don't Know		6	7%
	Total		89	100%

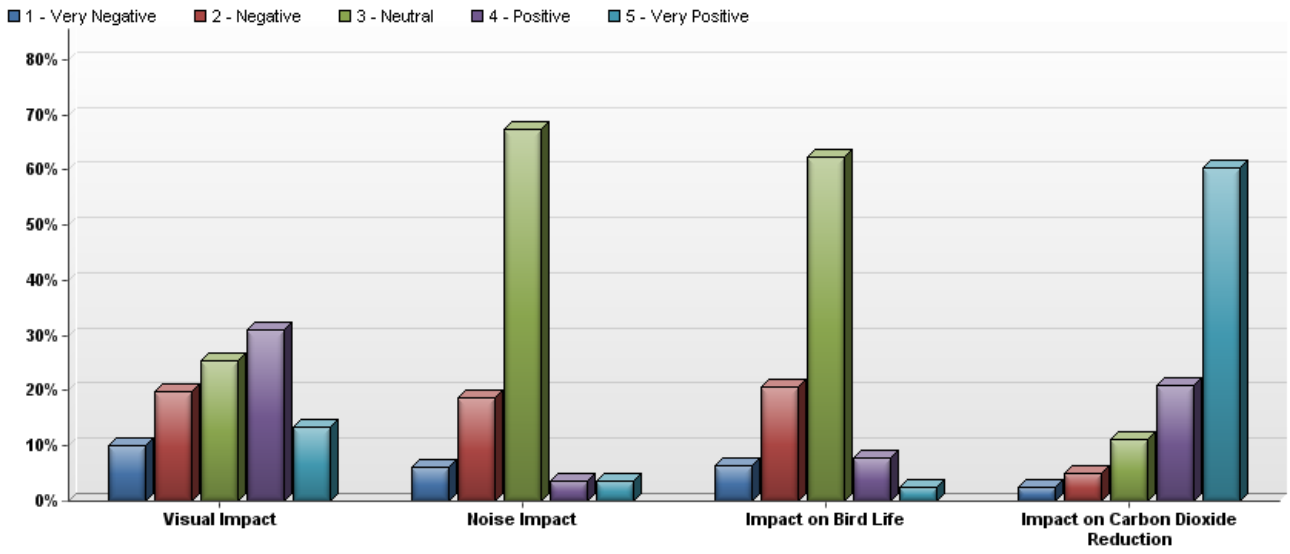
92% of the respondents in all three study locations were in favor of the development of offshore wind farms.

9. To what extent do you understand offshore wind turbines?

#	Answer		Response	%
1	1 - Not at all		6	7%
2	2 - Vaguely		28	31%
3	3 - Moderately		25	28%
4	4 - Fairly Well		31	34%
5	5 - Expert in the field		0	0%
	Total		90	100%

The views expressed with regard to question nine were quiet mixed with 31% having a vague understanding, 28% having a moderate understanding and 34% understanding offshore turbines fairly well.

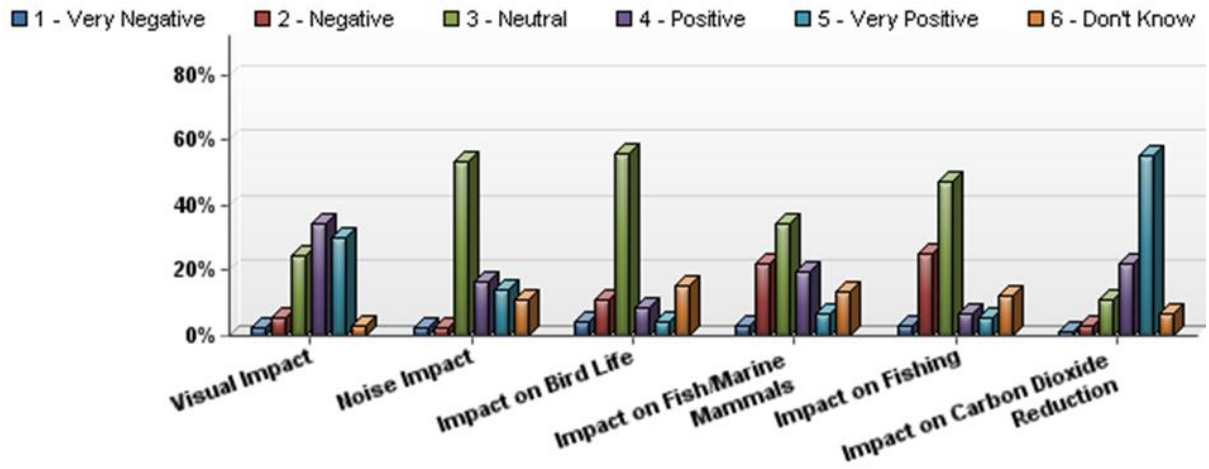
12. With regard to ONSHORE turbines, what are your feelings towards the following?



45% of the population felt that onshore turbines had either a positive or very positive visual impact. 68% of the population had a neutral opinion with regard to the

noise impact from turbines. It was as similar outcome with the respondents were asked about their opinion on the impact on bird life. 62% had a neutral opinion on the issue. 81% of respondents felt that onshore wind turbines have either a positive or very positive impact on carbon dioxide reduction.

13. With regard to OFFSHORE turbines, what are your feelings towards the following?



Similar to the results from the onshore turbines question, 34% felt that offshore turbines had a positive visual impact with 30% of respondents feeling that they have a very positive visual impact. With regard to noise impact, 53% of respondents had a neutral opinion on the matter. The result was quite similar with regard to their opinion on the impact on bird life. 56% had a neutral opinion on the matter and 15% did not know. Overall, there was mixed views with regarding the impact on fish/marine mammals. 22% felt that offshore turbines would have a negative impact whereas 20% felt that they would have a positive impact. 35% had a neutral opinion on the matter.

23% of respondents felt that there would be a negative impact on fishing. Similar to the results from the onshore turbines question, the majority of respondents agreed that offshore turbines would have either a positive or very positive impact on carbon dioxide reduction.

14. Would you be willing to accept offshore wind turbines, within viewing distance from your home, if it resulted in reduced electricity bills?

#	Answer		Response	%
1	Yes		76	84%
2	No		9	10%
3	Don't Know		5	6%
	Total		90	100%

84% of the respondents from the three study areas would accept offshore turbines within viewing distance from their homes if it resulted in reduced electricity bills.

15. Would you be willing to accept offshore wind turbines, within viewing distance from your home, if it resulted in reduced carbon dioxide emissions?

#	Answer		Response	%
1	Yes		80	89%
2	No		9	10%
3	Don't Know		1	1%
	Total		90	100%

89% of the respondents from the three study areas would accept offshore turbines within viewing distance from their homes if it resulted in reduced carbon dioxide emissions.

4.2. Statistical Analysis Results

The strategy used for the statistical analysis of the results was to target questions from the questionnaire which dealt specifically with offshore wind turbines. A number of variables were analyzed in conjunction with these questions. The categorical variables were; the respondents' location with respect to the coast (referred to in SAS as Near coast), their gender, their education and what study location they were from. Age was considered a continuous variable. However as discovered in the analysis, not all of these variables had a major impact on the results. A number of hypotheses were devised in order to help determine the significance of the statistical analysis. The hypotheses were as follows:

- Due to offshore turbines being located at Arklow (Location 1), respondents there would have a greater perceived knowledge of the industry compared to those at Blackrock (Location 2) or Enniscrone (Location 3).
- Respondents living closer to the coast would have a better understanding of offshore turbines.
- Gender would not have any significant impact on the results.

- Respondents with higher education would have a better understanding of the turbines and would be more in favor of them.
- Younger respondents would have a more positive outlook on offshore turbines.

The results were as follows:

4.2.1. Question 8

Regarding question eight, there was a difficulty in statistically examining the results for due to the fact that a high proportion of the respondents had answered Yes. Therefore the best approach to take was to use a logistic model for analyzing the result. Coupled with this, a Pearson Chi-Square test was also conducted.

Test for Impact Analysis

Effect	DF	Wald Chi-Square	Pr > ChiSq
Location	2	0.5783	0.7489
Near coast	1	0.1769	0.6741
Gender	1	2.7990	0.0943
Education	4	1.0412	0.9035
Age	1	0.1707	0.6795

The logistic model was conducted on all the relevant variables and it was found that no specific variable was likely to impact the respondent's response to the question, as in this case, there was no P-value less than 0.05 which would otherwise have indicated an element of significance. This was backed up by Pearson Chi-Square tests in

which no Asymptotic P-value less than 0.05, which would have allowed us to reject the corresponding hypothesis.

4.2.2. Question 9

Linear regression was used to examine the data from question nine. In this question a five point Likert type scale was utilized with 1 equating to Not at all and 5 equating to Expert in the field. The most significant variable here was the study location of where the respondents were from.

Test for Impact Analysis

Effect	Num DF	Den DF	F Value	Pr > F
Location	2	79	7.68	0.0009
Near coast	1	79	3.51	0.0648
Gender	1	79	5.05	0.0274
Education	4	79	0.98	0.4255
Age	1	79	0.02	0.8917

In this particular instance, as discovered through the use of a Tukey test, we fail to reject the hypothesis that respondents from Arklow had a better perceived knowledge of offshore turbines than respondents from the other two locations.

4.2.3. Question 13

Question 13 was designed with in association with question 12 to assess whether the views of the respondents were similar or different with respect to onshore and

offshore wind turbines. For the purpose of the statistical analysis, question 13 was examined as this dealt exclusively with offshore turbines. A five point Likert type scale was utilized with 1 equating to Very Negative and 5 equating to Very Positive. Respondents had the option of selecting Don't Know however this was excluded from the statistical analysis. Although the highest number of respondents who selected Don't Know was 12%, it was deemed that excluding this would not unduly affect the result. As a Likert type scale was utilized, it was possible to assume that the response was continuous, and with this in mind, linear regression was used. The results were as follow:

4.2.3.1. Noise Impact

Solution for Fixed Effects

Effect	Location	Near coast	Gender	Education	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept					3.6233	0.4732	68	7.66	<.0001
Location	**1**				0.2233	0.2303	68	0.97	0.3358
Location	**2**				-0.1896	0.2630	68	-0.72	0.4735
Location	**3**				0	.	.	.	.
Near coast		**1**			-0.01260	0.2760	68	-0.05	0.9637
Near coast		**2**			0	.	.	.	.
Gender			**1**		0.4147	0.2110	68	1.97	0.0535

Solution for Fixed Effects									
Effect	**Location**	**Nearcoast**	**Gender**	**Education**	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**
Gender			**2**		0	.	.	.	.
Education				**1**	-1.1338	0.9472	68	-1.20	0.2355
Education				**2**	0.1326	0.3981	68	0.33	0.7400
Education				**3**	-0.05235	0.3913	68	-0.13	0.8940
Education				**4**	0.3504	0.4077	68	0.86	0.3930
Education				**5**	0	.	.	.	.
Age					-0.1755	0.07621	68	-2.30	0.0244

The most significant variable to affect the respondent's attitude towards noise impact was Age. In this instance, the P-value obtained for the age variable was less than 0.05 indicating a certain element of significance. Generally, it was older age categories which felt that the noise impacts from offshore turbines would have a negative impact, hence it was necessary to fail to reject the relevant hypothesis.

4.2.3.2. Impact on Bird Life

Solution for Fixed Effects									
Effect	**Location**	**Near coast**	**Gender**	**Education**	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**
Intercept					2.7552	0.4082	65	6.75	<.0001
Location	**1**				0.4403	0.1990	65	2.21	0.0304
Location	**2**				-0.00866	0.2256	65	-0.04	0.9695
Location	**3**				0	.	.	.	.
Near coast		**1**			-0.1233	0.2482	65	-0.50	0.6211
Near coast		**2**			0	.	.	.	.
Gender			**1**		0.6989	0.1777	65	3.93	0.0002
Gender			**2**		0	.	.	.	.
Education				**1**	-0.7717	0.7896	65	-0.98	0.3321
Education				**2**	0.1695	0.3343	65	0.51	0.6138
Education				**3**	0.009477	0.3294	65	0.03	0.9771
Education				**4**	0.5967	0.3417	65	1.75	0.0855
Education				**5**	0	.	.	.	.
Age					-0.1376	0.06472	65	-2.13	0.0373

The three variables which had the greatest degree of influence with regard to the respondents attitudes towards the impact on bird life were; the study location of the respondents, their gender and their age. It was found that through the use of a Tukey test, the respondents in Arklow felt that turbines had more of a positive impact on bird life compared with those in Blackrock or Enniscrone. Hence it was necessary to fail the reject the associated hypothesis. It was also discovered through the tests that more males (Gender 1) than females (Gender 2), felt that offshore turbines would have a positive impact on bird life. Therefore, it was necessary to reject that associated hypothesis. Similar to the noise impacts, it was discovered that older people felt that turbines would have a negative effect on bird life.

4.2.3.3. Visual Impact

Solution for Fixed Effects

Effect	Location	Near coast	Gender	Education	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept					2.7333	0.5136	75	5.32	<.0001
Location	**1**				0.9477	0.2543	75	3.73	0.0004
Location	**2**				0.5932	0.2801	75	2.12	0.0375
Location	**3**				0	.	.	.	.
Near coast		**1**			0.2382	0.2719	75	0.88	0.3838
Near		**2**			0	.	.	.	.

Solution for Fixed Effects									
Effect	**Location**	**Near coast**	**Gender**	**Education**	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**
coast									
Gender			**1**		0.008754	0.2214	75	0.04	0.9686
Gender			**2**		0	.	.	.	.
Education				**1**	-1.4220	1.0400	75	-1.37	0.1756
Education				**2**	0.4934	0.4302	75	1.15	0.2551
Education				**3**	0.4761	0.4240	75	1.12	0.2650
Education				**4**	0.8060	0.4468	75	1.80	0.0752
Education				**5**	0	.	.	.	.
Age					-0.03785	0.07790	75	-0.49	0.6284

The most significant result obtained with regard to visual impact was related to study location. It was found that respondents from Arklow felt that offshore turbines had a more of a positive visual impact than respondents from Enniscrone. This was also verified by the Tukey test. Therefore it is necessary to fail to reject the associated hypothesis.

4.2.3.4. Fish/Marine Mammals

With regard to impact on fish/marine mammals, it was found from the tests that no particular variable had an overly significant impact on respondent's answers. In this instance, the P-Value for all variables was less than -1.

4.2.3.5. Fishing

Solution for Fixed Effects

Effect	Location	Near coast	Gender	Education	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept					2.0109	0.4655	68	4.32	<.0001
Location	**1**				0.2437	0.2245	68	1.09	0.2814
Location	**2**				-0.3531	0.2517	68	-1.40	0.1652
Location	**3**				0	.	.	.	.
Near coast		**1**			-0.01774	0.2711	68	-0.07	0.9480
Near coast		**2**			0	.	.	.	.
Gender			**1**		0.1934	0.1982	68	0.98	0.3327
Gender			**2**		0	.	.	.	.
Education				**1**	-1.0664	0.9044	68	-1.18	0.2424
Education				**2**	0.7297	0.3814	68	1.91	0.0599
Education				**3**	0.5585	0.3691	68	1.51	0.1349

Solution for Fixed Effects

Effect	Location	Near coast	Gender	Education	Estimate	Standard Error	DF	t Value	Pr > |t|
Education				**4**	0.6130	0.3900	68	1.57	0.1206
Education				**5**	0	.	.	.	.
Age					0.05827	0.06808	68	0.86	0.3951

Differences of Least Squares Means

Effect	Location	_Location	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Location	**1**	**2**	0.5969	0.2378	68	2.51	0.0144	Tukey-Kramer	0.0379
Location	**1**	**3**	0.2437	0.2245	68	1.09	0.2814	Tukey-Kramer	0.5261
Location	**2**	**3**	-0.3531	0.2517	68	-1.40	0.1652	Tukey-Kramer	0.3451

In the case of fishing, the study locations proved to be the most significant variable. According to the Tukey test, the Adjusted P-value from Arklow, indicated that more respondents from there felt that offshore turbines would have a positive impact on fishing than respondents in Blackrock or Enniscrone.

4.2.3.6. Impact on Carbon Dioxide Reduction

Solution for Fixed Effects

Effect	Location	Near coast	Gender	Education	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept					4.1574	0.4469	72	9.30	<.0001
Location	**1**				0.3824	0.2178	72	1.76	0.0834
Location	**2**				0.6830	0.2420	72	2.82	0.0062
Location	**3**				0	.	.	.	.
Near coast		**1**			0.1588	0.2407	72	0.66	0.5116
Near coast		**2**			0	.	.	.	.
Gender			**1**		0.8047	0.1931	72	4.17	<.0001
Gender			**2**		0	.	.	.	.
Education				**1**	-3.6542	0.8871	72	-4.12	0.0001
Education				**2**	-0.4886	0.3737	72	-1.31	0.1952
Education				**3**	-0.6224	0.3609	72	-1.72	0.0889
Education				**4**	-0.3910	0.3838	72	-1.02	0.3117
Education				**5**	0	.	.	.	.
Age					-0.03743	0.06838	72	-0.55	0.5858

Test for Impact Analysis				
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Location	2	72	4.02	0.0221
Near coast	1	72	0.44	0.5116
Gender	1	72	17.37	<.0001
Education	4	72	4.49	0.0027
Age	1	72	0.30	0.5858

There were three variables which most influenced the respondents' answers regarding the impact that offshore turbines would have on carbon dioxide reduction. These were gender, study location and education. Although nearly all respondents felt that offshore turbines would have a positive impact on carbon dioxide reduction, it was found in these tests that the majority were male. Therefore it is necessary to reject the hypothesis that gender has no major impact on the results. Similar to the other variables, location was also important. It was discovered that a higher proportion of Blackrock respondents felt that offshore turbines would have a very positive impact on carbon dioxide reduction compared to the Arklow and Enniscrone respondents. With regard to education, the respondent with the primary education (Education 1) felt that offshore turbines would have a negative impact on carbon dioxide reduction, hence is it necessary to fail to reject the hypothesis associated with education.

4.2.4. Question 14

Similar to question eight, there was a difficulty in statistically examining the results for question 14 as a high proportion of the respondents had answered Yes. Once again, the logistic model was used coupled with a Pearson Chi-Square test.

Test for Impact Analysis

Effect	DF	Wald Chi-Square	Pr > ChiSq
Location	2	2.5742	0.2761
Near coast	1	2.1351	0.1440
Gender	1	2.7001	0.1003
Education	4	0.6168	0.9612
Age	1	0.0326	0.8567

Pearson Chi-Square Test	
Chi-Square	3.8911
DF	1
Asymptotic Pr > ChiSq	0.0485
Exact Pr >= ChiSq	0.0778

This produced one significant variable which most impacted the respondents' opinions regarding their answer for question 14. This variable was their gender. As discovered from the tests, gender had an Asymptotic P-value less than 0.05 (0.0485) and it was the male respondents which had a higher proportion of Yes answers.

4.2.5. Question 15

The logistic model and Pearson Chi Square test were also utilized for question 15.

Test for Impact Analysis			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
Location	2	4.6263	0.0990
nearcoast	1	1.3103	0.2523
Gender	1	1.8496	0.1738
Education	4	2.5033	0.6440
Age	1	0.0502	0.8228

Just as in question eight, the logistic model and Chi Square test found that no specific variable was likely to impact the respondent's response to the question. In this case, there was no P-value less than 0.05 which would otherwise have indicated an element of significance.

4.3. Summary

This chapter gave a breakdown of the results obtained from the questionnaires which were returned. Graphs were developed to aid in the presentation of results and correlations were devised. Results were presented individually from the three study areas, and then combined to provide a complete overview. The results were also analyzed statistically in order to aid with the validity of the questionnaire used. In all three locations, there was generally a strong support for renewable energy and also for the development of offshore wind turbines. People would be accepting of offshore

turbines within viewing distance from their homes, if it resulted in reduced electricity prices and reduced carbon dioxide emissions. Responses towards various questions related to wind energy, and positive and negative impacts associated with the erection of offshore turbines were also addressed. Positive impacts included increased security of electricity supply and less impact with landowners. Negative impacts included cost levels and impacts on the fishing industry. The next chapter provides an analysis of the results from this chapter..

CHAPTER 5. ANALYSIS OF RESULTS

The previous chapter gave a breakdown of the results compiled from the questionnaires received. The aim of this chapter is to analyze these results and see whether they differ from results of previous research. This will assist in drawing a set of conclusions from the research.

5.1. Attitudes towards Renewable Energy

In all three study locations, there was strong support towards the concept of renewable energy. In Arklow, 97% of the respondents were in favor of renewable energy development. In Blackrock and in Enniscrone, all of the respondents were in favor of renewable energy development. As discovered in section 2.2, Ireland is heavily reliant on imported fossil fuels, however there is an emerging market for renewable sources of energy backed up by national targets and policies. It is clear from the respondents in the three study locations, that there is an appetite amongst the public for the further development of the renewable energy sector in Ireland.

From question six in the questionnaire, it was discovered that 50% of the Arklow respondents understood the concept of wind generated electricity fairly well, with 38% having a moderate understanding. In Blackrock, these figures stood at 60% and 24%

respectively. In Enniscrone, 35% had a moderate understanding of renewable energy and 35% understood renewable energy fairly well. These figures are all very positive and reinforce the fact from above that as well as being in support of renewable energy development, there is also a relatively strong knowledge of the industry, in this particular case, wind energy.

5.2. General Attitudes towards Offshore Wind Farms

The respondents in Arklow were in the position of having an established offshore wind farm within viewing distance from the town. The farm was in situ for a number of years at the time the questionnaire was distributed. It was clear that this had a bearing on the responses to question eight in the questionnaire, when the respondents were asked if they were in favor of offshore wind farm development in Ireland. 94% of respondents were in favor. There is a difference when comparing this to the Blackrock and Enniscrone results. In Blackrock, there were a lower percentage of those in favor of offshore wind energy development, 92%, whilst in Enniscrone, the figure was lower again at 90%. These are still very high percentages but it is clear that having the ability to witness the offshore farm on a daily basis has impacted in the psyche of the Arklow respondents in a positive way. This is in line with the results of the statistical analysis carried out in section 4.2.2, and also of research by Warren et. al. (2005) and Farrier (1997), by the fact that those living closest to the offshore farm and with more direct contact with it, are actually the ones who were most supportive of it. From the negative responses obtained from question 11 of the questionnaire, a prominent theme was the

cost associated with offshore turbines as opposed to any major environmental or seascape issues.

The impact on the psyche of the Arklow respondents is perhaps more visible in terms of how well they understood the concept of offshore wind farms. A total of 76% of respondents had a moderate or fairly good understanding of offshore wind turbines, with this figure in Blackrock being 68%, and 42% in Enniscrone. With Arklow and Blackrock having a stronger involvement with offshore wind projects than Enniscrone, it is no great surprise that the levels of understanding are higher in those locations. In fact in Enniscrone, 52% of respondents had a vague understanding of offshore turbines compared with 20% in Blackrock and 21% in Arklow.

In all three locations, there was a strong appetite for the development of offshore wind farms if it resulted in reduced electricity prices and reduced carbon dioxide emissions. This tends to be in line the research carried out by Firestone and Kempton (2007) which suggested that people would be more open to the idea of an offshore wind farm if they could see tangible benefits from it such as cheaper electricity. It is different though to what was discovered by Haggett (2011) by the fact that people would accept an offshore wind farm in exchange for reduced carbon dioxide emissions. In her study, people needed to see a more immediate benefit to offshore wind farms before they would become more accepting of them.

5.2.1 Attitudes with Respect to Proximity

It was discovered in previous studies such as Firestone and Kempton (2008), and Swofford and Slattery (2010), that proximity to the coastline can have a bearing on the attitudes of people towards offshore wind farms. This conclusion held true in this study. For example in Arklow, of those that lived further than 10 km from the coast, 80% were in favor of offshore wind farm development in Ireland compared with the 90% who lived closer to the coast. There was also less of an understanding of offshore turbines amongst the respondents who lived further than 10 km from the coast than those who lived closer to the coast. Of those living within 10 km from the coast, 96% of respondents would accept more offshore turbines within viewing distance from their homes, if it resulted in reduced electricity prices. All of the respondents would accept more offshore turbines if it resulted in reduced carbon dioxide emissions. The figures for those living further than 10 km from the coast were considerably less, 67% and 83% respectively. Judging by these figures, there was a greater degree of acceptance of the offshore turbines by those who lived closer to the coast than those who lived further away.

Although the construction of the offshore farm at Blackrock has not yet started, the results are consistent with those above. Of the respondents who lived closer to the coast, 95% were in favor of offshore wind energy development compared to 80% of those who lived further than 10 km from the coast. The respondents who lived closer to the coast also had a far better understanding of offshore wind turbines. 60% had a fairly good understanding compared with 20% who lived further than 10 km from the

coast. This would suggest that although the farm was not yet built, having a better affinity with the ocean led to a greater understanding of those things associated with it. Of those living within 10 km from the coast, 95% of respondents would accept offshore turbines within viewing distance from their homes if it resulted in reduced electricity prices and 90% of respondents if it resulted in reduced carbon dioxide emissions. Of those living further than 10 km from the coast, a lower figure of 80% would accept offshore turbines in exchange for both reduced electricity prices and reduced carbon dioxide emissions. This reinforces what was discovered from the Arklow results in that those living closer to the coast had a greater degree of acceptance of the offshore turbines compared with those who lived further away.

The corresponding results for Enniscrone were slightly different. All of the respondents were in favor of offshore wind farm development regardless of proximity to the coast. Of those that were living further than 10 km from the coast, 50% had a vague understanding of offshore turbines. Of those living closer to the coast, 52% had a vague understanding. Of the respondents living within 10km from the coast, 74% would accept offshore turbines within viewing distance from their homes if it resulted in reduced electricity bills. 81% would accept offshore turbines within viewing distance from their homes if it resulted in reduced carbon dioxide emissions. It is clear that the lack of any proposed offshore farm in Enniscrone has led to a lack of knowledge of the respondents about the offshore sector.

5.2.2. Attitudes with Respect to Age

In Ladenburg (2008), the author highlighted the importance which age played on the attitudes of respondents in Denmark. In that study, respondents over the age of 49 tended to have a more negative attitude towards offshore wind farms than the younger respondents. This hypothesis held true in this study as can be seen from the statistical analysis especially with relation to some of the variables in question 13 (section 4.2.3). In Arklow, most of those who were in favor of offshore wind farm development were aged between 21 and 30. Unlike Ladenburg's research, there were no respondents who were not in favor, however those who were unsure were aged between 31 and 50. The majority of respondents who had a moderate understanding of offshore wind turbines were aged between 21 and 30. However, interestingly, those who had a fairly good understanding were older, and represented 58% of the respondents, whom were aged between 41 and 65. When asked if they would accept more offshore wind turbines in exchange for cheaper electricity and reduced carbon dioxide emissions, nearly all of the respondents were in the 22 to 30 age categories, 29% and 32% in both instances. This would perhaps suggest that younger people, possibly those with young families, are more aware of environmental issues and are looking for ways of saving money.

In Blackrock, of those that were in favor of offshore wind farm development, 22%, the highest percentage was aged between 31 and 40. Just as in Arklow, there was nobody who was not in favor of the development of the industry. However those who were unsure fell into the 18 to 21 and 51 to 65 age categories. The Blackrock respondents had a fairly good understanding of the concept of offshore wind turbines.

For the most part, those who had a fairly good understanding were aged between 22 and 50. Those who had a vague understanding were older. They were over the age of 51. This is quite different to the results in Arklow and would imply that age had no major bearing on how well the respondents understood offshore wind turbines. Those who would be willing to accept offshore wind turbines in exchange for reduced electricity bills and reduced carbon dioxide emissions were all aged between 31 and 40. Just as in Arklow, it is the younger generation that is more supportive of offshore wind with regard to these variables.

In Enniscrone the results with respect to age have been skewed somewhat by the fact that a large majority of respondents, 71%, were aged between 22 and 30. With this in mind, it would be inaccurate to analyze the results from here as in all instances, the majority of responses are coming from this age category.

5.2.3. Attitudes with Respect to Gender

In Firestone and Kempton (1997), it was discovered that an equal number of males and females opposed the Cape Cod offshore wind farm plans. This prompted the author to examine whether gender had any impact on the results of this study. In Arklow, 44% of the respondents were male and 56% were female. As discovered previously, all of the male respondents and 89% of the female respondents were in favor of offshore wind energy development. When asked about their understanding of offshore turbines, a higher percentage of those who understood them fairly well were male. Of those who had no understanding or a vague understanding, the majority were

female. This could potentially indicate that the male respondents were more technically minded than their female counterparts. All of the male respondents would be willing to accept more offshore turbines within viewing distance from their home if it resulted in cheaper electricity. The result was quite similar when the respondents were asked they would be willing to accept more offshore turbines within viewing distance from their home, if it resulted in reduced carbon dioxide emissions. The few respondents who were unsure were female. This would suggest that gender had no major bearing on these variables.

The results for Blackrock were very similar to those in Arklow with respect to gender. Just as in Arklow, 44% of the respondents Blackrock were male while 56% were female. With regard to support of offshore wind farm development, again, all male respondents were in favor while 86% of females were in favor. When asked about their understanding of offshore turbines, just as in Arklow, a higher percentage of those who understood them fairly well were male. The majority of those who had no knowledge or a vague knowledge were female. A higher percentage of males than females would accept the development of offshore wind farms in viewing distance from their homes if it resulted in both cheaper electricity and reduced carbon dioxide emissions.

In Enniscrone, there were more male respondents than female, and also a less of a gap between the numbers of both. Of the respondents there, 52% were male and 48% were female. 94% of the male respondents were in favor, with 6% being opposed, representing the only negative response towards the development of offshore wind from all three locations. 87% of females were in favor with 13% being unsure, which is

comparable to the other locations. There was less of an overall understanding of offshore turbines in Enniscrone compared to the other locations. However the pattern of the female respondents having less knowledge than the males remained the same. The majority of respondents had a vague understanding with 31% being male and 69% being female. Just as in Arklow and Blackrock, a higher percentage of male respondents than females would accept the development of offshore turbines in exchanged for reduced electricity bills and reduced carbon dioxide emissions.

In general, as discovered through the statistical analysis of the results, gender was an important variable with relation to how the respondents answered the questions. This can be seen from question 13 (section 4.2.3) and question 14 (section 4.2.4).

5.2.4. Attitudes with Respect to Educational Levels

Ladenburg (2009) discovered that the education levels of respondents played a role in his research. In that study, respondents from a nationally taken sample had a higher level of education than those from a sample closer to the offshore wind farms in question. On that basis, it was deemed beneficial to include education levels in the study. In Arklow, most respondents had either a secondary level education (38%) or third level bachelor (41%). 15% of the respondents had obtained a master while 6% of the respondents had obtained a Ph.D. Regardless of their education level, the majority of respondents were in favor of offshore wind energy development. The two respondents who were unsure were educated to a bachelor or masters level, indicating that a higher level of education did not necessarily lead to a more positive outlook of

the industry. The majority of respondents in Arklow had either a moderate or fairly good understanding of offshore wind turbines, with those who had a fairly good understanding being educated to secondary or bachelor's level. However the majority of those who had a vague understanding had either a bachelor, or higher level of education. This would indicate that having a high level of education did not necessarily translate to a better understanding of the offshore industry. The majority of respondents would accept more offshore turbines within viewing distance from their homes, if it resulted in reduced electricity bills or reduced carbon dioxide emissions. Those who were unsure had a bachelor, master or Ph.D., indicating that having a higher level of education did not necessarily lead them to jumping to any quick conclusions regarding the economic or environmental aspects of offshore wind.

Of the respondents in Blackrock, 4% had a primary education, 44% had a secondary education, 32% had a bachelor, 12% had a master and 8% had a Ph.D. The majority of respondents had a fairly good understanding of offshore turbines, and was in favor of offshore wind farm development regardless of education levels. Those who had a vague, moderate or no understanding had a secondary level education. Those who had a fairly good understanding had either a master or Ph.D. Interestingly the respondent with the primary level of education also had fairly good understanding of offshore turbines. Unlike the results from Arklow, this would give a general indication that those with higher levels of education had a better understanding of turbines. However with the respondent with the primary level of education being the anomaly, it proves that hypothesis wrong. Most respondents were willing to accept the

development of offshore turbines within viewing distance from their homes if it resulted in reduced electricity bills and reduced carbon dioxide emissions. Similar to the Arklow results, those who were unsure had higher levels of education, meaning that they might not have been as quick to jump to conclusions about offshore wind as those with lower levels of education.

Of the respondents in Enniscrone, 26% had a secondary level of education, 39% of participants had bachelor, 29% had a master and 6% had a Ph.D. Again, most were in favor of offshore wind farm development with those not in favor, or being unsure, having bachelor degrees. The majority of respondents had a vague understanding of offshore turbines. This includes the majority of higher educated respondents, including those with a Ph.D. The respondents who understood them moderately or fairly well were educated to either a bachelor or masters level. This proves that higher levels of education have not necessarily have had an impact on the overall understanding of the industry. Just as in Arklow and Blackrock, the majority of respondents would be willing to accept the development of offshore wind turbines within viewing distance from their homes if it resulted in reduced electricity bills or reduced carbon dioxide emissions. Those who would not be willing to accept them however had higher levels of education, namely bachelors and masters. The same conclusions can be drawn as before, that some of those who have a higher education might not have been as quick to jump to certain opinions about offshore wind as those with lower levels of education.

5.3. Onshore Versus Offshore

Rather than simply asking the respondents of their preference between onshore farms and offshore farms, questions 12 and 13 from the questionnaire sought to provide this information through a more in-depth approach. The reason for this is that respondents might have been quick to jump to one answer without thinking about all the variables associated with them.

In Arklow, the respondents felt that there was a far more positive visual impact from offshore turbines over onshore turbines. There was also the feeling that offshore turbines had less of a noise impact compared with onshore turbines. They also felt that offshore turbines would have less of a negative affect on birds compared to onshore turbines. Close to 50% had a neutral view with regard to the impact on fish/marine mammals and this figure was over 60% for the impact on fishing. With regard to the impact on carbon dioxide reduction, the respondents felt that offshore turbines would have a more positive impact compared to onshore turbines.

In Blackrock offshore turbines were seen to have slightly less of a negative visual impact than onshore turbines. For onshore turbines, there were predominantly neutral views with regard to noise and ornithological impacts. With offshore however, there were a higher percentage of respondents who were unsure about these particular impacts. This is no great surprise given the lack of any offshore farm in situ at the moment. The respondents felt that offshore turbines would have a positive impact on fish/marine mammals however many were unsure. Over 40% though felt there that they would have a negative impact on fishing. This would back up what was learned in

the literature review of offshore turbines providing a natural shelter for fish. The respondents agreed that onshore and offshore turbines would have a positive or indeed very positive impact on carbon dioxide reduction.

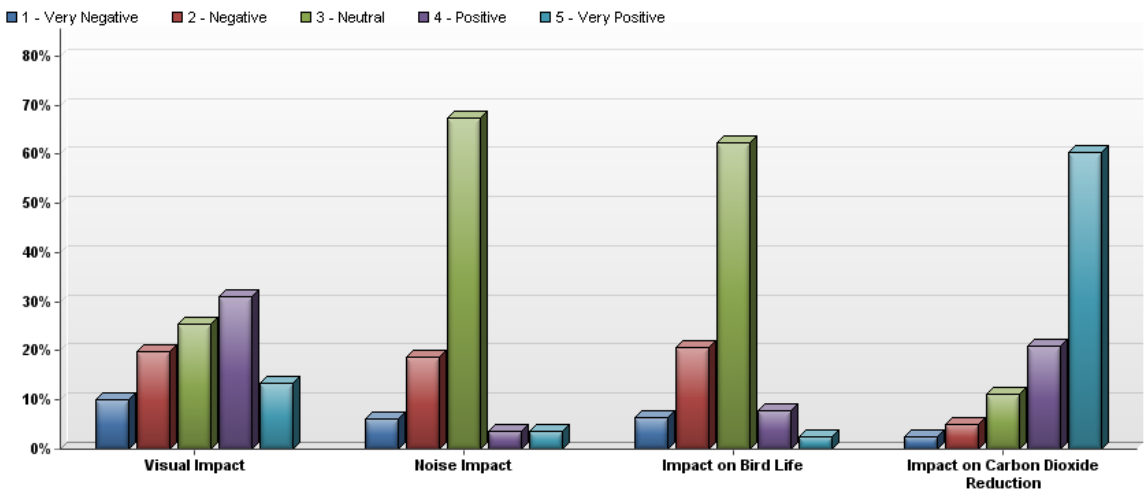
In Enniscrone, a higher percentage of respondents felt that offshore turbines had a more positive visual impact than onshore turbines. They were also of the opinion that offshore turbines had far less negative noise and ornithological impacts than onshore turbines. Of course, similar to Blackrock, a greater percentage of respondents were unsure of these variables compared to the respondents from Arklow. The absence of any offshore farm is obviously an underlying reason for this lack of awareness. The Enniscrone respondents felt that offshore turbines would have a negative effect on both fish/marine mammals, and on fishing. Although they were in agreement with the respondents from the other two locations in agreeing that both onshore and offshore turbines would have a very positive effect on carbon dioxide reduction. The results were quite similar in both instances.

5.4. Impact of the Likert Style Scale

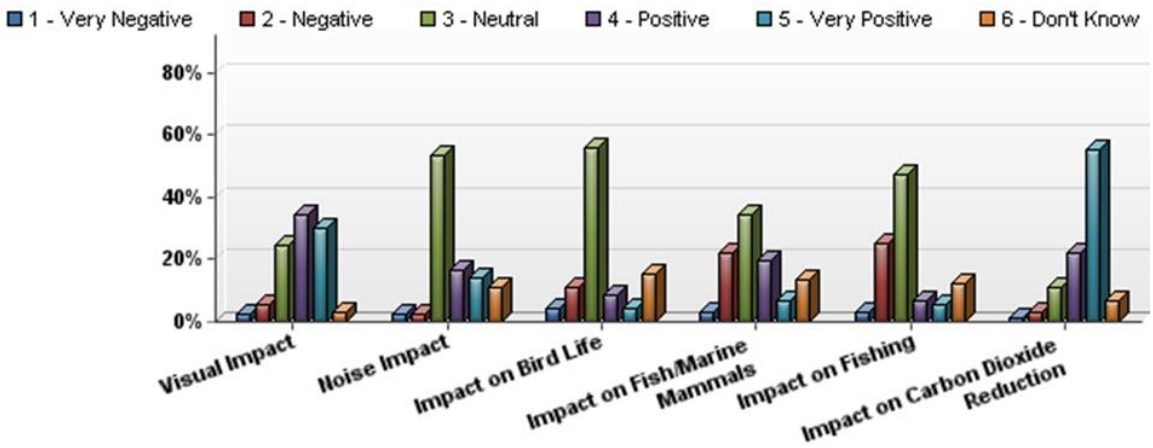
The Likert style measurement scale was utilized in four questions in the questionnaire. Questions 12 and 13 incorporated a six-point scale comprised of Very Negative, Negative, Neutral, Very Positive and Don't Know, with respondents required to pick one of these options. The combined results from the three study areas yielded quite a large proportion of neutral responses, particularly for questions which might be

more difficult to answer. The following are the responses from questions 12 and 13 of the combined results.

12. With regard to ONSHORE turbines, what are your feelings towards the following?



13. With regard to OFFSHORE turbines, what are your feelings towards the following?



As can be seen from the two graphs, there are relatively high response rates for the neutral values from the questions related to noise impact, impact on bird life, impact on fish/marine mammals and impact on fishing. The neutral point was offered so that respondents, who definitely had an opinion, however were unsure whether to pick a positive or negative response, had another choice apart from the Don't Know option. This is a similar view to that of Schuman and Presser (1981). Their argument was that respondents of questionnaires who had a truly neutral stance were not forced to pick an option which was not compatible with their viewpoint. Proponents for not having a neutral point on the scale make the argument that not having a neutral option makes the respondents think more about the issue, and does not give them an easy option (Converse & Presser, 1986). This has not been the case with this questionnaire however as for questions 12 and 13, respondents were given a Don't Know option.

Interestingly however, in question 12, nobody selected the Don't Know, and it was selected very few times in question 13. Weijters, Cabooter and Schillewaert (2009), feel that not having a neutral point will result in more respondents picking a negative option, as having to think more in-depth about the issue can evoke negative inclinations.

5.5. Summary

This chapter provided an analysis of the results generated from this study. The attitude towards renewable energy in Ireland has been examined. The attitude towards offshore wind farms has also been examined with respect to proximity from offshore farms, age of respondents, gender of respondents, and their educational levels. In general, it was found that there is a strong support in Ireland for renewable energy development. It was also found that there is very strong support for offshore wind farm development, with only minimal opposition encountered. Proximity was important as those that had a greater exposure to offshore wind farms had a better understanding of the concept. Unlike other studies examined, age did not have a major bearing on the results, and there was a similar outcome with respect to gender.

CHAPTER 6. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FUTURE STUDIES

To conclude this study, chapter six will provide a summary of the thesis, with the significance, research questions, objectives and methodology being revisited.

6.1. Summary of the Study

This study aimed to fill a significant gap in research, that gap being a lack of knowledge of what the attitudes of Irish people was towards offshore wind energy. This body of work as a whole is the culmination of research carried out over a number of months. The research was exploratory in nature by the fact that for many of the respondents, it was their first opportunity to voice their opinions about offshore wind energy.

6.1.1. Research Questions

The questions central to this research were:

1. What are Irish people's attitudes towards the development of offshore wind farms in Ireland?

2. Do these attitudes have any implications towards the future development of offshore wind farms in Ireland?

6.1.2. Objectives of the Thesis

The objective of this thesis was to fill a gap in research that existed regarding the attitude of Irish people towards offshore wind farm development. It is hoped that what was discovered from this research could be of use to a number of bodies, namely, investors, developers, and government officials. In the case of investors, the information compiled could give an indication as to whether there is an appetite amongst the public for further development of the offshore wind sector in the country. In the case of developers, the information compiled could give an indication as to whether there would be any significant opposition to the development of offshore wind farms. In the case of government officials, the information compiled could inform policy direction with respect to planning future offshore wind farm developments. This policy direction might include the development of an educational guide on offshore wind energy. This would be particularly beneficial for locations such as Enniscrone, where it was discovered that a lack of education among the public there had an impact on their knowledge of offshore wind.

6.1.3. Methodology

In order to obtain the attitudes of the respondents towards offshore wind farm development, a qualitative research methodology was employed in this study. This

came in the form of questionnaire distribution. The use of questionnaires could "provide a broad coverage of a population enabling us to explore spatial and social variations in people's attributes, attitudes, and actions" (Preston, 2009: 46). The distribution process involved approaching potential respondents in public locations of the three study areas and asking them to mail a completed questionnaire back to the author. The results were then entered into the *Qualtrics* survey software program to generate the necessary graphs, and these were analyzed along with some statistical analysis and correlations were devised.

6.1.4. Data Analysis

An analysis of the results was conducted to aid in establishing a set of conclusions for this study. This analysis involved examining the results and correlations generated from the questionnaires, and attempting to identify whether these agreed or differed with results generated from similar studies in other countries.

6.2. General Conclusions

This section examines the conclusions drawn from the analysis of the results.

6.2.1. Attitudes towards Renewable Energy

It was discovered that there is strong support in Ireland for renewable energy development. With the country being heavily reliant on imported fossil fuels for electricity generation (SEAI, 2011a), it is clear that there was an awareness among the

respondents to break away from this dependency. In all three study locations, the respondents responded very favorably to the idea of increased renewable energy development. With wind being the most utilized source of renewable energy in Ireland, it was no great surprise that this source was well understood.

6.2.2. Attitudes towards Offshore Wind Farms

The attitude of Irish people towards offshore wind farm development was the central theme of this study. It has been discovered that, overall, like the support for renewable energy development, there was a strong support for offshore wind farm development. There was only minimal opposition to the concept. Respondents in Arklow, where Ireland's only offshore wind farm is located, had a very positive outlook on offshore wind energy. Having this exposure to the offshore farm in Arklow resulted in respondents there having a far better understanding of the overall concept, in comparison to those living in areas with no exposure to offshore wind farms. This exposure has resulted in them having a positive rather than negative outlook on offshore wind farms. Although there was support for offshore wind farms in the other two study locations, there was less of an understanding of the general concept. This theory of proximity having an impact on attitudes reflects results that were discovered in other similar studies (Warren et. al., 2005). In relation to the proximity theory was the fact that respondents living closer to the coast had a better understanding of offshore wind farms than those living more inland regardless of what study location they were from.

Unlike some other studies examined such as Ladenburg (2008) the age of respondents did not have a major bearing on the results of this particular study. The only significance it had was when respondents were asked whether they would accept offshore wind farms in exchange for reduced electricity bills and reduced carbon dioxide emissions. In this instance it was generally younger respondents who were more in agreement.

The gender of the respondents also had a bearing on this study, which is consistent with previous studies such as Firestone and Kempton (2007). It was generally males who had a more positive attitude towards and were better informed about the offshore wind industry.

It was believed by the author that prior to undertaking this study education levels might have a major bearing on the results. This proved somewhat to be the case. It was discovered that despite perceptions, having higher education levels did not lead to a better understanding of the offshore wind sector or of the operation of offshore wind turbines. It was clear that people who had lower levels of education but with more of an exposure to an offshore wind farm had a better understanding of the industry than those with higher levels of education and no major exposure to an offshore wind farm.

6.3. Addressing the Research Questions

It is clear that the research questions for this study have been addressed. It has been discovered what the attitudes of Irish people are towards offshore wind farms.

These attitudes are generally quite positive. Their implications are important for any future development of offshore wind farms in Ireland. Having this understanding of attitudes will be useful to the different bodies outlined in section 6.1.2. above.

6.4. Recommendations for Future Studies

As with any study, it is quite common for hindsight to come into play and acknowledge that things could have been better. This is an acknowledgement of where improvements could have been made.

6.4.1. Recommendations on the Topic

This study focused specifically on coastal towns to determine the attitudes of Irish people towards offshore wind farm development. This was a bit assumptive given the fact that people who live in non-coastal regions of the country, could have just as strong an opinion on offshore wind farm development than those living along the coast. Although the questionnaire did have respondents who lived further than 10 km from the coast, a greater picture of the attitudes of people not living in proximity to the coast should have been taken. A simple solution to this problem would have been to take a sample of a population from an inland town with no major maritime connection.

A greater emphasis could have been placed on the preference between onshore and offshore wind farms. However, this issue could form part of a greater study of the preferred choices of renewable energy in Ireland.

A question related to the preference of the respondents regarding various different types of energy sources should have been included in the questionnaire. Specifically this should have been included in the *Attitudes towards Renewable Energy* section as people may have different opinions regarding different types of renewable energy sources.

6.4.2. Recommendations on the Research

The reasoning behind using questionnaires was to be of convenience to the respondents and not take up too much of their time. If the questionnaire was short then there was a better chance of having it completed. This rational proved to be correct. However having more in-depth conversations with members of the local communities in question could potentially have established a whole new set of opinions and attitudes towards offshore wind farms.

More time should have been allotted for the distribution of questionnaires. There was a reasonably adequate response rate, however, a greater number of completed questionnaires could have been received had more time been spent distributing them.

Completing a pilot test of the questionnaire was vitally important and would be recommended for future studies. It enabled the author to obtain a full picture of where changes were necessary and where improvements could be made to the questionnaire. Having this input from outside people allowed for a degree of neutrality with regard to their opinions on the topic.

Overall, these are only a few of the issues which come to the mind of the author and no doubt the readers of this study can probably pick out more.

6.5. Concluding Statement

This study has not only provided the author with a greater knowledge about the offshore wind sector, but it has also proved to be a valuable lesson in learning. Significant experience has been gained from the research process, and the skills developed, such as completing a literature review, designing a questionnaire, analyzing results and indeed engaging with the public, will no doubt be of benefit to the author. Ultimately, asides from being of benefit to the offshore wind industry, this study should also be of significant benefit to future researchers.

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APPENDIX

APPENDIX: INSTITUTIONAL REVIEW BOARD CLEARANCE

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	ROBERT HERRICK KNOY 157
From:	JEANNIE DICLEMENTI, Chair Social Science IRB
Date:	05/14/2012
Committee Action:	**Exemption Granted**
IRB Action Date:	05/14/2012
IRB Protocol #:	1205012252
Study Title:	Investigations of attitudes towards offshore wind farm development in Ireland: Their implications tov development of the industry

The Institutional Review Board (IRB) has reviewed the above-referenced study application and has determined that it meets the criteria for exemption under 45 CFR 46.101(b)(2) .

If you wish to make changes to this study, please refer to our guidance "**Minor Changes Not Requiring Review**" located on our website at http://www.irb.purdue.edu/policies.php. For changes requiring IRB review, please submit an **Amendment to Approved Study** form or **Personnel Amendment to Study** form, whichever is applicable, located on the forms page of our website www.irb.purdue.edu/forms.php. Please contact our office if you have any questions.

Below is a list of best practices that we request you use when conducting your research. The list contains both general items as well as those specific to the different exemption categories.

General

- To recruit from Purdue University classrooms, the instructor and all others associated with conduct of the course (e.g., teaching assistants) must not be present during announcement of the research opportunity or any recruitment activity. This may be accomplished by announcing, in advance, that class will either start later than usual or end earlier than usual so this activity may occur. It should be emphasized that attendance at the announcement and recruitment are voluntary and the student's attendance and enrollment decision will not be shared with those administering the course.
- If students earn extra credit towards their course grade through participation in a research project conducted by someone other than the course instructor(s), such as in the example above, the students participation should only be shared with the course instructor(s) at the end of the semester. Additionally, instructors who allow extra credit to be earned through participation in research must also provide an opportunity for students to earn comparable extra credit through a non-research activity requiring an amount of time and effort comparable to the research option.
- When conducting human subjects research at a non-Purdue college/university, investigators are urged to contact that institution's IRB to determine requirements for conducting research at that institution.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not

submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 1

- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Categories 2 and 3

- Surveys and questionnaires should indicate
  - only participants 18 years of age and over are eligible to participate in the research; and
  - that participation is voluntary; and
  - that any questions may be skipped; and
  - include the investigator's name and contact information.
- Investigators should explain to participants the amount of time required to participate. Additionally, they should explain to participants how confidentiality will be maintained or if it will not be maintained.
- When conducting focus group research, investigators cannot guarantee that all participants in the focus group will maintain the confidentiality of other group participants. The investigator should make participants aware of this potential for breach of confidentiality.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 6

- Surveys and data collection instruments should note that participation is voluntary.
- Surveys and data collection instruments should note that participants may skip any questions.
- When taste testing foods which are highly allergenic (e.g., peanuts, milk, etc.) investigators should disclose the possibility of a reaction to potential subjects.