What are the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources?

Dissertation submitted in part fulfilment of the requirements for the degree of Master of Business Administration (MBA) at Dublin Business School

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Declaration

I, Beatriz Silva Fernandes, declare that this research is my original work and that it has never been presented to any institution or university for the award of Degree or Diploma. In addition, I have referenced correctly all literature and sources used in this work and this work is fully compliant with the Dublin Business School’s academic honesty policy.

Signed: Beatriz Silva Fernandes

Date: 07/01/2019
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Abstract

The renewable energy industry is at an important moment nowadays. The World is fighting against climate change. Based on that the European Union set energy targets to all state members, which must be achieved by 2020. The targets involve greenhouse gas emissions being reduced by 20%, energy efficiency enhanced by 20%, and 20% of the energy consumed to be from renewable sources.

Regarding Ireland, the country is well known for having excellent renewable energy resources and its targets is one of the most demanding among other EU members. By 2020, the Irish government is committed to producing at least 16% of all energy spent through renewable resources. Renewable electricity, renewable heat, and the renewable transport sector will represent 40%, 12%, and 10% respectively. Ireland is also committed to reducing its GHG emissions by 20% and to enhance its energy efficiency by 20%.

Ireland has made substantial progress towards achieving its targets. However, the improvements were not enough and it is anticipated that Ireland will not meet its EU 2020 targets. The overall achievement is estimated to be between 12.7% and 13.9%. This research will provide a deep analysis of the barriers faced by Ireland in achieving its EU 2020 targets.

This study will benefit businesses as a basis to inform the points Ireland needs to improve when attempting to achieve future renewable energy targets. In addition, it is recommended that further studies should be undertaken to expand the knowledge over the barriers in the Irish renewable energy sector.

Keywords: Renewable Energy; EU Targets; Energy Efficiency; Greenhouse Gas Emissions; Wind Energy; Solar PV; Bio-energy; Transport Sector; Heat Sector; Electricity Sector.
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Chapter 1

1. Introduction

1.1. Background of the Research

The renewable energy industry, both in Ireland and internationally, is at an important moment. All over the world, it is possible to see the major changes in the gas and oil markets. The fossil fuel prices are lower comparing to previous years, and they are expected not to increase over the next decade. In parallel, renewable energy technologies have had a significant reduction in prices, mostly in solar PV and offshore wind (Gannon, 2017).

According to IEA (2017), in 2016, renewables resources represented nearly two-thirds of net new power capacity worldwide, almost 165 GW in operation. This performance is seen to continue in strong growth by 2022 and the renewable electricity capacity is expected to expand by over 920 GW. By 2022, more than 80% of the renewable capacity growth over the world will be represented by solar and wind energy. It is presumed that Denmark will become the world leader, followed by Ireland, as shown in figure 1. In some countries in Europe, such as Ireland and Germany, the generation of electricity using wind resources will exceed 25%.

![Figure 1: VRE share in annual electricity generation. Source: IEA (2017).](image)
According to World Economic Forum (2018), all over the world governments have been making efforts to the transition to renewable energy, also to track progress towards sustainable energy aims and to increase energy productivity.

Regarding Ireland, the country is well known for having excellent renewable energy resources, which are crucial suppliers for the Irish energy grid. Among all those renewable resources, bio-energy, solar, and wind energy could provide excellent opportunities for businesses in Ireland, and also for domestic consumers. Through the use of renewable resources, Ireland can reduce its dependence on fossil fuel, enhance its sustainability and energy security (DCCAE, 2018b).

According to Javelosa and Marquart (2017), the Irish Parliament has made history by passing a bill which leads the country to stop from investing in fossil fuels, both in coal and oil. Through this bill, Ireland will become the first country to remove investment on fossil fuels completely. Since 1990, the share of electricity from renewable energy has increased from 5.3% to 27.2% in 2016, most of this improvement is attributed to wind energy (Department of Communications, Climate action & Environment, 2017).

Based on the combat against climate change, The European Parliament and The Council of The European Union, has set the Directive 2009/28/EC. The Directive involves the increased use of energy from renewable sources, energy efficiency and energy savings in the electricity, heat and transport sectors. The Directive also aims to control the European energy consumption and to reduce greenhouse gas emissions. All of these factors are associated with promoting the security of energy supply, innovation and technological development, education, social inclusion, and reduce poverty (Ervine, 2015).

The Directive implies energy targets to all EU members, which takes into account each Member States' different starting points, economic performance, renewable energy potential, and it must be achieved by 2020. The targets involve greenhouse gas emissions being reduced by 20%, energy efficiency enhanced by 20%, and 20% of the energy consumed to be from renewable sources (DCCAE, 2009).

By 2020, the Irish government is committed to producing at least 16% of all energy spent through renewable resources. This target is shared by three sectors, with individual targets for each sector, the renewable electricity sector, 40%, the renewable heat sector, 12% and the renewable transport sector, 10%. (DCCAE, 2018b). Among all European countries and their
targets, this dissertation will focus only on Ireland’s targets, which is one of the most demanding, and also on the challenges when attempting to achieve them.

1.2. Problem Definition

One of the main reasons behind The Directive is the reduction of greenhouse emissions and the reliance on energy imports. As a whole, the European Union is going in the right direction. In 2016, 22 of the 28 member states had increased their share of renewables. Nevertheless, not all members are performing at the same level, few of them need to make additional efforts when attempting to meet the EU targets by 2020, as shown in figure 2 (Gray, 2017).

![Figure 2: Share of energy from renewable sources in the EU Member States. Source: Gray (2017).](image)

According to SEAI (2018b), Ireland has made substantial progress towards achieving its targets, however, the improvements were not enough and it is anticipated that Ireland will not meet its mandatory EU target for an overall 16% renewable energy share by 2020. The overall achievement is estimated to be between 12.7% and 13.9%. The energy efficiency and the greenhouse emissions targets will also be missed. The shortfall will require the purchase of
statistical transfers from the EU member states who have exceeded their 2020 targets, furthermore, it will make future energy targets even more difficult and costly (SEAI, 2017b).

According to Ó Gallachóir (2017), Ireland is facing challenges related to the expansion of existing policy, the increase of renewable energy penetration into the country, and the collaboration of businesses and communities. Ireland needs to focus on the renewable electricity sector, and also on the transport and heat sectors, which are the main obstacles to meeting the target.

The challenges of meeting the EU 2020 targets are the main problem that will be deeply studied by the researcher. The literature review shows that there have been studies conducted in Ireland in relation to energy targets, however, this study intends to offer a deeper analysis of the barriers faced by Ireland in achieving its EU 2020 targets.

1.2.1. Research Question

Through a careful analysis of the secondary data, and considering the current situation of Ireland in relation to its renewable energy targets, this dissertation aims to answer the following key research question:

"What are the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources?"

The key research question above lead to five sub-questions, which will be detailed in Chapter 3. The primary data to answer the research questions will be collected through interviews with professionals who work in the Irish renewable energy sector.

1.2.2. Aims and Objectives

The researcher aims to conduct this research in an unbiased and complete manner. Based on the topics covered in the literature review, the researcher aims to explore the barriers in the deployment of renewable energy resources in Ireland, such as wind energy, solar PV and bioenergy; the process of removing the investment on fossil fuels completely, consequently reducing greenhouse gas emissions by 20%; the challenges in improving its energy efficiency by 20%; the obstacles in increasing renewable energy penetration in the electricity, transport, and heat sectors, producing at least 16% of all energy consumed through renewable energy resources; and finally, the actions to overcome the challenges Ireland faces in reaching the EU
2020 targets. Furthermore, the researcher also seeks to explore the future of the Irish renewable energy sector.

1.3. Rationale for the Proposed Research

Renewable energy is an important trend nowadays. Climate change is concerning governments and citizens, who are willing to make changes toward this problem. One way of reducing the impact of our actions is looking to produce, distribute and consume energy in a more sustainable way, which now is possible due to renewable energy technologies (Adams, 2017).

According to Scheer (2018b), the expansion of renewables will continue over the next five years, which will cover 40% of the global energy consumption growth. In Ireland, over 10% of its total energy comes from renewable sources, including wind, bioenergy, hydro, geothermal, and solar. In 2017, the Irish renewable energy sector prevented 4.2 Mt CO2 being released to the atmosphere.

In relation to the EU renewable energy targets, 2020 is coming, and despite significant actions taken by the Government, businesses, and communities, it is inevitable that Ireland will shortfall its targets by 2020. It is very clear that the climate goals in Ireland are not sufficiently aligned to the nature of its economy. Immediate and significant action is essential so Ireland can avoid future shortfalls when attempting to achieve renewable energy targets set by the EU (Scheer, 2018b). Delivering this national goal is a challenge and it is primordial to look beyond 2020 (DCCAE, 2009).

According to DCCAE (2009), it is essential to the Irish's energy policy the deployment of renewable energy, which can contribute to avoiding climate change and enhance energy security. The Government is committed to accelerating the transformation of Ireland into a low carbon economy. The challenges involved in the deployment of the renewable energy sector towards achieving the EU targets are the main topic of this dissertation.

1.4. Recipients for the Research

This exploratory study involves a current and discussed subject worldwide. It will provide a deep analysis of the barriers faced by Ireland in achieving its EU 2020 targets. Therefore, it will benefit businesses as a basis to inform the points Ireland needs to improve to achieve future renewable energy targets.
The researcher plans to have this research available to provide a basis for future studies which will expand, in a more detailed review, the study about renewable energy in Ireland.

In terms of career, a high-level master’s qualification will provide to the researcher the ability to enhance the career opportunities within the Irish renewable energy sector.

### 1.5. Suitability of Researcher for the Research

The researcher undertook her undergraduate studies in Energy Engineering, which is associated with renewable energy. The author has worked in the area of solar energy and Research & Development. At the initial phase of this dissertation, the researcher will have completed all modules of the MBA General program from Dublin Business School. The information gained throughout the modules and the knowledge about the main topic will form the basis for the research.

### 1.6. Structure

A logical fashion was used to structure this dissertation. The following structure was adapted from the Dissertation Handbook provided by Dublin Business School. The sequence of the chapters is presented in an order to provide the reader with a clear comprehension of the aims and findings of the dissertation. Figure 3 shows the structure of the dissertation.

![Figure 3: Structure of the Dissertation.](image)

- **Abstract**: The abstract provides a summary of the research, informing the reader about the topic of the dissertation;
- **Chapter 1 – Introduction**: This chapter gives the reader the background to the research. It lays out the problem definition, the research question, as well as, the aims and
objectives. The introduction also sets the rationale, the recipients, the approach, and the suitability of the researcher for the proposed research;

- Chapter 2 – Literature Review: This chapter provides the reader with an understanding of renewable energy in the context of the study. It gives a comprehensive and critical review of the renewable resources in Ireland and the EU 2020 targets;

- Chapter 3 – Research Methodology: This chapter justifies in details the selected methods used to conduct the research. It also includes the research population and sample, as well as, data collection and data analysis. Finally, this chapter includes ethical issues and the limitations during the process of writing this research;

- Chapter 4 – Findings and Data Analysis: This chapter provides the findings that arose from the data collected;

- Chapter 5 – Discussion: This chapter will interpret the findings whilst relating them to the research questions and objectives;

- Chapter 6 – Conclusions and Recommendations: This chapter presents the conclusions that arose from the data analysis and discussion;

- Chapter 7 – Reflections: This chapter points out the learning obtained by the researcher through the dissertation process.
Chapter 2

2. Literature Review

2.1. Introduction

It is becoming increasingly clear that renewable energy is the future. In 2017, the global grid had a record quantity of new capacity from renewable energy, which overtook new fossil fuel plants, with investments in renewable energy reaching nearly $3 trillion. This is bringing benefits to those who have adopted clean energy, for large sectors of the economy, as well as, for householders and small businesses (Solheim, 2018).

Renewable energy has the potential to bring about a better quality of life and environment. It contributes to positive climate action and better global energy security. It is evident that the world is going in the right direction in relation to the use of renewable energy. However, there is still a long way to go and actions are required to move away from global carbon addiction (Solheim, 2018).

This challenge involves and affects every country in the world. With regard to the European Union, a new climate and energy targets were agreed in 2007, which will reduce greenhouse gas emissions and enhance both energy efficiency and the use of renewable sources in the electricity, heat and transport sectors. In the specific case of Ireland, despite economic growth, which leads to increased emissions, its energy system is moving in the right direction, especially after a particularly windy year in 2017. Ireland has a wide range of renewable energy resources. Nevertheless, if the country wants to meet its renewable energy targets and reduce its GHG emissions, there are still plenty of actions that must be taken (Scheer, 2018a).

The main topic of this dissertation is the challenges Ireland is facing in order to meet its targets as per the 2007 EU renewable energy agreement. Information on the current Irish situation in relation to the use of renewable energy will be provided in the literature review. The targets and the barriers preventing Ireland from achieving its targets will be discussed further on in this section.
2.2. Renewable energy in Ireland

According to Holland and Howley (2016), Ireland is becoming a society based on sustainable energy, including technology, structures, and practices. The country is part of the global green movement and is on the right way to be recognised as a decarbonised country. Ireland is committed to developing renewable energy as an integral part of its climate change strategy and sustainable objectives. Renewable energy contribution is key to its three main energy policy aims. These aims are cost competitiveness, energy security, and environmental protection. Renewable energy also contributes to the decarbonisation of energy supply and to reduce Ireland’s dependence on imported fossil fuels. Furthermore, Ireland has the potential to become a net exporter of renewable energy and technology.

According to Eirgrid Group (2015), due to the increasing integration of renewable energy and wider technological innovation, Ireland’s electricity system is going through a significant period of transformation and also has an important mission in creating sustainable energy options for the future. Many organisations and groups are involved in this mission, with responsibility for furthering this change around Ireland, through the development of operational requirements and infrastructure, taking into account the challenges of operating the electricity system safely and efficiently. These challenges involve taking into consideration a number of complex demand and supply problems, such as security of supply, technology and the use of a smart grid.

According to Holland and Howley (2016), Ireland can be a worldwide example, due to its investments in sustainable projects. The investments reached a record of €105 million in 2017, both in energy efficiency and renewable energy. It included investments in home and community energy upgrades, which also embraced vulnerable homes at risk of energy poverty. Every county in the country is now part of a sustainable energy community network (SEAI, 2018c).

In 2016, homes all around the country became more energy efficient and research, development and demonstration projects in renewable energy were supported, engaging and empowering society to contribute to Ireland’s energy transformation. It is a fact that clean energy is essential for Ireland. Irish communities and businesses are now engaged to change the country’s energy future (SEAI, 2017d).
According to SEAI (2018a), the new RESS will include community-led projects and community capacity building measures. This scheme has specific requirements for community involvement in renewable energy projects, mainly community ownership, and innovative finance measures across the residential and business sectors. Through energy efficiency projects, business is benefited with energy and financial savings, competitiveness, and employment opportunities (SEAI, 2017b).

Regarding GHG emissions, Ireland has reduced its national emissions by around 4 Mt through the use of renewable energy for electricity, transport, and heat (Scheer, 2018). The country is on the right path to achieve its commitment according to the Kyoto Protocol, although there is the possibility of a requirement for the purchase of credits to achieve the limit agreed. Nevertheless, if Ireland wants to achieve future targets, it has to keep on developing as a low carbon economy. However, in relation to Ireland's 2020 EU targets, which involve GHG emissions being reduced by 20%, it is looking increasingly unlikely that Ireland will meet them. The main contributors to this are the agriculture and transport sectors. Figure 4 shows emissions from 1990 to 2012, comparing it with the Kyoto Protocol target (Environmental Protection Agency, 2013).

![Figure 4: Greenhouse gas emissions, both historical and projected, from 2008 to 2012, including the Kyoto Protocol target. Source: Environmental Protection Agency (2013).](image)

In relation to gross final energy consumption and gross electricity generation, renewable energy contributed around 9% and 27%, respectively, in 2015. During this time, more than 80% of
renewable electricity produced came from wind energy, followed by hydro, biomass and renewable waste, landfill gas, biogas, and solar. Figure 5 shows the contribution of renewable energy sources by technology in 2015. Wind energy is currently the most important renewable energy technology in Ireland, and along with it, this dissertation will focus on the contribution of bioenergy and solar power. The amount of electricity generated from renewables increased from 697 GWh in 1990 to 7,857 GWh in 2015 and over the same period, the use of renewable energy has increased from 4.9% to 25.3% (Holland and Howley, 2016).

![Figure 5](image.png)

**Figure 5:** Contribution of renewable energy sources by technology in 2015. Source: Holland and Howley (2016).

To summarise, it is a real possibility that Ireland could generate electricity based 100% on renewable energy, such as wind power, solar and bioenergy. The country can rely on an energy system that does not depend on fossil fuels (O'Sullivan, 2018). On the other hand, in relation to Ireland's renewable energy targets, there are many barriers that must be overcome in order to achieve the aims successfully. Ireland's energy has the potential to be sustainable, clean, affordable and secure. With its resources, investments in renewable energy, innovation on the grid and citizens engaged to change the country's energy future, there is no doubt Ireland is going on the right track to becoming a low carbon economy, based on a more sustainable and smarter energy future (SEAI, 2017a).

### 2.2.1. Wind energy

The renewable resource which has contributed the most to Ireland's electricity over the years has been wind energy. As time has passed, wind power in Ireland has continued to be the most important resource of renewable electricity. The installed capacity generated through the use of this resource has grown to 2,851 MW throughout Ireland (DCCAE, 2018c).
The wind resource potential in Ireland is huge. Regarding onshore, it is one of the most cost-effective renewable sources around Europe, and regarding offshore, Ireland benefits from its extensive area in the Irish Sea and the Atlantic. Furthermore, in the coming decades, wind turbine technology and technology for integrating wind energy into the grid will continue to advance. Therefore, Ireland is likely to become one of the main exporters of renewable electricity into the European market by 2030, as shown in figure 6. In addition, the revenue generated by wind energy could reach around €15 billion by 2050 (SEAI, 2010).

Figure 6: Annual Electricity Demand vs. Wind Generation. Source: (SEAI, 2010).

According to Sustainable Energy Authority of Ireland (2017), not only is wind energy the biggest contributor of renewable energy in Ireland, but also the cheapest. In 2016, 85% of Ireland's renewable electricity and almost 21% of Ireland's total electricity demand was provided by wind energy. After natural gas, in Ireland, wind energy is the second largest source of electricity. These contributions moved the country up to third position worldwide in 2015, after Denmark and Portugal, in the use of wind energy. In the last few years, Ireland has made a meaningful improvement in expanding wind energy projects. Figure 7 shows the wind mapping system around Ireland (SEAI, 2018d).
Nevertheless, despite all of this potential, if Ireland wants to achieve its target, the construction of land-based wind farms providing at least 250 MW per year is fundamental, in addition to the expansion and modernisation of the electricity grid. There are still many challenges faced by Ireland relating to the successful deployment of renewable energy in transport, heat, and electricity, including social acceptance, cost efficiency and effectiveness, regulatory certainty, and predictable and transparent frameworks (DCCAE, 2018c).

To conclude, Ireland has excellent wind resources and the country is investing in its deployment. The price of wind turbines has been decreasing, which, combined with low-interest rates, has left the industry in a good economic situation, leading to more wind energy projects. Other factors affecting deployment include the grid connection and wind capacity. Nevertheless, even though Ireland has great wind potential, the country is facing challenges to achieve its renewable targets. Among these challenges is the fact that new wind power capacity of 1500 MW must be added to the national grid by 2020. In 2015 the deployment rate was below expected for the sector. Furthermore, if Ireland wants to keep on the right path to achieve its targets, it is crucial that it works to address these barriers to wind energy deployment (International Energy Agency, 2015).
2.2.2. Bioenergy

The largest contributor to Irish renewable energy through heat generation has been bioenergy and it is expected to continue to play an important role in replacing fossil fuels, especially with regard to the larger heat users, such as the industrial and commercial sector (DCCAE, 2018a).

Currently, 3.5% of the energy used in Ireland comes from biomass grown inside the country. It is likely this contribution will increase by 2035, with bioenergy potential close to 30%. This potential includes forestry, energy crops, agricultural and other wastes, taking into consideration current market prices for energy. Regarding bioenergy sites, biofuel refineries have had limited development in Ireland, mainly due to the fact they must be quite large to achieve economies of scale. On the other hand, wood processing sites and anaerobic digestion are common in Ireland as is the production of biogas (Sustainable Energy Authority of Ireland, 2017a). The bioenergy installations in Ireland are shown in Figure 8.

Figure 8: Major Composting Sites. Source: Irish Bioenergy Association (2017)
According to SEAI (2015), bioenergy resources in Ireland have significant potential to expand. This expansion is dependent on higher market prices, especially for investment in management practices or equipment, specialised machinery, as well as on the decrease of supply-side barriers to resource development.

To conclude, Ireland has a climate advantage with regard to bioenergy crops. However, achieving the 12% target for renewable heat is challenging and additional action is required. In addition, supports in relation to the national bioenergy resources, both demand and supply-side, to forestry, waste recovery, agriculture, innovation policies, and job creation are essential. Furthermore, demand and supply must be stimulated, as well as research, development and demonstration (DCCAE, 2014).

2.2.3. Solar energy

Although Ireland was the last EU Member State to adopt a support mechanism for Solar PV, as the solar market in Europe and worldwide is expanding, Irish research and industry have shown interest in the value of this global market (Bolger, 2016). The country does not seem to be in a good location for the deployment of solar technology, which requires plentiful sunlight to work in its maximum capacity. Nonetheless, improvements in solar technology and cost reductions have turned solar PV into a practicable option in Ireland. The country has started to realise the importance and potential of solar energy for the renewable energy mix and also to achieve its renewable energy targets. (Sustainable Energy Authority of Ireland, 2017a).

There is a small but growing deployment in the solar PV industry in Ireland, with over 6MWp installed at the end of 2016, mainly on rooftops. However, those installations were not enough to contribute significantly to achieving Ireland's 2020 targets, with solar heating having a more important contribution (SEAI, 2018b).

The characteristics of solar PV schemes, such as the procedural matters and development impacts involved, require exploration when undertaking its deployment. Currently, there is no specific planning and development guidance in the Irish context for solar energy deployment. The lack of guidance is an issue for the development sector and planning authorities due to the fact it involves uncertainty in relation to how solar energy schemes should be considered. On the other hand, the solar energy sector can contribute to decarbonise Ireland's energy system.
Therefore it is essential to deliver a planning guide for this sector and unlock the potential of this renewable resource (Walsh, 2016).

Furthermore, Ireland has important strengths in the energy sector that can be transferable to the solar PV sector, for example in research and development, building materials, systems integration and optimisation, process engineering, a high-value manufacturing base, and onshore wind experience. The opportunities for Ireland to join the solar PV market are many. The Irish research and industry sectors can share their expertise in fields such as silicon wafer production, local job creation, storage and monitoring solutions, among others (Sustainable Energy Authority of Ireland, 2017a).

To summarise, knowing what must be done is not enough to make a real-world impact. There are plenty of actions which must be taken so Ireland can play an important role in the global solar PV sector, leading Irish business to invest in domestic PV systems. The research community, industry, and public agencies can take positive steps to help unlock the opportunities in this sector, such as setting up a solar PV forum with research communities and industry, generating opportunities through knowledge and collaboration transfer. Considering that solar PV has become one of the most important renewable technologies, it is essential to assure that Irish citizens have access to helpful information on the technology when it comes to investment decisions (Sustainable Energy Authority of Ireland, 2017b).

2.3. The Target

One of the main topics of this dissertation is the EU agreement on new climate and energy targets, agreed in 2007. As mentioned before the targets, 20-20-20, involve greenhouse gas emissions being reduced by 20%, energy efficiency being enhanced by 20%, and 20% of all energy consumed to be from renewable sources, all by 2020 (DCCAE, 2009). Ireland’s targets are one of the most demanding, followed by Denmark and Luxembourg. The challenge to meet 2020 targets are illustrated in Figure 9.
By 2020, the Irish government is committed to producing at least 16% of all energy consumed through renewable energy resources, under the 2009 Renewable Energy Directive. Renewable electricity, renewable heat, and the renewable transport sector will represent 40%, 12%, and 10% respectively, as shown in figure 10 (DCCAE, 2018b).

Figure 9: The progress made to achieve Ireland’s 2020 targets. Source: Scheer, Clancy and Gaffney (2016).

Figure 10: Headline energy and emissions targets. Source: Scheer, Clancy and Gaffney (2016).
According to SEAI (2018a), Ireland will not meet its mandatory European target by 2020, with the estimated achievement being between 12.7% and 13.9%. Figure 11 summarises the estimated achievements of Ireland's renewable energy targets. The estimated progress can be compared to the targets mentioned above. The shortfall will most likely lead the country to purchase statistical transfers from EU member states who have exceeded their 2020 targets.

![Figure 11: Summary of scenario results for 2020. Source: SEAI (2018a).](image)

Even though Ireland will not be able to achieve its 2020 targets, definite progress has been made towards Ireland’s energy efficiency and for future renewable energy targets. In relation to CO2 emissions, through the use of renewable energy technologies and the deployment of energy efficiency, more than 6 Mt of CO2 emissions are avoided every year. The progress made so far creates enterprise, economic, and environmental benefits for Ireland. However, this progress does not guarantee Ireland will achieve future energy targets. In fact, the shortfall may lead to significantly more difficult and costly investments in the future (Scheer, Clancy and Gaffney, 2016).

Despite the progress Ireland has made, the barriers to achieving renewable energy targets will remain after 2020. Accelerated efforts in the renewable electricity, heat, and transport sectors are required to avoid future shortfalls (Scheer, Clancy and Gaffney, 2016). Targets beyond 2020 are likely to be even higher and to require tough policy decisions, deep insight, and increased commitments from Irish citizens, enabling them to take control of their energy usage and needs. The barriers related to renewable energy targets will be discussed in this dissertation (SEAI, 2017a).

To summarize, Ireland is expected to miss its 2020 target by up to 3%. Therefore, the path towards future targets will be considerably harder. The following years will require a new approach and vision in relation to renewable energy technologies. The barriers to this
deployment must be minimised (Muenchmeyer, 2018). The Irish experience in the renewable energy sector must be used when aiming to meet future targets, which demands an acceleration of deployment of energy efficiency technologies and renewable energy, as well as a deep decarbonisation of the energy sector (SEAI, 2017c).

2.4. The Barriers

Ireland has made progress towards achieving its energy efficiency and renewable energy targets. However, the 2020 target looks certain to be missed and a larger and continuous effort is needed. Failure to achieve energy and emissions targets by 2020 will result in EU fines and a more difficult trajectory afterwards, both in potential compliance costs and future deployment. At this moment, it is essential for Ireland to incentivise sustainable energy technologies and practices by developing an ongoing policy action (SEAI, 2017b).

According to Howley (2016), the economic recession had an impact on energy demand. However, the strong growth in the Irish economy and the expected low oil prices point to an increase in energy demand towards 2020 and beyond. This situation makes the task of achieving energy targets even more challenging, although ongoing actions in relation to energy efficiency could help to balance some energy demand growth. However, it would not be enough considering it is driven by economic progress (SEAI, 2017b).

In relation to energy efficiency, Ireland was required to enhance it by 20%. By the end of 2017, almost 13% of the energy efficiency target had been achieved. This progress was achieved through a wide number of measures and programmes in all energy-using sectors of Ireland, including residential, commercial and industrial (SEAI, 2018b). Nevertheless, the lack of further development and expansion of new policy measures will lead to a shortfall of nearly 7 TWh in 2020, which equates to 16% of efficiency improvement, compared to the 20% target. Challenges including the upgrade of homes and businesses, making savings from the transport sector and the implementation of cross-sectoral measures exist in relation to energy efficiency (SEAI, 2017b).

Regarding renewable electricity, it is the smallest sector in relation to energy end-use demand. For this reason, when compared to transport and heat contributions, the 40% renewable electricity target contributes considerably less to the total target (SEAI, 2018b). Ireland has made progress towards achieving the 40% renewable electricity target, especially with wind...
energy, hydro and other renewable electricity sources also contributed. At the end of 2015, a total of 25% renewable electricity share was achieved, although it was still well short of the 40% target (SEAI, 2017b).

The main challenges for renewable electricity generation are in the deployment of wind, solar PV and bioenergy technologies, as well as further contributions from the heat and transport sectors and private investments, which are supported by the REFIT. Figure 12 describes the achievements to the end of 2015 and what is required in order to meet the 40% target (Scheer, Clancy and Gaffney, 2016). The development of ocean energy, additional interconnection, and offshore wind is also a challenge. Currently, the DS3 program is supporting the key dependencies on the electricity system (SEAI, 2018b).

![Figure 12: Renewable electricity (RES-E) progress and target. Source: SEAI (2017c).](image)

Concerning the transport sector, it is currently the sector that is most reliant on imported fossil fuels in the form of biofuels and petroleum products. Furthermore, it is also the largest energy-using sector. Transport energy demand is strongly influenced by the level of commercial activity in the economy, oil prices as well as employment levels (SEAI, 2018b).
At the end of 2015, renewable energy in the transport sector achieved 5.7% compared to the 10% target. Biofuel is responsible for most of this progress. Presently, all transport fuel contains around 3.2% of biofuel mixed with diesel or fossil-based petrol. Meanwhile, the progress of the renewable transport sector depends on the growth of biofuels’ blending share and incentives to support the use of EVs, overall, electrification of the transport sector, which was affected by the economic recession, as well as consumer choices of transport mode. Figure 13 describes the progress towards the 10% target (SEAI, 2017b).

![Figure 13: Renewable transport progress and target. Source: SEAI (2017c).](image)

Regarding the renewable heat sector, the main contributor to the 12% target has been the industrial sector, followed by the services and household sectors (SEAI, 2018b). At the end of 2015, out of the 12% target, only 6.5% had been achieved. The traditional solid biomass was responsible for most of this heat.

Even though there is a recent increase in modern renewable heat, Ireland is facing challenges to strengthen its growth. This requires an increased deployment of renewables, with strong energy efficiency measures being implemented within the services sector, such as heat pumps, the deployment of modern renewable heat supported by grants, and additional biomass CHP installations. Figure 14 shows the progress with regard to the 12% target (SEAI, 2017b).
Figure 14: Renewable heat progress and target. Source: SEAI (2017c).

In relation to greenhouse gas emissions, the target set is to reduce emissions by 20%, below 2005 levels. The target involves large carbon emitters, such as the industry, aviation, and electricity generation sectors, as well as the transport, residential, and agricultural sectors (SEAI, 2018a). Over the last 10 years, reduction in GHG emissions has been registered. However, the agricultural sector remains the main contributor to emissions, followed by the transport and energy industries. Figure 15 shows Greenhouse Gas Emissions in 2015 by sector (Environmental Protection Agency, 2017).
Replacing the use of fossil fuels and energy imports through the use of renewable energy is essential for reducing GHG emissions. Figure 16 shows the emissions avoided by renewable energy between 2005 and 2016 (SEAI, 2018a). Between 2001 and 2011, there was a reduction in GHG emissions. However, with the recovery in the economy, since 2012 emissions have been rising. This situation demonstrates how challenging it can be for Ireland to decarbonise main parts of its economy, especially in agriculture, the residential sector, and road transport. Ireland wants to become a low-carbon, sustainable economy. Therefore, public investment must play a significant role. The main issues include infrastructure for low-carbon private transport, including electric vehicles, more efficient homes and businesses, and investment in public transport (Llado, 2018).
To summarise, Ireland has made important progress towards achieving its renewable energy and energy efficiency targets. Nevertheless, it is necessary to continue expanding these efforts. In addition, the intense growth in the economy and the continuing low oil prices have led to an increase in energy demand, making the responsibility of achieving energy targets even more challenging. Furthermore, the low fossil fuel price makes the shift to sustainable energy more limited (SEAI, 2017b).

The deployment of renewable energy technologies and energy efficiency must be stimulated through ongoing energy policy. The delivery of the 2020 targets requires that wind capacity and the penetration of biofuel must increase, renewable heat must be encouraged in industrial and commercial sites, businesses and homes must improve energy efficiency, and that the use of electric vehicles must be accelerated, among other measures. The Irish government and public must engage to achieve energy efficiency, renewable energy, and emissions reduction targets, so the benefits of a sustainable energy system can be reaped by all (SEAI, 2017b).

2.5. Conclusions on literature review

Renewable energy is a rising global phenomenon and its growth is set to accelerate. However, it is essential to ensure this progress is going in the right direction. There must be a balance between incentives for companies to focus on the deployment of renewable energy, and fair
competition while ensuring fair opportunities to get good returns on their investments. The development of clean energy is complementary to the progress of society (Tanti, 2018).

According to Berke (2018), the only way to slow down climate change is through the transition of the global energy system to renewable sources. However, nations will still need to use a mix of renewable energy sources with traditional energy sources until barriers from developing clean technologies, such as energy storage capabilities, are overcome.

Regarding Ireland, the transition to a low-carbon society is challenging. Replacing fossil fuels with renewable energy is crucial for making progress towards decarbonisation. There is an urgent need for private and public investment in energy infrastructure, including energy storage, smart distribution, and management systems. Although Ireland has enhanced its energy-efficiency, the country will not reach its 2020 renewable energy targets. Due to the strong growth of the Irish economy, the efforts must be intensified (Llado, 2018).

The literature review details the research in the area of renewable energy. It explores the current Irish situation in relation to the deployment of renewable technologies, the energy targets Ireland must achieve and the barriers to accomplishing them. The theme is current and important not only for Ireland but for the whole world. Ireland is concerned about climate change and it is making progress towards the decarbonisation of its energy system.
Chapter 3

3. Research Methodology

3.1. Introduction

The purpose of this research is to explore the main barriers Ireland is facing to achieve its renewable energy targets by 2020, as per the 2007 EU renewable energy agreement. This chapter will detail the research methodologies used to conduct this study. The quality of any research depends on the methods chosen to collect data. The methods must be explained and the results obtained must be meaningful (Saunders, Lewis and Thornhill, 2015, p. 5).

Saunders, Lewis and Thornhill (2015, p. 4) defines methods as the procedures and techniques used to collect and analyse data in research. On the other hand, the term methodology is used to refer to the theory that supports the undertaken research. The methodology needs to take into account the topic and the purpose of the research.

The Research Onion designed by Saunders, Lewis and Thornhill (2015, p. 124), figure 17, was the model selected to develop the research methodology for this dissertation. The different layers guided the researcher to explain the reason for each choice made in relation to the research methodology. The explanation gives credibility to the research.
The philosophy adopted in this dissertation is interpretivism, with an inductive approach. The data were collected using semi-structured interviews with open-ended questions. Based on the research onion, the following sections of this chapter will explain in detail the choice of each option within each layer.

### 3.1.1. Research Objectives

Considering the renewable energy industry in Ireland is at an important moment, this research aims to explore the existing barriers in the Irish renewable energy sector, which are preventing Ireland from achieving important targets set by the European Union.

Based on the literature review and the main objective, the researcher must explore the following topics:

1. The main renewable energy resources in Ireland and the barriers to their development. The focus will be on wind energy, solar PV and bioenergy, considering the additional opportunities they can provide for Irish business and domestic consumers;
2. The possibility of Ireland becoming the first country to remove investment on fossil fuels completely and the main obstacles on meeting the 2020 EU targets, which involves reducing greenhouse gas emissions by 20%;

3. The challenges Ireland is facing to enhance its energy efficiency by 20%, as per the EU Renewable Energy Directive;

4. The main barriers preventing Ireland from producing at least 16% of all energy consumed through renewable energy resources. Furthermore, the barriers for the three sub-targets in the electricity, transport, and heat sectors;

5. The main actions to overcome the challenges Ireland faces in reaching its EU targets. In addition, the future of the Irish renewable energy sector.

The research objectives will be achieved through the research questions presented in the following section.

3.1.2. Research Questions

The analyse of the main question "What are the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources?" led to the following sub-questions:

1. What are the main renewable energy resources in Ireland, both in terms of current production and future potential, and what are the main barriers to their development?

2. What are the main obstacles preventing Ireland from meeting its EU Renewable Energy Directive target to reduce greenhouse gas emissions?

3. What are the main reasons for Ireland failing to improve its energy efficiency at the desired rate, as per the EU Renewable Energy Directive?

4. What are the main challenges Ireland is facing in the process of achieving the EU Renewable Energy Directive targets in the electricity, heat and transport sectors?
5. What can be done to overcome the challenges Ireland faces in reaching its EU targets, also with a view to avoiding failures in meeting future targets?

The data to answer these research questions will be collected through an interview with professionals who work in the Irish renewable energy sector.

### 3.2. Research Methodology

There are several ways for a researcher to approach a research. For this dissertation, the researcher took into consideration both qualitative and quantitative approaches. The distinctions between the two approaches are shown in figure 18.

![Figure 18: Distinctions between quantitative and qualitative data. Source: Saunders, Lewis and Thornhill (2015, p. 569)](image)

According to Blumberg, Cooper and Schindler (2014, p. 148), the difference between the two approaches is mainly based on the type of information used to conduct a study. On the one hand, qualitative studies rely on qualitative information, such as narratives, words, and sentences. On the other hand, quantitative studies depend on quantitative information, such as figures and numbers. The choice for either a quantitative or qualitative studies is a matter of how the researcher will acquire knowledge.

Qualitative research emphasizes words when collecting and analysing data. It is linked to an inductive approach and the philosophy of interpretivism, focusing on how individuals understand their social world. It has a social reality and emphasizes the generation of theories in the relationship between research and theory (Bryman and Bell, 2015, p. 38).

To summarize, quantitative and qualitative research are different in terms of research strategy, epistemological issues, the role of theory and ontological concerns. Nevertheless, the
distinction is not a strict rule. Based on the information above and the focus of this study, the researcher chose a qualitative approach.

3.3. Research Design

Based on the six layers of The Research Onion, designed by Saunders, Lewis and Thornhill (2015), the researcher built the most suitable research design for this dissertation, as shown in figure 19, including the following elements:

1. Research Philosophy;
2. Approach to theory development;
3. Methodological choice;
4. Research Strategy;
5. Time horizon;
6. Techniques and Procedures.

![Research Design Diagram](image)

Figure 19: Research Design.

3.3.1. Research Philosophy

The term research philosophy refers to the development of knowledge, including its assumptions and beliefs. A reliable research philosophy will support the researcher in relation
to the methodological choice, the research strategy, and the techniques and procedures to collect and analyse data. All these elements will allow the researcher to plan a consistent research project (Saunders, Lewis and Thornhill, 2015, p. 124).

According to Saunders, Lewis and Thornhill (2015, p. 135), the main philosophies in business and management are:

1. Positivism;
2. Critical realism;
3. Interpretivism;
4. Postmodernism;
5. Pragmatism.

The purpose of interpretivism is to generate new comprehension of social worlds (Saunders, Lewis and Thornhill, 2015, p. 140). The basic principles of interpretivism are: the social world is subjective, in other words, interpretivists believe that an objective view of the social world is impracticable, research is guided by interests and the researcher is part of what is being researched. The involvement of the researcher is crucial in this philosophy (Blumberg, Cooper and Schindler, 2014, p. 17).

Interpretivist researchers collect what is meaningful to the participants of their research, they focus on their experiences. With this focus, interpretivism is, undoubtedly, subjectivist (Saunders, Lewis and Thornhill, 2015, p. 141). In addition, interpretivists consider that their interpretation of data, with their own beliefs, is crucial for the research process. The challenge for interpretivists is to understand the social world from the point of view of the participants. In relation to business and management research, the interpretivist perspective is highly applicable (Saunders, Lewis and Thornhill, 2015, p. 141).

Interpretivism was the philosophy chosen for this research. The researcher’s involvement in this study is essential, the data will be collected based on the participants' experiences and subjectively interpreted. The researcher will explore different experiences acknowledging the interests of the participants. This study aims to explore insights and understand a phenomenon (Blumberg, Cooper and Schindler, 2014, p. 17).

3.3.2. Research Approach
The second layer of the research onion requires the choice of an approach to theory development, which can be deductive, inductive or abductive. The research project implies the use of theory, which will be explicit in the findings and conclusions of this research (Saunders, Lewis and Thornhill, 2015, p. 144). Interpretivism is typically inductive. Through the use of an inductive approach, the conclusion is obtained from one or more facts or fragments of evidence (Blumberg, Cooper and Schindler, 2014, p. 21).

The purpose of this study is to collect data by interviewing professionals in the Irish renewable energy sector, then analyse the data to understand the nature of the problem in the renewable energy sector in Ireland. The inductive approach is the most suitable for this dissertation due to the fact it enables the researcher to understand the actual situation. This approach is connected to a qualitative data and the analyse of a small sample is more appropriate (Saunders, Lewis and Thornhill, 2015, p. 147). Figure 20 shows the inductive logic of research in a qualitative study.

According to Creswell and Creswell (2018, p. 181), through an inductive approach, the qualitative researcher will build, from the bottom up, categories, patterns, and themes. Therefore, they will be able to organize the data into abstract information units. This process clarifies the steps taken until the researcher establishes an understanding set of themes.
3.3.3. Research Choice

The third layer of the Research Onion is related to the methodological choice, which can be mono, mixed and multi, as shown in figure 21. The methodological choice is associated with research philosophy, approach, and strategy. The researcher's role depends on obtaining access to participants and to their data (Saunders, Lewis and Thornhill, 2015, p. 166).

![Methodological choice diagram](source)

Figure 21: Methodological choice. Source: Saunders, Lewis and Thornhill (2015, p. 167).

The mono-method is the methodological choice for this dissertation. It uses a single data collection technique, in this case, semi-structured interviews, associated with the qualitative analysis procedure. The methodological choice will assist the researcher to answer the research questions and, therefore, achieve the research objectives (Saunders, Lewis and Thornhill, 2015, p. 168).

3.3.4. Research Strategy

The next layer of the research onion is the strategy. According to Saunders, Lewis and Thornhill (2015, p. 177), a research strategy is a plan which will enable the researcher to answer the research questions, consequently, achieve the research aims. The research strategy is the connection between research philosophy and the methodological choice to collect and analyse data. Grounded theory is the most suitable research strategy for this dissertation.

According to Saunders, Lewis and Thornhill (2015, p. 193), grounded theory refers to the result of a research process. It is the theory that was developed inductively from data. This strategy can be used to explore issues in business and management. In qualitative data, it is common to
analyse data as you collect them, for example, when the researcher conduct an interview, it is important to analyse it before conducting the next one. Grounded theory enables the researcher to achieve this. It provides a systematic and emergent strategy to collect and analyse qualitative data. The key elements of grounded theory is shown in figure 22.

![Diagram of key elements of grounded theory](image)

Figure 22: Key elements of grounded theory. Source: Saunders, Lewis and Thornhill (2015, p. 197).

In grounded theory, as soon as the researcher develop the research idea and the research participants agree to participate, the data collection must start. The researcher who opts to use this strategy must be sure to be interested in and engaged with the research idea (Saunders, Lewis and Thornhill, 2015, p. 195).

### 3.3.5. Time Horizons

According to Saunders, Lewis and Thornhill (2015, p. 200), it is important to choose a time horizon as part of the research design. A time horizon can be cross-sectional or longitudinal. Cross-sectional is a "snapshot" at a particular time. Most of the research projects adopt the "snapshot" time horizon, due to the fact they are time constrained. On the other hand, longitudinal provides a diary perspective over a given period.
Considering this research involves the study of a particular phenomenon at a particular time, and the timetable to undertake it is really limited, the most appropriate time horizon is the "snapshot". Interviews will be conducted over a short period of time, capturing opinions of the research participants.

3.4. Data collection and Data analysis

Primary and secondary sources were used to collect data and approach this research.

3.4.1. Secondary Data Collection

According to Saunders, Lewis and Thornhill (2015, p. 316), secondary data were data previously collected for some other purpose, which will support the researcher to undertake the research, answer the research question and achieve the objectives. It provides additional knowledge and interpretations. The secondary data used in this research were referenced and cited to avoid plagiarism.

3.4.2. Primary Data Collection

This dissertation adopted an interpretivist philosophy, an inductive approach, and a qualitative aspect. The primary data will be collected by using semi-structured interviews, considering this study is exploratory and the population is considerably small.

According to Bryman and Bell (2015, p. 479), in qualitative research, interviews are the most usual method to collect primary data. Qualitative interviews are flexible, there is an emphasis on participants' own perspectives, and the approach is usually less structured when compared with a quantitative research. By using a qualitative interview, the researcher will collect rich and detailed answers.

The researcher aimed to interview professionals who work in the Irish Renewable Energy sector, gathering different opinions about the Irish situation towards the EU 2020 targets. Semi-structured interviews were the technique selected to collect primary data, considering the purpose of the research and the importance of establishing personal contact. In semi-structured interviews, although the researcher has a theme and questions that must be covered, depending on the flow of the conversation, the interview can depart from the schedule. Furthermore, new questions can be asked, the order and the wording of the questions can vary, different from a quantitative interview. On the other hand, the researcher must be aware of the nature of the
questions, considering they will support the researcher to answer the research questions and achieve the research objectives (Saunders, Lewis and Thornhill, 2015, p. 391).

The interviews were conducted on a one-to-one basis, between the researcher and the expert in renewable energy, except for two interviews by email and one in a group. The questions were previously prepared, based on the literature review, and covered the research topic. The researcher used a semi-structured interview guide to support the interviews and ensure that relevant topics were discussed. The researcher met the participants face-to-face, individually, and the conversation was recorded. Interviewees were encouraged to develop their ideas, express their opinions and share their experiences regarding the research topic. Interviews by email were also conducted, considering the lack of availability of the professionals to meet in person.

According to Denscombe (2014, p. 222-225), conducting a face-to-face interview involves: planning the interview, introduction and formalities, starting the interview, monitoring the progress, and finishing the interview.

In relation to planning the interview, the first step involved the selection of the population and the sample (Section 3.5). The renewable energy experts were contacted in advance by email, with an invitation to participate in an academic research and an information sheet, which included all the main details about the research (Appendix 3 and 4). The participants who agreed to contribute to the research set a time and venue suitable for them to conduct the interview. All participants were volunteers, and they could refuse to participate at any time. The semi-structured interview guide was previously available for the participants, therefore, they could prepare themselves for the interview.

During the initial phase, the researcher asked for permission to record the interview. The interviewees were informed about their personal privacy, the confidentiality of the information given, which was used only by the researcher and which could be removed under request. Furthermore, the participants were also informed about the transcription of the interview and asked to sign a consent form (Appendix 5). Therefore, the interviews were conducted in an ethical manner.

Before starting the interviews, there was a brief introduction of both parties and a short summary of the undertaken research, after that, the researcher moved on to the open-ended questions. The interviews were recorded by using a voice recorder and lasted no more than one
hour. During the interviews, the participants provided valuable information about renewable energy, which was further transcripted and analysed by the researcher. Two of the five interviews were conducted by email, the first with a member of the Eirgrid Group and the second with a member of PM Group. Three interviews were conducted face-to-face, one of them was a group interview, with three members of DCCAE.

3.4.3. Coding and Analysis

This research used qualitative data, which was collected by semi-structured interviews. Each interview was recorded using a voice recorder. The interviews were entirely transcribed, considering the researcher aimed at the implied meanings of the discussions. As soon as the transcription process was completed, the participants' answers were coded into themes. As the interviews were conducted, the themes were developed and updated. Based on that, the researcher started the data analysis (Denscombe, 2014, p. 10).

The qualitative data analysis involves the analysis of talk and text. The researcher adopted the grounded theory approach, which is usually related to the analysis of interview transcripts, therefore, it enabled the researcher to interpret the conversations with the participants. During the analysis process, each transcript was meticulously read, coded and categorized. Each category was constantly reviewed.

As the grounded theory tends to be inductive, the researcher aimed at establishing concepts and theories, generalized conclusions, which contained meaningful statements of the data collected. The categories enabled the researcher to create a structure to answer the research questions and meet the research objectives. Figure 23 shows the process of coding and analysing data, based on the grounded theory, used by the researcher.
The process of coding and analysing data, based on the grounded theory included (Denscombe, 2014, p. 318-321):

- Explore the data: The researcher became familiar with the data by carefully reading the transcripts, paying attention to the minute details. This process enabled the researcher to identify themes in the data;
- Memos: As the data analysis progressed, new ideas, thoughts, and information emerged. It was important for the researcher to write memos and explore the possibilities regarding the data analysis. The memos support the researcher to refine codes and categories;
- Code the data: The data collected were attached to codes and then linked to the analysis process. Codes were also used to identify and store the data collected in an organized manner;
- Categorize the codes: codes were grouped into categories;
- Reduce number of codes and categories: At the beginning of the process, there was a large number of codes and categories. The researcher focused on the useful and meaningful ones to be part of the analysis;
- Develop a hierarchy of codes and categories: The codes were identified between higher and lower level. The higher level codes are more inclusive and wider;
• Check the emerging codes, categories and concepts with the data: The researcher started the data analysis before all interviews were conducted. Therefore, it was crucial to revise every step, to ensure they were still all connected to the initial data;  
• Move towards key concepts: Key concepts are identified by the use of higher level codes and categories. The concepts provided the basis for data comprehension, theories, and generalised conclusions.

The researcher followed this process to analyse the qualitative data.

3.5. Population and Sample

3.5.1. Population

According to Saunders, Lewis and Thornhill (2015, p. 274), the population is the full set of cases from which a sample is selected. The target population is a more manageable population, considering not all set of cases would be known by the researcher or accessible. The target population is the actual focus of the research. The target population of this dissertation is all the professionals who are currently working in the Irish renewable energy sector, specifically with the EU 2020 targets.

3.5.2. Sampling

According to Saunders, Lewis and Thornhill (2015, p. 274), for most of the research questions, it is impracticable to collect data from the whole population. In this case, the researcher needs to select a sample. The sampling technique chosen for this dissertation was the self-selection sampling, which is a non-probability technique. The process followed to choose this sampling technique is shown in figure 24.

A non-probability sampling technique is used when the researcher does not know the chances of each case being selected from the target population. It is also used when it is impossible for the researcher to answer research questions and meet objectives that require statistical inferences about the characteristics of the population (Saunders, Lewis and Thornhill, 2015, p. 276).

In addition, a self-selection sampling is a volunteer sampling technique, used for exploratory studies. When using this technique, the researcher allows each case, for example, the
professionals in the Irish renewable energy sector, to demonstrate an interest in participating in the research. In this technique, there is a possibility to contact individuals (Saunders, Lewis and Thornhill, 2015, p. 303).

Figure 24: Choosing a non-probability sampling technique. Source: Saunders, Lewis and Thornhill (2015, p. 296).
The sample was selected within the target population, then contacted by email with an invitation to participate in this academic research. Based on the responses of the professionals who were willing to participate in this research, interviews were conducted. The self-selected sampling is shown below:

- Engineers Ireland members – x 1;
- Eirgrid Group members – x 1;
- The Department of Communications, Climate Action and Environment members – x 3;
- Dublin Airport Energy Department members – x 1;
- PM Group members – x 1

According to Saunders, Lewis and Thornhill (2015, p. 297), when the researcher is intending to collect qualitative data through semi-structured interviews, the sample size depends on the research questions and objectives. In other words, the sample size depends on what the researcher needs to find out, what will have reliability, what will be helpful, and what can be done with the available resources. Based on that, the suitable sample size for semi-structured interviews is between 5-25 individuals, as shown in figure 25.

<table>
<thead>
<tr>
<th>Nature of study</th>
<th>Minimum sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-structured/In-depth interviews</td>
<td>5–25</td>
</tr>
<tr>
<td>Ethnographic</td>
<td>35–36</td>
</tr>
<tr>
<td>Grounded Theory</td>
<td>20–35</td>
</tr>
<tr>
<td>Considering a homogeneous population</td>
<td>4–12</td>
</tr>
<tr>
<td>Considering a heterogeneous population</td>
<td>12–30</td>
</tr>
</tbody>
</table>

Figure 25: Minimum non-probability sample size. Source: Saunders, Lewis and Thornhill (2015, p. 297).

Although the researcher had contacted all the sample selected within the population, the sample size was restricted to seven individuals, the self-selected sample, due to the lack of more responses to the invitations.

### 3.6. Ethical Issues and Procedure

According to Saunders, Lewis and Thornhill (2015, p. 239), research ethics refers to behavioral standards that guide the researcher in relation to the rights of the participants who contribute to the research. The participants become the subject of the research and are affected by it,
therefore, the researcher must be always aware of ethical considerations. Research ethics should be considered throughout the academic research process, from designing and planning research to reporting data. In relation to avoiding plagiarism, all secondary data and other sources were properly referenced and cited.

3.6.1. Participation and Ethics

The selected sample was contacted by email with an invitation to participate in this academic research, as well as the information sheet for participants, Appendix 3 and 4. The information sheet included information about the nature of the research, the participants’ rights, the process to collect and analyse data, and whom to contact in case of questions regarding this research. The initial ethical considerations were dealt with by e-mail.

The professionals who expressed a willingness to be interviewed set a time and venue suitable for them to conduct the interview. All interviews were conducted during the dissertation process. They were recorded and then transcribed, as it was previously agreed with the participant. The transcripts are available on Appendix 7-11. A consent form was signed in the end of each interview by both parties, the participant and the researcher.

3.7. Limitations to the Research

The main limitation faced by the researcher during the dissertation process was getting access to the professionals who work in the Irish renewable energy sector. The emails were not sent directly to the experts, their personal email addresses are not available, which caused a delay in the responses, or no responses whatsoever. Another limitation was in relation to time constraints, which reduced the time available to conduct more interviews. The researcher works part-time, causing limitations regarding the amount of time available to dedicate to the research process.

3.8. Summary

In this chapter, the research process was explained in details. Based on the Research Onion, an appropriate justification was given for each choice regarding research philosophy, approach, methodological approach, strategy and time horizon. The techniques and procedures applicable to data collection and analysis were described and reviewed. The ethical considerations and the acknowledgement of limitation regarding the research process were also detailed in this chapter.
Chapter 4

4. Findings and data analysis

The purpose of this study is to provide a deep analysis of the barriers faced by Ireland in achieving its EU 2020 targets in the electricity, heat and transport sectors, as well as its targets related to energy efficiency and greenhouse gas emissions. Furthermore, this study also aims to explore the future of the Irish renewable energy sector. The two main strategies to analyse qualitative data are asking questions and making comparisons (Corbin and Strauss, 2015, p. 90).

This chapter will highlight the five interview transcripts conducted with seven professionals who work in the Irish renewable energy sector. It will also provide a clear understanding of the views and opinions expressed, as well as support the discussion presented in the next chapter.

The data collection tool used in this dissertation was semi-structured interviews with open-ended questions. In total five interviews were undertaken, two by email, two individual and one in a group. The interviews were carried out during December 2018. All interviewees work in the Irish renewable energy sector.

The interviews were composed of 19 questions, which supported the researcher to obtain an understanding of the research topic based on the interviewees' experiences. The interviewees were encouraged to speak about their own point of view and perspective on the Irish renewable energy sector. The interviews were transcribed and to carry out this analysis a set of codes and sub-codes were developed and applied to the transcripts. The research questions will be addressed in this analysis.

4.1. Profile of the Participants
4.2. Research Question 1

What are the main renewable energy resources in Ireland, both in terms of current production and future potential, and what are the main barriers to their development?

The purpose of Research Question 1 is to obtain information on the main renewable energy resources in Ireland, considering the electricity, heat and transport sectors, and the barriers to their development. Question 3 on the interview guide supported the researcher to obtain this information: “Which renewable resources do you believe will be the main contributors to the Irish electricity, heat and transport sectors going forward into the future? What do you consider to be the main barriers to their development?” Interviewee 7 did not answer this question. Across the five interviews, the participants mentioned wind and solar PV for the electricity sector and EVs for the transport sector. The additional answers are shown as follows.

Interviewee 1 also mentioned that the barriers to onshore wind farms involve social opposition and the amount of land available for it. Bio-energy will play a certain part, considering they require huge facilities and a lot of finances. In the heat sector, it will be air-source heat pumps and gas. In terms of transport, it will also be natural gas. To overcome the barriers “Ireland needs to increase renewable penetration in electricity, in order to make heat and transport more renewable”.

Interviewee 2 added CHPs, in terms of microgeneration, for the electricity sector. In terms of heat, district heating schemes, anaerobic digestion, essentially biogas and biomethane. In terms
of transport, also CNG and hybrid. The four main barriers are the governance, the society in general, technical reasons, and planning infrastructure.

Interviewee 3 also talked about hydro for electricity. In relation to the heat and transport sectors, the use of biofuels in both sectors was added. Heat pump could have potential to contribute in the future.

Interviewee 4 also mentioned biomass (renewable gas/biofuel), and wave technology. Among the barriers are the government tariffs and carbon tax on fossil fuels, which will need to be increased to incentivise development and to encourage greater use of renewables.

In the group interview, interviewee 6 added hydro, landfill gas, and biomass. In relation to barriers, interviewee 5 believes that the barriers Ireland is having in relation to the deployment of renewable resources are in relation to planning, objectors, a limited supply of biomass in the country, the cost of the technologies, and grid policy. Interviewee 6 mentioned the deep recession over the last decade, when there was no capital funding available, and also a very dispersed population.

Once the main renewable resources and the barriers to their development were identified, the researcher delved deeper into wind energy, which is the biggest contributor among renewable resources in Ireland. In relation to the future of wind energy in Ireland, question 4 asked “Considering Ireland has excellent wind resources, do you believe the country can rely on its continuous growth? Interviewee 7 did not provide an answer to this question. All the other participants stated that Ireland cannot rely on wind energy, the reasons are shown as follows.

Interviewee 1 mentioned the fact that wind is intermittent, very hard to manage, and it is only windy 33% of the time. The main issues mentioned were technological, such as managing wind batteries, and spaces of land available. “Ireland needs to invest heavily in R&D in order to be able to get more percentage of wind into the system.”

Interviewee 2 explained that for that to happen, “Ireland needs to improve the network, the infrastructure and get better interconnection to Europe.”

Interviewee 3 said the main reason is that wind as an energy resource is uncertain and has variable nature. It is also electrically decoupled from the system and not synchronously connected. Adding to that, Interview 4 stated that the energy storage is poor. “A diverse range of renewables including storage is required to secure renewables as a reliable energy source.”
In the group interview, interviewee 5 mentioned planning issues for onshore and offshore wind. Also for offshore wind, it was mentioned cost and grid development policy. In addition to onshore wind, interviewee 6 also mentioned issues in relation to the available land for it, and in relation to offshore wind, it was added the support scheme.

Still regarding wind energy in Ireland, question 5 tried to approach the barriers in its deployment. “In your opinion, what are the main challenges faced by Ireland to succeed in the deployment of wind energy technologies? How do you feel that these challenges can be overcome?” Interviewee 7 did not provide an answer to this question. All other participants mentioned grid connection and local opposition as being the main barriers. The additional answers are shown as follows.

Interviewee 1 added that the local opposition locks financing, which increases the risk of not getting planning commission. In relation to offshore wind, the main barrier has been cost, but that has dropped massively in the last number of years. Interviewee 2 also mentioned that the planning approval needs to be streamlined and that the solution for the local opposition is moving offshore.

Interviewee 3 stated that the “DS3 program is pushing the boundaries on overcoming these challenges.” It suggests that developers should work in conjunction with local communities from early in the planning phase. Interviewee 4 stated "the location, the size, and scale of the turbines.” The financial benefits of this technology must be demonstrated to the local communities.

In the group interview, interviewee 5 said that “a large challenge at the moment is the national guidelines”, in relation to location and to repower the wind farms. Interviewee 6 added, in regard to offshore wind, barriers in terms of consent and support scheme. In relation to the public objection, the RESS is going to target community ownership and bring communities more into the renewable electricity generation sector in general.

Once the information on wind energy was gathered, the researcher focus on bioenergy. Question 6 asked “With regard to the heat and transport sectors, what actions would you consider necessary for the further expansion of bioenergy in Ireland for these sectors? What are the barriers to its expansion, and how can they be overcome?” Interviewees 5 and 6 did not answer the question. The answers to this question were varied and are shown as follows.
Interviewee 1 and interviewee 3 believe in the electrification for the heat sector. Interviewee 3 stated that the main barrier in improving the electrification of heat and transport is consumer choices and opinions. There are also technology barriers and lack of charging infrastructure for EVs. “It is important that the government has the right subsidies in place and that it continues to push uptake of EVs.”

Interviewee 2 believes it is not worth to generate biofuel within Ireland, considering the huge portions of land to generate it. In terms of biogas, biomethane, and CNG, that could benefit both sectors at the same time. People need to be incentivised and the infrastructure improved.

Interviewee 4 stated that the development of biofuel requires a reliable biomass source at a large scale. That will only happen with government incentives, also for the segregation of organic waste and biogas projects. In relation biomethane, it needs conversion targets and injection to gas grid, upgrading of existing service stations.

In the group interview, interviewee 7 mentioned that bioenergy has issues in the demand and supply sides. To overcome these barriers, on the demand side there should be put in place supports schemes for the production of bioenergy; on supply side, forestation should be increased. In relation to waste products, more anaerobic digestion and waste energy plants must be built. It was also suggested for the heat sector district heating and the use of waste heat. In the transport sector, the obligation of including 8% biofuel in the tank must be increased; the amount of imported biofuel must be reduced; electrification of the fleet; CNG; biomethane; and hydrogen.

Moving from bioenergy, the research looked at Ireland’s potential in relation to solar energy. Question 7 asked “Ireland has a small but growing solar PV deployment industry. In your opinion, what are the main barriers to increasing Ireland’s solar PV deployment?” Interviewee 7 did not provide an answer to this question. Interviewees 2, 3, 4, 5 and 6 agreed that the cost for solar PV has been a barrier, although it has been decreasing. The additional answers are shown as follows.

Interviewee 1 believes that the barriers include a smaller opposition, when comparing it to wind, and connection to the grid. Interviewee 2 also talked about the connection to the grid, which will change with the DS3 program. It was also added to the barriers grant scheme and lack of belief in Ireland’s potential, but these are starting to change. Interviewee 3 added the
weather and technical challenges of integration into the power system. Interviewee 4 also mentioned lower efficiency rates in Ireland and low incentive tariff.

In the interview group, interviewee 5 also mentioned planning restrictions and no support scheme generally available for solar at the moment, apart from microgeneration. That will change under the RESS. In relation to overcoming these barriers, interviewee 6 mentioned that there is also a potential for solar to be included in Ireland's renewable mix in the future.

Question 8 asked, “Do you believe improvements in solar technology, combined with Irish strengths in the renewable energy sector, can turn solar PV into a more practicable option in Ireland?” Interviewee 7 did not provide an answer to this question. The other participants agreed that solar PV can be a practicable option in Ireland. The point of each participant is shown as follows.

Interviewee 1 stated that Ireland has everything that is required for solar, the land, the planning commission effectively. “It is about people getting the financing now and get on with that.” Interviewee 2 mentioned that with a lower price and the support scheme, people will definitely start to invest in solar PV.

Interviewee 3 stated that it will take time, and although the capacity factor of PV in Ireland is low, solar PV can turn into a more practicable option in Ireland with subsidies and on the continued decreasing of the costs. Interviewee 4 added that it depends on a greater incentive for domestic homes to install them.

In the group interview, interviewee 5 mentioned that there are possibilities under the RESS that solar could be supported as technology in Ireland, especially because of the lower costs. Adding to that, interviewee 6 said that solar will naturally become more prevalent because of the increased demand for renewable electricity. Incentives need to be provided to attract solar into the scheme. “It will be more expensive, however, it is more accessible to communities.”

4.3. Research Question 2

What are the main obstacles preventing Ireland from meeting its EU Renewable Energy Directive target to reduce greenhouse gas emissions?
The aims of research question 2 are to understand the main obstacles on meeting the 2020 EU targets that involve reducing greenhouse gas emissions by 20% and the possibility of Ireland becoming the first country to remove investment on fossil fuels completely.

Although Ireland is on the right path to achieve its commitment according to the Kyoto Protocol, the country will miss the EU targets. Question 9 on the semi-structured interview guide asked “What are the main obstacles you feel are preventing Ireland from meeting its target to reduce greenhouse gas emissions by 20%, according to its EU targets? What actions do you believe can be taken to help overcome these obstacles?” Interviewee 4 believes that the Government is the main reason. Across all the other interviews, the transport sector was mentioned. The additional answers are shown as follow.

Interviewee 1 added agriculture and heat. It is necessary to incentivize EVs, to be inventive about how to address the release of the gases in the agriculture sector, and move to air-source heat pumps. Interviewee 2 also mentioned heating, ETS and non-ETS emissions. The government needs to apply carbon tax in non-ETS; revise the ETS programme 2020 to 2030, the building stock needs to be improved, and incentivise EV and CNG. Interviewee 3 also added the heat sector.

In the group interview, interviewee 5 added agriculture emissions and some emissions from the electricity generation, like oil, gas, coal, and peat. Interviewee 6 also mentioned “the nature of the dispersed population and deep recession”. To overcome these barriers, interviewee 6 mentioned the available funding. Interviewee 5 added the obligation rate, in relation to biofuels, incentives for EVs, the new RESS and the Renewable Heat Support Scheme. Interviewee 7, mentioned that there are projects to invest in infrastructure for Evs, as they have started to become more accepted.

Once the main obstacles to achieve the targets related to greenhouse gas emissions were identified and also the solutions, the researcher took into account the fact that Ireland might become the first country to remove investment on fossil fuels completely and ask the participants their opinion on this possibility. Question 10 asked “How likely is Ireland to remove investment in fossil fuels completely? If you believe this likely, in what timeline could you see this happening?” Interviewee 7 did not provide an answer to this question. Interviewee 3 and 4 said that it is unlikely. Interviewee 3 explained that fossil fuel generation of some sort will be required in future power systems. The additional answers are shown as follows.
Interviewee 1 said that it is very likely and one of the reasons is a bill in the Parliament that ban anybody drilling oil and gas offshore of Ireland. The second reason is that Ireland has committed to stop using peat and coal. “I think that by 2025 there will be no more fossil fuels investments, with the exception of natural gas.”

Interviewee 2 mentioned that Ireland cannot move away from fossil fuels for the next 50 years. “This could change if all the renewable energy technologies over the next 20, 30, 40 years are invested in and installed, then Ireland may be able to move.”

In the interview group, interviewee 5 thinks “it is going to be very slow to remove fossil fuels completely.” The main reason as pointed out by interviewee 6 is that Ireland does not have any other dispatchable sources of energy, such nuclear, or much hydro comparing to other European countries. However, they stated that “the ambition is there, and by 2050 Ireland wants to have removed fossil fuels from the energy sector. The challenge now is how to accelerate that.”

4.4. Research Question 3

What are the main reasons for Ireland failing to improve its energy efficiency at the desired rate, as per the EU Renewable Energy Directive?

The research question 3 sought to understand the main reasons for Ireland not enhance its energy efficiency by 20%, as set by the EU. Question 11 of the interview guide asked the opinion of the participants in this regard “In your opinion, what the main reasons for Ireland failing to improve its energy efficiency at the desired rate in the residential, commercial and industrial sectors?” Interviewee 7 did not provide an answer to this question. Interviewee 1, 2, 5 and 6 mentioned the financial crisis. Interviewee 3 pointed out the rate of uptake of electric vehicles and electric heating, which must be economically favourable. Interviewee 4 mentioned the Government strategy and FDI.

Interviewee 1 added that Ireland missed out in about five years of making things more efficient generally. However, now there are far more financing and funding available to make all sectors more efficient, but it is going to take time.

Interviewee 2 also mentioned the heating and the lighting side of the residential sector. “It takes a lot of money to invest in changes.” The financial crash was associated with the commercial and industrial sectors.
In the group interview, interviewee 5 said that “although there has been considerable progress, the appetite is a key factor in being below potential performance.” It is important to make people aware, in all sectors, of potential gains and of the supports available, persuading them to make changes that can be the key to achieve the potential. Interviewee 6 added in relation to the funding available “That is starting to change again.”

4.5. Research Question 4

What are the main challenges Ireland is facing in the process of achieving the EU Renewable Energy Directive targets in the electricity, heat and transport sectors?

Ireland will miss its target of producing at least 16% of all energy consumed through renewable energy resources. The aim of this question is to discover the main reasons behind this shortfall in the electricity, transport, and heat sectors. Firstly, the researcher involved the electricity sector. Question 12 asked “What are the main challenges to integrating more renewable energy resources into the electricity sector safely and efficiently?” Interviewee 4 and 7 did not provide an answer to this question. Both interviewees 1 and 3 mentioned technological challenges.

Interviewee 1 also mentioned interconnection with Europe, store capabilities and demand-side management. Interviewee 3 added the variable and uncertain nature of the underlying wind resource but also to the technical characteristics of the wind turbines themselves.

Interviewee 2 mentioned the frequency, the intermittency, and the backup to it, and the fact that the load centres and the resource are not in the same place. To overcome those issues there needs to be battery storage, better interconnection to Europe, better distribution and transmission infrastructure, and upgraded the system.

In the interview group, interviewee 5 mentioned challenges in relation to planning and national wind energy guidelines, development of grid policy offshore, and getting the actual renewable electricity into the grid. The world leading program DS3 is working on that. Adding to that, interviewee 6 mentioned the DS3 program needs to be extended beyond 2020 for future targets.

Once the barriers in the electricity sector were detected, question 13 asked about the transport sector: “In your opinion, what would be the main required changes in the renewable transport sector in Ireland so it could stop relying on imported fossil fuels?” Interviewees 5 and 6 did not provide an answer to this question. Interviewee 4 said the same as question 6. Across all other participants, electrification was mentioned.
Interviewee 1 also added biogas and better policies. Interviewee 2 also mentioned investments in both private and public transport, CNG, infrastructure, upgrade the rail link and the original bus routes. “The Government needs to make a move and have a clear plan.”

Interviewee 3 added that attractive subsidies and a broader choice of EVs are now available, meaning that the rate of uptake is expected to increase significantly over the coming years. However, a change on such a large scale will take time.

In the group interview, interviewee 7 also mentioned extension of the DART network, build a few metro lines, convert the larger vehicles to natural gas, and substitute biomethane in there, a plug-in electric hybrid, hydrogen and HVO will also be a possibility in the future. The big challenge is in the amount of biofuel that can be blended with fossil fuels in the tank. That is not going to happen until early in the next decade, after 2020. “The government has a stated ambition that all new passenger cars sold in Ireland after 2030 will be zero emissions capable.”

Regarding the heat sector. Question 14 in the semi-structured interview guide asked: “What do you believe to be the main challenges for the use of more renewable resources in the Irish renewable heat sector?” Interviewee 5 and 6 did not provide an answer to this question. Interviewee 3 mentioned a gradual transition to electric heating, considering people will not change without having an economic reason to do so. Participants 1 and 2 mentioned district heating. The additional answers are shown as follows.

Interviewee 1 also mentioned the use of roof space, to make things more efficient. Interviewee 4 added reuse of excess heat from industry. Interviewee 2 mentioned that people rely on solid fuel or gas and it is expensive to change. Apart from district heating, the challenges can be overcome with heating pump, the renewable heat incentive, tax incentives or some more grant issued for it, and the new building regulation. “I think heat will improve, but it is going to take time.”

In the interview group, interviewee 7 also mentioned that the cost of investment in bioenergy and heat pumps, is expensive, and they do not give a quick payback. Another issue is gas and it is hard for bioenergy to compete where gas is. The energy needs to affordable for all of the population. Ireland needs to put more energy efficient systems in and try to bring everybody along, not pricing anybody out of this market.

Store capabilities have been a challenge all over the world, question 15 sought to understand the participants’ opinion in this regard: “Do you consider energy storage capabilities to be a
barrier to the development of clean technologies in Ireland?” Interviewees 1, 2, 3, and 4 mentioned that the lack of storage capabilities has been a barrier. Interviewees 4, 5 and 6 mentioned the progress Ireland has made. The additional answers are shown as follows.

Interviewee 1 mentioned that not only in Ireland, but all over the world store technology has a long way to come in order to have a completely renewable grid. Interviewee 2 said that although Ireland is good at managing, the country needs the storage and a better interconnection with Europe. Interviewee 3 also added that storage devices could provide system services that are needed to securely operate the power system.

In the interview, interviewee 5 stated: “We have noticed that there is storage plants beginning to be set up in various parts of the country recently so regulations will have to be put in place for those.” They will facilitate new connections on the grid, improve reliability of supply, and contribute to wholesale electricity prices coming down. Adding to that, interviewee 6 said that Ireland is moving together now to develop policies to support more battery storage. Interviewee 7 mentioned that personal ownership of electric vehicles will also help.

Lastly, even though it is a fact that Ireland will miss its targets, Question 16 looked at the participants’ opinion on this matter. “Do you believe it is an inevitability that Ireland will fail to meet its 2020 targets? Is it likely that Ireland will have to purchase energy credits to avoid heavy fines?” Interviewee 7 did not answer this question. All other participants agreed that Ireland has already missed the targets and will have to pay heavy fines.

Interviewee I and 3 agreed that Ireland may not have missed the targets in the electricity sector, but it is unlikely that the heat and transport sectors will change quickly enough. Adding to that Interviewee 1 believes that the Government will have to pay the fine or purchase credits.

In the group interview, interviewee 5 stated that “Ireland is likely to be in the region of between 12.8 to 14% of the 16% target”. In relation to the fines, it was mentioned statistic transfer mechanism and purchase credits from other member states that will have a surplus. Adding to that, Interviewee 6 mentioned that when the target was set Ireland was at something like 3% renewable energy, and it is going to end up between 12.8% and 14%. Ireland is doing everything in its power to meet the targets.

4.6. Research Question 5
What can be done to overcome the challenges Ireland faces in reaching its EU targets, also with a view to avoiding failures in meeting future targets?

The Research Question 5 involves the main actions to overcome the challenges Ireland faces in reaching its EU targets and also the future of the Irish renewable energy sector. Question 17 in the semi-structured interview guide supported the researcher to answer this question. “What do you believe can be done to overcome the barriers Ireland faces in meeting its EU 2020 targets?” Interviewees 3, 4, 6 and 7 did not answer this question.

Interviewee 1 believes in making renewable cars and electric cars tax-free. In transport, policy-wise, bus lanes for electric cars, free parking in certain places, just incentivise it. In the heat sector, it is investment, the SSRH will help with that. Interviewee 2 think that the Government could improve the energy efficiency figures and reduce the base load. In the group interview, interviewee 5 mentioned connection policy to the grid, in other words, to prioritise connections for new flexible technologies and increase renewable generation in the grid.

Although Ireland will miss the targets, the country has made progress until now. Question 18 asked “What can Ireland learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets? What can be done to avoid shortfalls when attempting to meet targets in the future?” Interviewee 4 did not answer this question. Interviewee 1 and 6 mentioned energy demand and data centres.

Interviewee 1 also believes that Ireland needs to build acceptance community and have new planning regulations and guidelines. Interviewee 2 mentioned that Ireland was focus on wind, and they need to branch it out further, with the RESS and the RHI. Adding to that, Ireland needs to tackle agriculture, improve the incentive schemes, implementing the new technology awareness, make legally binding targets, and make companies, people, and industries, in particular, responsible for their energy consumption, through additional taxes, or avoided taxes.

Interviewee 3 talked about Norway, the world leader in electrification of transport, and how Ireland could learn to incorporate high numbers of EV’s, by attractive subsidies, including financial and non-financial incentives such as low vehicle licence fees, bus lane access and free parking. Perhaps also apply comparable logic to the electrification of heat.

In the group interview, interviewee 5 said that Ireland has to look at what other states are doing in relation to this. Adding to that, interviewee 6 also mentioned the current funding available, which will help to implement support schemes, whether it is for heat or electricity, that other
states have already done, and also, bring communities and citizens more into the energy transition in terms of generation. Interviewee 7 talked about the networks within Europe and exchange of information.

Question 19 looked at Ireland’s potential in relation to renewable energy. “How likely is it that Ireland will become a world leader in the use of renewable energy resources, and eventually, a net exporter of energy?” Across all interviews, the participants believe Ireland can become a worldwide example. Interviewee 2 and 6 mentioned a better interconnection with Europe.

Interviewee 1 thinks that Ireland already has a very high percentage of renewable penetration in electricity. “We are leaders and we are going to continue to be. In relation to a net exporter, we will not be a massive exporter, we will trade forward and back.” Interviewee 2 also added that it is important to make sure that Ireland’s own electric grid network is resilient strong.

Interviewee 3 stated that Ireland is already a world leader in the renewable energy generation sector, and it can also be in heat and transport. This will require careful management and cooperation within Ireland. Interviewee 4 said Ireland has the potential to become a leading user and exporter.

In the group interview, interviewee 5 mentioned the importance of diversifying Ireland’s energy generation portfolio and decarbonising the energy sector by 2050. The DS3 program is one of the leaders when it comes to integrating renewable electricity to the grid. Ireland has a target set of reducing greenhouse gases by 80-95% by 2050. Adding to that interviewee 6 also stated that wants to bring all of the departments together and have a government approach to tackling climate change with Ireland becoming a leader. Interviewee 7 said that Ireland definitely needs to move away from that imported energy.

Question 20 sought to understand the pitfalls of being fully dependent on renewable energy. “Do you feel there are potential pitfalls to becoming highly dependent on renewable energy resources, and if so, what are those potential pitfalls?” Interviewee 7 did not answer this question. Interviewees 2 and 6 mentioned lack of interconnection with Europe.

Interviewee 1 stated that there is no pitfall to be able to be self-sustainable. Interviewee 2 mentioned climate change and Ireland’s technical capacity to manufacture some of the renewable energy technology. Interviewee 3 talked about technical challenges, which require careful consideration and with careful consideration can be resolved. Interviewee 4 stated that
renewables rely on an integrated system approach for overall success and a diverse range of renewable supply will be key.

In the group interviewee, interviewee 5 mentioned the DS3 program, which makes sure that anything that is produced goes into the grid. It was also added the technological challenges. Interviewee 6 talked about the careful transition to renewables and storage.

Lastly, Question 21 asked, “In your opinion, what are the main actions required to engage and empower communities and businesses to contribute to Ireland's energy transformation?” Interviewee 3 did not provide an answer to this question.

Interviewee 1 believes in ownership communities, which can be done with the RESS, increasing the knowledge on this topic, and grant schemes. Interviewee 2 mentioned the SEC for communities, people become more aware about where their energy comes from. For businesses CSR and Public Relations, capital return, incentives, tax avoidance schemes, and accelerated capital allowance.

Interviewee 4 mentioned greater awareness of the potential for renewables and community development. To encourage more businesses, tax relief, incentives, and carbon credits.

In the group interview, interviewee 5 mentioned that the new RESS scheme wants to integrate communities and business into any projects that are happening in various parts of the country. Adding to that interviewee 6 talked about projects, developer led and community led, which support communities and citizens to be part of the energy transition. Interviewee 7 mentioned “better energy community scheme”, where communities can apply for grants and supports to upgrade the energy efficiency of their community.

4.7. Summary

This chapter provided the findings that arose from the data collected through the five interviews conducted. Each participant expressed its opinion and share its experience regarding the barriers faced by Ireland to achieve its renewable energy targets. The researcher adopted the grounded theory approach. Each transcript was coded and categorized. Overall, the responses provided by the participants complement each other. The categories enabled the researcher to create a structure to answer the research questions and meet the research objectives.
Chapter 5

5. Discussion

5.1. Introduction

This chapter will review and interpret the findings detailed in Chapter 4 and whilst relating them to the secondary data detailed Chapter 2. The discussion will include an evaluation of the finding in the context of barriers faced by Ireland to achieve its EU 2020 targets. The findings are interpreted in order to answer the research questions and meet the research objectives. The structure of this chapter will relate the discussion to each of the research questions.

5.2. Renewable Energy Resources and The Barriers to their Development

Overall, across the five interviews, all the participants mentioned that the main renewable energy resources going forward into the future in Ireland are offshore and onshore wind, and solar PV for the electricity sector and EVs for the transport sector. The literature review had the same perspective (SEAI, 2017b). Other renewable resources that are going forward into the future mentioned by the majority of the participants and also in the literature review are biomass, hydropower, landfill gas, air-source heat pumps, and CHP, in terms of microgeneration (SEAI, 2017b). It is proved that Ireland has a great variety of renewable resources.

In the heat sector, it will also be district heating schemes and biofuels. The transport sector will also include natural gas, CNG, hybrid, and biofuels. In the literature review, complementing the participants’ responses, bio-energy, geothermal, renewable waste, and biogas will also contribute to the Irish gross final energy consumption and gross electricity generation (Scheer, 2018b) (Holland and Howley, 2016) (DCCAE, 2018b).

In relation to the barriers to the development of the resources mentioned above, the majority of the participants talked about the citizens’ engagement, innovation on the grid policy, technical reasons, planning infrastructure, incentives to the development and greater use of renewables, and the security of supply. All these barriers were also mentioned in the literature review (Eirgrid Group, 2015) (SEAI, 2017a).
Overall, the participants also added in relation to the barriers the government, such as the government tariffs and the carbon tax on fossil fuels, and also a very dispersed population. To overcome the barriers one of the participants mentioned that the amount of renewable penetration in the electricity sector must increase, therefore, the heat and transport sector will also be more renewable.

This research focused on the contribution of wind energy, bioenergy, and solar power, as well as the barriers to their development. In relation to wind energy and the future of this resource in Ireland, the literature review mentioned that wind power will continue to be the most important resource of renewable electricity (DCCAE, 2018c).

Nevertheless, the participants had a different opinion in this regard, it was stated that Ireland cannot rely on wind energy. The reasons involve the fact that wind is intermittent and very hard to manage. Technological issues, spaces of land available, planning and support scheme, cost, and grid development policy were also added as issues that must be improved for greater deployment of wind energy.

According to SEAI (2010), in the coming the decades, wind technologies will continue to advance. Based on that, as well as, investment in R&D and better interconnection to Europe, the participants believe that Ireland could rely on wind energy in the future.

In regard to the barriers to the development of wind energy in Ireland, the expansion and modernisation of the electricity grid, local opposition, wind turbine technology, cost efficiency and effectiveness, regulatory certainty, and predictable and transparent frameworks were mentioned by the majority of the participants and also in the literature review (DCCAE, 2018c) (International Energy Agency, 2015). It was also added in the literature review the construction of onshore wind farms and wind capacity. One of the participants spoke of the location and repowering the existing wind farms. As part of the solutions for these barriers, the participants mentioned the DS3 program, and in relation to the public objection, community ownership through the RESS.

Regarding bioenergy, the majority of the participants and the literature review mentioned that the main barriers to its deployment are the fact that bioenergy sites must be quite large to achieve economies of scale. Supports schemes for the production of bioenergy could support to overcome this barrier. Issues in the demand and supply sides and incentives for forestry and
waste energy plants were also mentioned (Sustainable Energy Authority of Ireland, 2017a) (DCCAE, 2014). The participants also talked about technological barriers and infrastructure.

According to SEAI (2015), the expansion of bioenergy depends on higher market prices, supports in the agriculture sector, policies innovation, job creation, and R&D. The participants spoke of government incentives for biogas, biomethane, CNG, hydrogen, and district heating. In the transport sector, the obligation of including 8% biofuel in the tank must be increased, and also the amount of imported biofuel must be reduced.

In relation to solar energy and the main barriers to increasing its deployment, the majority of the participants and the literature review mentioned the cost for solar PV, technical challenges, lower efficiency rates, and the lack of planning restrictions and development guidance. The potential of this sector can be unlocked through a planning guide for the community and business (Walsh, 2016) (Sustainable Energy Authority of Ireland, 2017b). Connection to the grid and low incentive tariff were also mentioned by the participants.

In relation to overcoming these barriers, both the interviewees and in the literature review was mentioned that Ireland has started to realise the importance and potential of solar energy for the renewable energy mix (Sustainable Energy Authority of Ireland, 2017a).

According to Sustainable Energy Authority of Ireland (2017a), improvements in solar technology, cost reductions, and Ireland’s strengths in the energy sector, have turned solar PV into a practicable option in Ireland. The participants agreed with this statement. Under the RESS and continued decreasing of the costs, solar will naturally become more prevalent in Ireland, also due to the increased demand for renewable electricity.

5.3. Greenhouse Gas Emissions Target

Regarding the main obstacles on meeting the 2020 EU targets that involve reducing greenhouse gas emissions by 20%, the participants mentioned that the agricultural sector remains the main contributor to emissions, followed by the transport, energy industries, and residential sector. The economic recession, when there was no funding available to invest in renewable energy, and infrastructure EVs were also mentioned. The same obstacles were mentioned in the literature review (Howley, 2016) (Environmental Protection Agency, 2017).

The participants mentioned that there is available funding now and the new RESS and the Renewable Heat Support Scheme, therefore, it is necessary to incentivize and to invest in
infrastructure also for CNG, to be inventive about how to address the release of the gases in the agriculture sector, and move to air-source heat pumps. The government needs to apply carbon tax, and improve the building stock and the obligation rate, in relation to biofuels.

It was also mentioned in the literature more efficient homes and businesses, and investment in public transport. Replacing fossil fuels with renewable energy is crucial for making progress towards decarbonisation (Llado, 2018).

According to Javelosa and Marquart (2017), Ireland will become the first country to remove investment on fossil fuels completely, due to a bill in the Irish Parliament that leads the country to stop from investing in fossil fuels, both in coal and oil. This bill was also mentioned by one of the participants. Ireland can rely on an energy system that does not depend on fossil fuels. There is a real possibility that Ireland could generate electricity based 100% on renewable energy (SEAI, 2017a) (O’Sullivan, 2018).

Nevertheless, the participants had a different point of view. Fossil fuel generation of some sort will be required in future power systems. It is going to be very slow to remove fossil fuels completely, considering Ireland does not have any other dispatchable sources of energy compared to other European countries. However, the participants stated that the ambition is real. If all renewable energy technologies are invested in and installed, by 2050, Ireland will have removed fossil fuels from the energy sector.

5.4. Energy Efficiency Target

In relation to the main reasons for Ireland not have enhanced its energy efficiency by 20%, the majority of the participants mentioned the financial crisis. There was no funding available to make all sectors more efficient. There are more funding available now, however, it is going to take time to improve Ireland’s energy efficiency in all sectors. This barrier was also mentioned in the literature review (SEAI, 2017b). In addition to the barriers, it was also mentioned the rate of uptake of EVs, and the heating and the lighting side of the residential sector, which must be economically favourable. Furthermore, the appetite is a key factor in the target being below potential performance. In other words, the Irish society must be informed about the potential gains and the supports available. The changes in all sector are crucial to achieving future energy efficiency targets.
The literature review added other reasons, such as challenges including the upgrade of homes and businesses, making savings from the transport sector, and also the lack of further development and expansion of new policy measures. In addition to the main barriers, the strong growth in the Irish economy pointed to an increase in energy demand. This situation makes the task of achieving energy efficiency targets even more challenging (SEAI, 2017b).

5.5. The electricity, heat and transport sectors

Regarding the challenges of integrating more renewable energy resources into the electricity sector, the majority of the participants and the literature review mentioned technological challenges, better interconnection with Europe, challenges in relation to planning and national wind energy guidelines, store capabilities, the use of a smart grid, and developing and getting the actual renewable electricity into the grid (SEAI, 2018b) (Scheer, Clancy and Gaffney, 2016).

Operating the electricity system safely and efficiently involve taking into consideration a number of complex demand and supply problems, such as security of supply (Eirgrid Group, 2015). Demand-side management was also mentioned by one of the participants. Furthermore, contributions from the heat and transport sectors and private investments (Scheer, Clancy and Gaffney, 2016) (SEAI, 2018b).

To overcome those issues the participants mentioned that there needs to be better distribution and transmission infrastructure, and upgraded the system. The world leading program DS3, mentioned by the participants and in the literature review, will support the necessary changes in the electricity sector (SEAI, 2018b).

In relation to the main required changes in the renewable transport sector, the majority of the participants and the literature review mentioned the electrification of the fleet and support to EVs (SEAI, 2017b). Among the other required changes mentioned by the participants are investments in both private and public transport, such as CNG, biogas, natural gas, biomethane, hybrid, and hydrogen. As well as better policies, infrastructure, upgrade the rail link and the original bus routes.

The biggest challenge mentioned by one of the participants is in the amount of biofuel that can be blended with fossil fuels in the tank, which was also mentioned in the literature review. Consumer choices over the transport mode were also added (SEAI, 2017b).
Regarding the heat sector, the main challenges for the use of more renewable resources in this sector mentioned by the participants and in the literature review are the deployment of renewables, with strong energy efficiency measures being implemented within the services sector, such as heat pumps, and the deployment of modern renewable heat supported by grants (SEAI, 2017b). Additional biomass and CHP installations were also mentioned in the literature review.

A gradual transition to electric heating was mentioned by more than one participant. Irish citizens rely on solid fuel or gas and it is expensive to change. It is hard for bioenergy to compete where gas is. District heating, reuse of excess heat from industry, tax incentives, and the new building regulation are also considered to be a challenge in this sector. One of the participants mentioned that to overcome these barriers the energy needs to be affordable for all of the population, not pricing anybody out of this market.

Challenges in relation to storage capabilities were mentioned in the literature review. The transition to renewable sources in Ireland depends on private and public investment in energy storage capabilities (Llado, 2018) (Berke, 2018). Across the interviews, lack of storage capabilities was also mentioned as a barrier. One of the participants talked about storage devices, which could support the secure operation of the power system, facilitate new connections on the grid, improve the reliability of supply, and contribute to wholesale electricity prices coming down. Adding to that, another participant mentioned that Ireland is developing policies to support more battery storage.

Lastly, it is important to mention in this section that the interviewees and the literature review agreed that Ireland will miss its targets. According to SEAI (2018a), the estimated achievement being between 12.7% and 13.9%. It is likely that Ireland will have to purchase statistical transfers from EU member states who have exceeded their 2020 targets. Consequently, future energy targets will be even more difficult and costly (Scheer, Clancy and Gaffney, 2016). The majority of the participants agreed that Ireland will have to pay heavy fines.

5.6. The Future of the Irish Renewable Energy Sector

It was discussed in the interviews what actions must be taken to overcome the barriers Ireland faces in meeting its EU 2020 targets and to avoid future shortfalls. The majority of the participants mentioned, and also the literature review, the deployment of energy efficiency, in businesses and homes, expansion of the existing policy, increased investments and penetration
of renewable energy technologies into the country, innovation on the grid, and deep decarbonisation of the energy sector in the renewable electricity sector, as well as in the transport sector, with EVs, and in the heat sector, specially in industrial and commercial sites (SEAI, 2017c) (SEAI, 2017b) (Muenchmeyer, 2018).

Furthermore, according to Ó Gallachóir (2017), the collaboration of businesses and communities must be incentivised, which was also mentioned by three participants (SEAI, 2017a). The climate goals in Ireland must be aligned to the nature of its economy (Scheer, 2018b). There is an urgent need for private and public investment in energy infrastructure, including energy storage and management systems (Llado, 2018). It was also added by the participants that Ireland needs to tackle agriculture, energy demand and data centres.

Although Ireland will miss the targets, the country has made progress until now. Ireland can learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets. The majority of the participants suggested that Ireland has to look at what other states are doing, such as implementing support schemes for renewable technologies. Norway is an example of the electrification of the transport sector. Networks within Europe and exchange of information was also mentioned.

The progress made so far in the deployment of energy efficiency and in the use of renewable energy technologies, created enterprise, economic, and environmental benefits for Ireland. (Scheer, Clancy and Gaffney, 2016). Ireland is turning into a more sustainable energy community (SEAI, 2018c). Homes are becoming more energy efficient, R&D in renewable energy is being supported, and communities and businesses are starting to be more engaged with the energy transformation (SEAI, 2017d). However, for future targets, continuous effort is needed.

According to Holland and Howley (2016), Ireland can be a worldwide example in the deployment of renewable energy technologies. Across all interviews conducted by the researcher, the participants agreed that Ireland is already a world leader in the renewable energy generation sector, with DS3 program, and it can also be in heat and transport sectors.

In relation to Ireland becoming a net exporter of energy, according to (SEAI, 2010), Ireland is likely to become one of the main exporters of renewable energy and technology into the European market. The majority of the participants believe that Ireland has the potential to become an exporter, however, it is necessary to improve the interconnection with Europe, make
sure that Ireland’s own electric grid network is resilient strong, and the importance of diversifying Ireland’s energy generation portfolio and decarbonising the energy sector.

In relation to the pitfalls of being fully dependent on renewable energy, according to Tanti (2018), the growth of this sector is set to accelerate, and it is essential to ensure this progress is going in the right direction. Regarding Ireland, the majority of the participants talked again about the necessity of a better interconnection with Europe, technical challenges, a diverse range of renewable supply, careful transition to renewables, and storage. The DS3 program was mentioned another time as being the supporter to exclude the pitfalls.

Lastly, it is important to discuss the main actions required to engage and empower communities and businesses to contribute to Ireland’s energy transformation. The majority of the participants, as well as the literature review, mentioned the new RESS. This scheme will incentivise communities’ ownership, community-led projects and community capacity building measures. It also has specific requirements for community involvement in renewable energy projects. In relation to business, energy and financial savings, and competitiveness were also mentioned (SEAI, 2018a) (SEAI, 2017b).
Chapter 6

6. Conclusions and Recommendations

6.1. Introduction

The research into the Irish renewable energy sector was undertaken due to the importance of the topic nowadays and the current Irish situation towards its energy targets. It is known through the primary and secondary data that Ireland will not meet its targets, however, there will be even more challenging aims to achieve in the future. Therefore, it is important to understand the barriers Ireland is facing now to make improvements and avoid future shortfalls and fines imposed by the EU. The literature review, combined with the interviews conducted, revealed the main barriers Ireland is facing and support the research to meet its research objectives, which will be shown in this chapter.

6.2. Research Objective 1

The main renewable energy resources in Ireland and the barriers to their development.

It is known that wind energy, solar PV and bioenergy can provide additional opportunities for Irish business and domestic consumers in the future, however, in this objective, the researcher aimed to search for other renewable resources going forward into the future, as well as, the barriers to their development.

Overall, the main renewable energy resources for the electricity sector will be offshore and onshore wind and solar PV, and for the transport sector, it will be EVs. Furthermore, considering Ireland has excellent renewable resources, there will also be a great contribution of other resources, such as biomass and biofuels, hydropower, landfill gas, air-source heat pumps, district heating schemes, CHP, natural gas, CNG, and biogas.

However, it is necessary incentives for the development of the resources mentioned above, as well as, innovation on the grid network and in the infrastructure. Technical issues, the security of supply, the government tariffs and the carbon tax on fossil fuels, are also barriers to the development of renewable resources.
In relation to wind energy, the renewable resource which has contributed the most over the years, the main barrier is local opposition, the amount of land available, as well as, repowering the existing wind farms. Technological issues regarding wind turbines and the expansion and modernisation of the electricity grid are also a huge problem faced by Ireland. The cost of this technology, and planning and support scheme have also been an issue.

Regarding bioenergy, the largest contributor to renewable energy heat, the main barrier blocking the investment in this resource is the fact that bioenergy sites require huge facilities and a lot of finances. Technological and infrastructure problems, issues in the demand and supply sides, and incentives for forestry and waste energy plants are among the major barriers to the deployment of bioenergy in Ireland.

In relation to solar energy, although Ireland does not seem to be located in a perfect geographical area for the deployment of this technology, with the decrease in prices and improvements in solar technology, the government, citizens and businesses have started to realise the potential of solar energy for the country. However, the cost is still one of the main barriers, along with technical challenges, such as connection to the grid, lower efficiency rates, and the lack of planning restrictions and development guidance.

### 6.3. Research Objective 2

**The possibility of Ireland becoming the first country to remove investment on fossil fuels completely and the main obstacles reducing greenhouse gas emissions by 20%**.

This objective sought to ascertain the main barriers faced by Ireland in meeting this target. The agricultural sector is the biggest emitter of GHG. It is a huge challenge to change how to release the gases in this sector. The transport is the second emitter. The lack of incentive and infrastructure for EVs are the main barrier in this sector. The residential sector, as well as, energy industries also contribute to GHG emissions.

The economic recession over the last decade is one of the main reasons for Ireland not meeting this target. There was no funding available to invest in the renewable energy sector. With more funding available now, there will be support schemes to invest in the transport sector, with more infrastructure for EVs and CNG, and for air-source heat pumps in the heating sector, making homes and businesses more efficient.
In relation to removing investment on fossil fuels completely, it is known that the ambition is real, however, this process is going to be very slow. All renewable energy technologies need to be invested and installed for Ireland stop using fossil fuel generation in power systems.

6.4. Research Objective 3

The challenges Ireland is facing to enhance its energy efficiency by 20%.

This objective looked at the main barriers in turning Ireland into a more efficient country. The financial crisis is also a barrier in this sector. Ireland missed few years in trying to make all sectors more efficient because there was no funding available. Although there is more money available now, it is going to take time to enhance the energy efficiency in Ireland. Among other challenges are the upgrade of homes and businesses, making the transport sector more efficient, and the lack of development in new policy measures. Furthermore, the strong growth in the Irish economy led to an increase in energy demand, making this task to improve energy efficiency even more challenging.

6.5. Research Objective 4

The barriers for the three sub-targets in the electricity, transport, and heat sectors.

In this objective, considering Ireland will miss its renewable energy targets, the researcher was seeking to ascertain the barriers to achieve the targets in the main sectors in the use of energy. In the electricity sector, the main reason is technological challenges, such as the use of a smart grid, getting more renewable electricity into the system, and distribution and transmission infrastructure. Another barrier is a better contribution from the heat and transport sectors, which also need to be more renewable, and private and public investments. The lack of interconnection with Europe is also a barrier, making the task to generate more renewable electricity even more difficult. The lack of planning and national guidelines and store capabilities also contributed to failing in the meeting the 40% target.

In relation to the transport sector, the main problem is the barriers in the electrification of the fleet and support to EVs. Lack of investments in both private and public transport, and also in the infrastructure, such as upgrading the rail link and the original bus routes, as well as the shortage of better policies and the amount of biofuel that can be blended with fossil fuels in the
tank are the major reasons for missing 10% target. Consumer choices over the transport mode also make the transition to renewables in the transport sector more challenging.

Regarding the heat sector, the main reasons for missing the 12% target are the obstacles in the deployment of renewables in this sector, such as heat pumps, biomass, CHP installations, district heating, and reuse of excess heat from industry, as well as in the deployment of modern grants, tax incentives, and the new building regulation. Another major reason is the fact that the Irish citizens heavily rely on solid fuel or gas and it is expensive to change to a renewable heat source.

6.6. Research Objective 5

The main actions to overcome the challenges Ireland faces in reaching its EU targets and the future of the Irish renewable energy sector.

Ireland is already a worldwide example in the use of renewable resources in the electricity sector, and it can also be in the heat and transport sectors. This objective looked at how Ireland can become a world leader in the renewable sector, avoiding future shortfalls when attempting to reach energy targets. Firstly, the climate goals in Ireland must be aligned with the nature of its economy. Secondly, the deployment of energy efficiency, in businesses and homes, must improve, as well as, the energy infrastructure, including energy storage, management systems, and the grid network. In relation to the existing policy, an expansion is needed to allow a higher penetration of renewable energy technologies into the country. The decarbonisation of the transport sector, with EVs, and of the heat sector, must accelerate. The collaboration of businesses and communities must be incentivised, through energy and financial savings, and communities’ ownership.

Furthermore, in order to become a net exporter of energy, Ireland needs to improve the interconnection with Europe, so it can export and import energy whenever it is necessary. However, it is primordial to have a strong grid network and storage capabilities, and a diverse range of renewable supply.

Ireland can learn from its own progress and apply the achievements made towards 2020 in future targets. Exchanging of information with other EU members can be helpful when implementing new measures in all sectors. Overall, if Ireland implements these actions, and also with the DS3 program, there is no harm to fully rely on renewable resources.
6.7. Conclusions

Overall, Ireland is going in the right direction in the transition to renewable energy. The ambition to decarbonise the country completely is real. Not only the government, but the society and businesses are becoming more engaged in the process. Even though Ireland will miss its EU 2020 targets, considerable progress has been made in relation to GHG emissions, energy efficiency, and in the electricity, heat and transport sectors. This progress will support Ireland when attempting to achieve future targets, and also the improvements over the barriers mentioned above in this chapter.

In relation to increasing energy efficiency, homes all over the country are becoming more sustainable. Ireland has also been decreasing GHG emissions and increasing the use of renewables in all sectors. However, for future targets, continuous effort is needed. The barriers mentioned in this chapter must be overcome, especially because future targets will be even more challenge to achieve.

6.8. Recommendations

The focus of this dissertation was the barriers faced by Ireland in relation to its EU 2020 targets. After a careful analysis of the primary and secondary data, it is known that Ireland needs to create better incentives for the development of renewable resources in all sectors. The amount of renewable penetration in the electricity, heat and transport sectors must increase. Innovation on the grid network and in the infrastructure, as well as, technological advancements, the security of supply, storage capabilities, and getting a better interconnection to Europe is primordial for the deployment of renewable resources and secure operation of the power system, which would facilitate new connections.

Furthermore, the government tariffs, the carbon tax on fossil fuels, and the government incentives must be revised for a better accomplishment of the targets. R&D must be invested in and through the DS3 program, with better distribution and transmission infrastructure, solutions will be created to overcome the barriers mentioned in this research.

Overall, the construction of more wind farms, onshore and offshore, must be accelerated. Public objection is one of the main barriers and with transparent frameworks, under the new RESS, this could be mitigated. In addition, there are needs for supports in the agriculture, heat and transport sectors. The use of biogas, biomethane, CNG, hydrogen, and district heating must
be incentivised. The amount of biofuel allowed in the tank must be increased, therefore Ireland could reduce its dependence on imported biofuels. Investment in public transport and Evs and a gradual transition to electric heating are urgent.

Through a planning guide for the community and business and Ireland’s strengths in the energy sector, the potential of the solar sector could be unlocked and solar energy would play a major part in the renewable energy mix. Investments in upgrading energy efficiency in all sectors are also needed.

Due to the nature of this research and a limited number of participants, a final recommendation would be that further studies should be undertaken to expand the knowledge over the barriers in the Irish renewable energy sector. Therefore, Ireland could improve and meet future energy targets.
Reflections

Introduction

My interest in renewable energy has its roots in my undergraduate studies in Energy Engineering. In Brazil, during my time in college, I worked with solar energy projects and Research & Development. As soon as I graduated, I moved to Dublin to study English and before going back to Brazil I thought about doing an MBA to enhance the career opportunities in Brazil, or in Ireland, within the renewable energy sector.

Before I choose the topic of my dissertation, I had no idea how big Ireland's potential in the renewable energy sector was. Firstly, I decided to search for something related to my background. However, when I was reading about the process Ireland was going through in the transition to a decarbonised society, I was surprised, and I had no doubt that was going to be my dissertation topic. I am very happy about my research topic because it gave me the opportunity to be connected again to a topic that I am really interested in.

Learning Style

According to McLeod (2017), “Learning is the process whereby knowledge is created through the transformation of experience”. The Experiential Learning Cycle, figure 27, affirms that a person has effective learning when following the four stages of the cycle. This process involves having a concrete experience, followed by reflecting on that experience. Furthermore, concluding and learning from the experience, and finally, planning and trying what you have learned during the experimentation process. I do believe I experienced all the four stages of this cycle during the whole process of this MBA. The experience I had was unique, from reading, writing and referencing. I have never experienced something like this in my academic life.
From the Learning Cycle it is possible to determine the learner’s learning style. There are four styles: diverging, assimilating, and converging, accommodating, as shown in figure 28. According to McLeod (2017), various factors influence a person's learning style, such as social environment and educational experiences.
Diverging learners are people who are sensitive and able to look at things from different viewpoints. Considering I am interested in people, imaginative, and I prefer “to watch rather than do” and to work in groups, I believe this learning style is the most suitable for myself. I work better in situations that require ideas-generation.

Personal Learning and Insight

The whole process of this MBA was a valuable experience. I had never done anything similar in my academic life. I have never thought I would be able to do a Masters in English, far from home. However, for me, the best experience I will get from this process is that I am capable of everything I dream of. It was really difficult, from the beginning to the end. Now when I look back I realise how enriching this course was to me, everything I have learned, people I have met, not only to my personal life but also to my future as an Energy engineer.

In terms of the dissertation process itself, it was very time-consuming and really intense. My supervisor, Owen O’Reilly, guided me through the entire process. He helped me to narrow down the research question, which was even broader in the beginning. From the moment I chose my research topic, I was sure I wanted to get in contact with professionals who work in the renewable energy sector in Ireland, especially because it can help in the future when I will be looking for a job.

When I was constructing the semi-structured interview guide, I wanted to reach all the questions I had in relation to barriers Ireland is facing when attempting to achieve its renewable energy targets. The interview guide was broad and I just could not simplify it, considering all the questions I wanted to answer. I thought it would be impossible to get professionals to talk to me, considering they were busy during Christmas time. As my supervisor would say in relation to the number of participants: “the more, the better”. However, unfortunately, I could not get more professional to talk to me.

Nevertheless, I could not be happier about the participants who helped to answer my questions. They were all extremely helpful and friendly. They provided very valuable comments, even more than I was expecting, and it brought me close to a topic I had missed to study about. I had no idea about the amount of data I would collect, therefore, it was very difficult to analyse it and there was a moment when I thought I would not be able to finish my dissertation.
I spent days in the library, worried about my lack of time, considering I had to manage to work at the same time. I am very grateful I could count on my colleagues, my friends and my family to get through this entire process. I still have the feeling that I could have written and read more about the research topic. But I submitted this dissertation knowing I did my best in every second. I will bring with me, for all my life, all the acquired learning, everyone I have met, and all the experience during the whole process of this MBA.
Bibliography


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Appendix 1. - Glossary

AD - Anaerobic Digestion;
CEO - Chief Executive Officer;
CHP - Combined Heat and Power;
CNG - Compressed Natural Gas;
CO2 - Carbon Dioxide;
CRU - Commission for Regulation of Utilities;
CSR - Corporate Social Responsibility;
DAA - Dublin Airport Authority;
DART - Dublin Area Rapid Transit;
DBS – Dublin Business School;
DCCAE – Department of Communications, Climate Action & Environment;
DS3 - Delivering a Secure Sustainable Electricity System;
DSU - Demand Side Unit;
DTTAS - Department of Transport, Tourism And Sport;
EBS - Electricity Supply Board;
EPA - Environmental Protection Agency;
ETS – Emissions Trading System;
EU – European Union;
EVs - Electric Vehicles;
FEGP - Fixed Electrical Ground Power;
FDI - Foreign Direct Investment;
GDP - Gross Domestic Product;
GHG – Greenhouse Gas;
GW – Gigawatt;
HVO - Hydrogenated Vegetable Oil;
Hz – Hertz;
IBEC - Irish Business and Employers Confederation;
ICAO - International Civil Aviation Organization;
IEA - International Energy Agency;
ISO - International Organization for Standardization;
kW – Kilowatt;
LED - Light-emitting Diode;
LPG - Liquefied Petroleum Gas;
MBA – Master of Business Administration;
Mt - Million tonnes;
MW – Megawatt;
MWp - Mega Watt peak;
Non-ETS - Non-emissions Trading;
OECD - Organisation for Economic Cooperation and Development;
PR - Public Relations;
PSO - Public Service Obligation;
R&D – Research and Development;
REFIT - The Renewable Energy Feed-In Tariff;
RESS - Renewable Electricity Support Scheme;
RHI - Renewable Heat Incentive;
RPS - Renewable Portfolio Standard;
SEAI - Sustainable Energy Authority of Ireland;
SEC - Sustainable Energy Communities;
SNSP - System non-synchronous Penetration;
Solar PV – Photovoltaics;
SRSC - Rapid Suction Pumps;
SSRH - Support Scheme Renewable Heat;
TII - Transport Infrastructure Ireland;
TSO - Electricity Transmission System Operator;
UK – United Kingdom;
US - The United States of America;
VRE - Variable Renewable Energy.
Appendix 2. – The DS3 Program

According to Eirgrid Group (2015a), in response to the European 2020 targets, EirGrid Group began a programme called “Delivering a Secure, Sustainable Electricity System” (DS3). This program aims to increase the amount of renewable energy on the Irish grid system in a secure and safe manner. So far the DS3 programme has increased the levels of renewable generation on the Irish energy system from 50% to 65%, and it aims to reach 75% over the coming years.

The DS3 programme is built on three pillars: System Performance, System Policies, and System Tools. Across these three pillars, Eirgrid is reviewing tools, incentives, policies, and standards to increase the levels of renewables in the Irish electricity industry. The DS3 programme is a World leader in operating the system securely and efficiently (Eirgrid Group, 2015a).
Appendix 3. - Invitation to Participate E-Mail

Dear _______,

Date _______

Request for Permission to Conduct Research

My name is Beatriz Fernandes. I am currently undertaking the final stage of a master degree in Business Administration in Dublin Business School. I would be grateful if I have your support and permission in relation to my research.

My dissertation is entitled "What are the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources?"

The data collection methods will include:

- Audio recording;
- Interview sessions;
- Email interview

I am contacting professionals in the Irish energy sector, like yourself, to assist with my research. I would like to invite you to participate in an interview, as part of my research to valid my dissertation.

The primary data will be collected through a semi-structured interview. There is a list of key questions to be covered, however, in order to give flow to the conversation, the interview can be expanded based on the answers you will provide. It is expected the interview will last no more than an hour.

I assure you all information provided will be confidential, no personal information will be used. All data collected will be restricted to the research and securely store.

I would be most grateful if you could take your time to meet me in person, at a time and venue that would be suitable for you, or to answer my questions by email if you feel you can contribute to my research.
If you need or would like any further information regarding my research project before agreeing to participate, please don't hesitate to contact me.

Yours sincerely,

Beatriz Fernandes
Appendix 4. - Information Sheet for Participants

Research Title

The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland to meet its target and researching the main barriers to achieving this target is the aim of this research.

My name is Beatriz Fernandes. I have a degree in Energy Engineering from PUC de Minas Gerais in Belo Horizonte, Brazil, and I am currently undertaking the final stages of a Masters in Business Administration in Dublin Business School. You are invited to assist with my research and to participate in an interview, which is required in order to fulfill the academic requirements of the MBA.

I am working under the guidance of my Supervisor, Owen O’Reilly and I have obtained ethical approval to undertake this research.

What will happen

The primary data will be collected through a semi-structured interview with professionals in the Irish energy sector. There is a list of key questions to be covered, however, in order to give flow to the conversation, the interview can be expanded based on the answers you will provide.

The data collection methods will include audio recording, interview sessions or email interview. All information provided will be confidential, and no personal information will be used in the dissertation. All data collected will be restricted to the research and securely stored on private storage using secure passwords.

Time Commitment
It is expected that no interview will last longer than 1 hour.

**Participants’ Rights**

You have the right to stop being a part of this research at any time without prior explanation. During the interview, you may omit or refuse to answer any question asked. Any or all data you provide can be withdrawn from this dissertation and/or destroyed prior to submission if you so require.

A summary will be available after the dissertation is completed. If you have any questions regarding this information sheet, you may ask the researcher before starting the data collection.

**Confidentiality/Anonymity**

In order to properly transcript the interview and analyse the findings, basic details about your experience in the Irish energy sector will be required. The data collection will not require any more personal information, other than a basic amount necessary to file and retrieve the transcripts. Each participant will be assigned a code, the details of which are available only to me. All data collected will be available and evaluated only by me.

The data collected will be maintained in order to prepare and conclude this dissertation. Once the final grade is presented, all information provided by the energy experts will be deleted.

**For Further Information**

I would be glad to answer your questions about this research at any time. You may contact me at 10380586@mydbs.ie
Appendix 5. - Informed Consent Form

Research Title

The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Project Summary

Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable energy resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland meet to its target and researching the main barriers to achieving this target is the aim of this research.

By signing this informed consent form, you are agreeing that:
(1) You have received and read the Participant Information Sheet;
(2) Any questions you might have asked about your participation in this research have been properly answered;
(3) You were informed that all data you provide during the interview will be confidential and available only to the student undertaking this dissertation;
(4) You are participating in this research voluntarily;
(5) You are aware of any risks (if any) involved in participating in this dissertation.

____________________________________  ________________________
Participant’s signature                  Participant’s Name

____________________________________  _____________________________________
Student’s signature                     Student Name

____________________________________
Date
Appendix 6. - Semi Structured Interview Guide

Introduction

1. You are currently working at (Organization), could you give a short summary of your experience in the Irish energy sector?

2. Could you tell me how (name of the organization) is committed to the development of renewable energy in Ireland?

Renewable Resources in Ireland

3. Which renewable resources do you believe will be the main contributors to the Irish electricity, heat and transport sectors going forward into the future? What do you consider to be the main barriers to their development?

4. Considering Ireland has excellent wind resources, do you believe the country can rely on its continuous growth?

5. In your opinion, what are the main challenges faced by Ireland to succeed in the deployment of wind energy technologies? How do you feel that these challenges can be overcome?

6. With regard to the heat and transport sectors, what actions would you consider necessary for the further expansion of bioenergy in Ireland for these sectors? What are the barriers to its expansion, and how can they be overcome?

7. Ireland has a small but growing solar PV deployment industry. In your opinion, what are the main barriers to increasing Ireland's solar PV deployment?

8. Do you believe improvements in solar technology, combined with Irish strengths in the renewable energy sector, can turn solar PV into a more practicable option in Ireland?
Greenhouse Gas Emissions

9. What are the main obstacles you feel are preventing Ireland from meeting its target to reduce greenhouse gas emissions by 20%, according to its EU targets? What actions do you believe can be taken to help overcome these obstacles?

10. How likely is Ireland to remove investment in fossil fuels completely? If you believe this likely, in what timeline could you see this happening?

The EU Renewable Energy Directive barriers

11. In your opinion, what are the main reasons for Ireland failing to improve its energy efficiency at the desired rate in the residential, commercial and industrial sectors?

12. What are the main challenges to integrating more renewable energy resources into the electricity sector safely and efficiently?

13. In your opinion, what would be the main required changes in the renewable transport sector in Ireland so it could stop relying on imported fossil fuels?

14. What do you believe to be the main challenges for the use of more renewable resources in the Irish renewable heat sector?

15. Do you consider energy storage capabilities to be a barrier to the development of clean technologies in Ireland?

16. Do you believe it is an inevitability that Ireland will fail to meet its 2020 targets? Is it likely that Ireland will have to purchase energy credits to avoid heavy fines?

The future of the renewable energy sector in Ireland

17. What do you believe can be done to overcome the barriers Ireland faces in meeting its EU 2020 targets?
18. What can Ireland learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets? What can be done to avoid shortfalls when attempting to meet targets in the future?

19. How likely is it that Ireland will become a world leader in the use of renewable energy resources, and eventually, a net exporter of energy?

20. Do you feel there are potential pitfalls to becoming highly dependent on renewable energy resources, and if so, what are those potential pitfalls?

21. In your opinion, what are the main actions required to engage and empower communities and businesses to contribute to Ireland's energy transformation?

Closing

22. Is there anything else you would like to share?

23. Do you have any questions for me?
Appendix 7. - Interview Transcript No 1 of 5.

Mr. Sutton, you are currently working as chairman in the Energy & Environment Division at Engineers Ireland, could you give a short summary of your experience in the Irish energy sector?

That is a volunteer role, I would do that once every couple of weeks with that organization. Here in Grant Thornton, this is where I actually get paid from, if that makes sense. I am originally an engineer and now chartered engineer. And I studied Environmental Engineering in Galway, back until 2010. Then basically I worked as an engineer with RPS Consulting at a consulting engineering company, my role with them was to work on natural gas power plants, wind farms, 55MW wind farm, and solar, but it was more planning commission, then bio-energy plants. It was a broad spectrum with them. From there, I moved to London. In London, I moved to business consulting, although I am an engineer in the background, in London, basically, I ended up in a business transformation program with Sellafield, a large nuclear company in Cumbria in the UK, so I did work for them and for Airbus, which has nothing to do with energy, but it was interesting. Then I came back to Ireland, roughly three years, four years now, and I am working with Grant Thornton and with Engineers Ireland. I was on the committee of Engineers Ireland when I came back. With Grant Thornton, I work with Eirgrid, Ervia, Gas Networks Ireland and Bord na Mona. We have done work from the analysis of the solid field market to analysis of how they connect wind farms and how people apply to connect to the electricity grid. It has been again a broad spectrum and at the moment I am doing a lot of work with Gas Networks Ireland but all business related work, and some wind farms and electricity connection. That is all connected with Grant Thornton. Then with the committee, I have worked there for three years, chairperson since May this year, and we do events in a large variety, but generally all in renewable energy, electricity, and climate change space. That is it in relation to question one, I hope that helps.

Of course it does, thank you. Could you tell me how Engineers Ireland is committed to the development of renewable energy in Ireland?

Engineers Ireland is a non-profitable organization. Their role is to act as a membership organization on behalf of its members. So we would train members, we would run events. We actually have an event tomorrow, we are bringing our members into a control centre, so they
can understand how the electricity grid is controlled in Ireland. We do a lot of continuous professional development events. We would do events where we would bring a guest, just like you, an MBA student, we would bring somebody in and they would discuss the issues with increased renewable penetration, or they can discuss the issues with the community acceptance of wind farms because some communities really do not like wind farms. That is what Engineers Ireland do, that is more about promoting because we are very much aligned in addressing the climate change issue and so on. We would support the department with policy-making and responding to consultation, that kind of thing. Does that help?

Of course, thank you. Now, in relation to renewable resources in Ireland, the renewable energy industry in Ireland is at an important moment and according to the Department of Communications Climate Action & Environment, wind, bio-energy, and solar energy could yield additional opportunities for Irish business and domestic consumers. That is why I am trying to focus on these three resources. Which renewable resources do you believe will be the main contributors to the Irish electricity, heat and transport sectors going forward into the future? What do you consider to be the main barriers to their development?

There are three things and they are very different. In order to make heat and transport more renewable, you need to actually move them into electricity, for example, to electrify cars, your electricity has to be renewable as well. So the first thing we need to do is make the electricity more renewable, increase renewable penetration in electricity. That is the first thing we need to do. I think wind farms onshore will continue in Ireland but at a slow pace, there are a couple of barriers. Because the more wind farms are built, the harder it is to find new land for them, so there will be a large area, like the bogs in Ireland. I do not know if you understand the bogs? Basically, they used to harvest the ground, they are like old forests, then they put that into power plants and burnt it. Really, really, not efficient. So those large areas would be great for wind farms. But that is it. Now there is too much opposition to wind farms, people do not like how they look like, I particularly like them. So that will not continue. What will happen is, solar will grow massive, it has not actually started in Ireland, but solar will be a huge part of electricity. Bio-energy, probably will not be, because you need huge facilities and a lot of finances, getting a small return. So bio-energy will play a certain part, but will not play a large part, ok? So that is it for electricity. In heat then, domestically, it should be relatively easy to get more renewable, for example, on your
roof you can have solar, then you can have air-source heat pumps. Do you understand those? They are going to be huge for domestics. Then, commercially, it will stay on gas, that is probably where it is going to stay. But they need to move heat towards electricity, that is how heat would be more renewable. In terms of transport, that will be very much about the electrification of the fleet. A certain small percentage will be gasifying, putting gas into trucks, not petrol, but actually natural gas. What we can do is trying to get renewable natural gas from anaerobic digestion, but again, when you look at the size of the fleet, it would be a very small percentage. In summary, wind will play a part, but it is gonna be more difficult to do it, more difficult to get finance for wind. Solar, we have not started in Ireland, so the opportunity is huge there. Offshore wind will be big, and I think when you fly from Dublin to London, when you look down there will be a big rise in offshore wind. We have not actually started that, but it will be big. So that will be the main ones. Does that help?

Of course, you are helping me a lot with your answers. In relation to wind energy, presently, wind energy is the biggest contributor of renewable energy in Ireland and also the cheapest. I believe you have answered this question on the previous question, but considering Ireland has excellent wind resources, do you believe the country can rely on its continuous growth?

Offshore yes, but then there is a problem, one thing I did not mention. If we can image a pie chart, the largest is the percentage of wind, the harder it is to manage on the network. Because wind is what we call intermittent, ok? It means, it is only windy 33% of the time and then it can start up and stop relatively quickly. So it is very hard to manage. Because electricity in a network needs constant power. If wind stops and there is too much demand, the network will crash. So there are two major issues. One is getting acceptance and finance for wind, the best way to do that, really, is going offshore. Because onshore is gonna be tough unless you have the land and large spaces of land. The other one is technologically, we are going to need to be better at managing wind batteries, we have to invest heavily in Research & Development in order to be able to get more percentage of wind into our system.

Ok, thank you. In the last few years, Ireland has made a meaningful improvement in expanding wind energy projects. Nevertheless, with all this potential, Ireland will still miss the renewable energy targets. In your opinion, what are the main challenges faced by Ireland to succeed in the deployment of wind energy technologies? How do you feel that these challenges can be overcome?
So today, a thing called nimbyism is a big one, which means "Not In My Back Yard". So there has been the main blocker because local opposition also locks financing. So a bank will not want to give a wind farm money as easily, because the risk is very high that they will not get planning commission. So I think a couple of things have been blockers, so financing, getting financing is though and one of the main reasons is because of the risk of not getting planning commission because the locals do not like it. The second one is connection, it has been quite hard to get grid connection in Ireland. Our network has always been supplied by gas, and by power plants, so you cannot just build another power plant otherwise we are going to have way too much electricity and we will be paying for it and we do not actually need it. I suppose, it is taking time for them to release grid capacity and that will continue to happen, but I do not think that is the main reason behind it. I think the main reason why wind has not taken off is opposition, if we could build wind farms in the docks in Dublin, we would, no problem, you see that in other countries, you do not see that here, because people are afraid there will be objections. Does it make sense?

It makes sense in general, but as an Energy engineer, it does not make sense to me. Anyways, in relation to bio-energy, it is the largest contributor to Irish renewable energy through heat generation and it is expected to continue to play an important role in replacing fossil fuels, especially in the larger heat users, such as the industrial and commercial sector. With regard to the heat and transport sectors, what actions would you consider necessary for the further expansion of bioenergy in Ireland for these sectors? What are the barriers to its expansion, and how can they be overcome?

So, bio-energy, included in that are trees and wood chip. And in two of our large power plants, they use a lot of wood chip in that. I do not necessarily call it clean energy, but it is. So I think that will continue, actually, I do not know if that will continue. Because it is renewable but it is not clean. So will bio-energy play a part? I think it will until about 2030, maybe earlier. We will still burn it, and we will burn it at home, so I think it will play a part in terms of domestic. Because people will have in their fires, they will have wood chip boilers. And I think people will stop burning coal, they will have to stop. But I think electrification will be the big thing for heat, not wood. People will move to air sources heat pumps, rather than putting wood in the stove. Is that ok? One other thing I did not mention on the wind, I think the cost of offshore wind has been extremely coming down a lot. So I think one of the blockers is that it has been very expensive to build in the Irish Sea wind farms, but that has dropped massively in the last
number of years. I do not have the figures. But if you look in the UK, the cost of offshore wind, actually the cost of solar has dropped. Eventually, it will be cheaper than fossil fuels.

Well... let’s hope for it. And about solar energy, Ireland has a small but growing solar PV deployment industry. In your opinion, what are the main barriers to increasing Ireland's solar PV deployment?

Up to recently, very recently, there has not been a grant for solar. So that is likely to change and it has changed. There is a new grant scheme that will include solar, so I think that will play a big part in Ireland. What are the barriers? I think there will be less opposition to solar, but there will be, believe or not. Connection, again, as we increase our renewable penetration, solar, wind, they are still very intermittent, solar not so much, but they are. So, again, that presents challenges. That is why I think solar will be a big part, I do not see as many barriers as I do to onshore wind.

Ok, thank you. And do you believe improvements in solar technology, combined with Irish strengths in the renewable energy sector, can turn solar PV into a more practicable option in Ireland?

Absolutely, yes. And especially, you can co-locate wind farm with a solar plant. I am not going into details, but you can go above the capacity that you are allowed to go for. I think you can go to 120%, something like that. So that means, you already have the land, you have the planning commission effectively, you have the hard part done with wind. So I think solar will play a part. What else can I add to that? Yes, solar PV. I think Ireland, we have everything that is required for solar, it is about people getting the financing now and get on with that.

In relation to greenhouse gas emissions, Ireland is on the right path to achieve its commitment according to the Kyoto Protocol. However, it will miss the EU targets. What are the main obstacles you feel are preventing Ireland from meeting its target to reduce greenhouse gas emissions by 20%, according to its EU targets? What actions do you believe can be taken to help overcome these obstacles?

I think we have done very well with electricity, in heat and transport we are not. So in transport, I think we need to incentivize people to have electric cars. And that does not need to be money. Actually, there is already a kind of money incentives to have an electric car. But if you look at London, you do not pay tolls, you do not pay a congestion charge, you get free parking in certain areas, you can use bus lanes and so on. So, if we are really going to move people towards
electric cars, we need to incentivize than to use electric cars and vehicles. That is something I think we need to do in transport, and we have not gone near. Agriculture is a huge one, it is a huge percentage of our greenhouse gas emissions. So we really need to look at that. And I do not know what we will do, because I do not think we are going to reduce our herd size, the number of cows and sheep we have. But we need to be inventive about how we address that.

That is more about preventing the release of the gases. In the heat sector, I think it will come along way very quickly, we need to use air-source heat pumps, and we will move to that. So why have not we reached our European targets? I would put it down to transport, agriculture, and heat. In electricity, we have done well. The way the target breaks down, I think we need to hit 15% or 16% in electricity and we will not be far from that. And because we have not hit heat and transport, electricity has not made it up, which is not going to happen. So the main reasons are, anyways, transport and heat. We still very rely on diesel and petrol.

**Ok, thank you. Ireland is part of the global green movement and will become the first country to remove investment on fossil fuels completely. How likely is Ireland to remove investment in fossil fuels completely? If you believe this likely, in what timeline could you see this happening?**

It is likely enough. At the moment there is a bill in the Parliament to ban anybody drilling offshore of Ireland. And that bill has been brought by the opposition. But because of the other parties, they have the majority, there is the potential that bill will get through. So people, companies, will not be able to drill for oil and gas of the Irish coast. So that will stop a lot of investment. It is not necessarily a good thing, because we do need gas, we are going to need gas for the future. So we need to be sustainable, we do not necessarily need to be completely renewable just yet. And how likely are we going to stop investments in fossil fuels? Very likely and that is one reason. The second one is that we used to use peat. And that is one reason. The second one is that we used to use peat. And we will stop, we have committed to stop that by 2030. Investment in that is gone and that is declining. And then coal, it is dirty fuel, however, coal gives you security. I cannot remember, but I think we have three weeks of coal stored in our coal power station in Moneypoint. I do not think we can get rid of that any time soon. But we will not make any more investments in coal. I think by 2025 there will be no more fossil fuels investments, with the exception of natural gas. And even with that, there will be far less than the investments in renewables.
Thank you. In relation to the barriers, in your opinion, what the main reasons for Ireland failing to improve its energy efficiency at the desired rate in the residential, commercial and industrial sectors?

To be honest, I think the financial crisis has a lot to pay because we missed out in about five years of making things more efficient generally. So, some people did upgrade their homes and businesses, but very few. We just did not have the money to incentivise it. Now you can see with the SEAI they are looking at deep retrofit scheme, which is basically making old homes more efficient, they are going to look at that. There are far more financing and funding available to be able to make things, like commercial, old residential and industrial more efficient. So I think, on that one, everybody accepts it, the community has accepted it, everyone looks at it and says "it makes sense". It is going to take time because things like this one are very, very efficient but for older buildings, there are going either need to be incentivised or they are going to need to rebuild a new building in order for them to actually want to invest the capital to make buildings more efficient. And that is it. Nobody wants to do it unless they are told it or actually paid to do it. And it will take time.

That is interesting, thank you. And what are the main challenges to integrating more renewable energy resources into the electricity sector safely and efficiently?

Technological challenges are the main ones. This will not be the only solution but we need to be more interconnected with Europe, so we can export power and import power when we need it. That will help. We need to store more energy, that will be a challenge, so we need electric vehicles to be able to do that, we need to have way more technologies to be able to do that. We need to have demand side management. I do not know if you understand that, but basically, if the wind drops, so does the power we can use, so they turn down what we can use, in a nice way, so they manage the demand. So they are all technological things that will need to happen and we are doing them. There is a lot of research, there is a lot of investments, there are a lot of projects ongoing. So it is a really exciting space, the CEO of Eirgrid said he wants to have 100% renewable grid and in order to do that, there will be massive challenges.

That is really exciting indeed, thank you. In your opinion, what would be the main required changes in the renewable transport sector in Ireland so it could stop relying on imported fossil fuels?
Biogas industry would be one and then electrification. You need policies, like allowing people to drive in bus lanes, both of those things.

Great, thank you for your opinion. And what do you believe to be the main challenges for the use of more renewable resources in the Irish renewable heat sector?

One of the things I did not mention is that as more efficient buildings are built, it will make investment in renewable in those buildings, afterwards, harder, right? Because this building will have a very low heat requirement, so, therefore, in order for, I do not know if you understand the concept of district heating, but it is basically where you have one, in this case, the incinerator, the waste energy plant that will heat all of the water for all the other buildings around, it is like a network for hot water and cooling, you can use that water to cool. Unfortunately, what is going to happen now, it is a really good technology, it is a really good idea. But because all the new modern buildings are going to have less heat requirement, it does not make sense as much as it used to, to build a massive network of district heating. So that is one issue. But on the positive side, we can start using roof space, we can make things way more efficient. So that will happen too.

Thank you, I liked the idea of district heating, it is interesting. Do you consider energy storage capabilities to be a barrier to the development of clean technologies in Ireland?

In the world, absolutely. I think for the Tesla battery, one of the materials they need for that, the only place they can get is at an opened quarry in Bolivia, I would not called a quarry, they scripted of, it is like a lake or something, I cannot remember. But that technology is going to need to come a long way. Even if they did not have that material, did not need that material, the size of the batteries that would be required to power the grid in Ireland would be extreme. That is the grid, technology has a long way to come, to have a completely renewable grid. But then in cars, technology is coming a long way, so that is storage as well really, basically, you can hook a car up into the network and that will become a battery. There is a long way to go with storage, which is a good thing, I think. It is an exciting thing, it is the next big thing.

Thank you for sharing your opinion on that. Do you believe it is an inevitability that Ireland will fail to meet its 2020 targets? Is it likely that Ireland will have to purchase energy credits to avoid heavy fines?

Absolutely, we have already missed our 2020 targets, maybe not in electricity but in heat and transport we have missed them. In heat there is a sustainable scheme for renewable heat which
is a renewable heat incentive, which should have been launched originally, I think, in 2016 and still have not been launched, so I think that is an inevitability, it is gone. Do I think we have to pay fines? I think we will roll over the targets, we will have the 2030 targets. Or potentially we will have to ring-fence money, instead of paying a fine, we will invest this in renewables. If not, yes, we will have to buy credits in order to avoid fines. But that is going to be a political thing that is set with the EU at the moment, they have quite enough about it. So we will see what happens. They want us to do our best until we get to the end. But yes, we will miss them.

**Thank you, Mr. Sutton. I will keep updated to see what happens. And what do you believe can be done to overcome the barriers Ireland faces in meeting its EU 2020 targets?**

To be honest, I think we have missed them. If I had all the money and power tomorrow, I would make renewable cars, electric cars tax-free, they are kind of close to that at the moment. I would like to take that off them and make them very cheap. Even at the moment, you need five thousand to buy one. Anyway, in transport I would, policy-wise, I would open all the roads so you would have bus lanes for electric cars, free parking in certain places, just incentivise it. That would be all policy towards transport. And then in heat, it is investment. If someone has a perfect working air conditioning or heat system, they are not going to change it, until it breaks down. So, the only reason they would change it, if they can save money out of it. So we need to incentivise people to save money. That is why the sustainable scheme for renewable heat is coming, but that needs to come really quickly.

**Ok, thank you. What can Ireland learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets? What can be done to avoid shortfalls when attempting to meet targets in the future?**

We need to build acceptance community. We need to have new planning regulations and guidelines. Yes, we do. We need to be very careful about data centers, because data centers will increase demand, and if they do that we have to increase the amount of renewables that we are building in order to power them. So, all of those things, basically.

**Thank you. How likely is it that Ireland will become a world leader in the use of renewable energy resources, and eventually, a net exporter of energy?**

I think it is extremely likely. We already have in electricity a very high percentage of renewable penetration. We already have other countries visiting our network operators, to see how we do it. We are leaders and we are going to continue to be. And, I think a net exporter, yes, we have
the resources to do it, it is the time and the investment to be able to do it. So, I think we will continue, and as demand drops, and I have no doubt that demand will drop because we will get more efficient, datacenters will get more efficient, a lot of things will get more efficient. So as demand drops and we have a very high level of renewable penetration for electricity, we will export that. We will not be a massive exporter, we will trade forward and back, but I think that we will never get to the point that we will be a massive exporter.

That is interesting, thank you. Do you feel there are potential pitfalls to becoming highly dependent on renewable energy resources, and if so, what are those potential pitfalls?

I think as long as we have the technology, that will allow us to manage it. We are fine. At the moment we are relying on other countries to give us fuel, we give them the money but in order to give us fuel. There is no pitfall to be able to be self-sustainable. No, I do not think there are any downsides to it at all, by the money it cost to get there.

Thank you. In your opinion, what are the main actions required to engage and empower communities and businesses to contribute to Ireland’s energy transformation?

In communities, it is, again, getting buy-in from communities. So, allowing them to have a percentage ownership, it is a huge thing to have a percentage ownership in developments, whether they solar, or wind, or bio-energy. And that is really important, because, there are incentive schemes, but when the community owns it, they see the wind spinning and think “I am making money here”, you know? So that is a really good thing. But in general, increasing the knowledge of these things. It will happen, it is going to take time. And then, what else? Yes, grant schemes, I have not mentioned this earlier, but the renewable electricity support schemes, it is the new grant that is coming for electricity, they need to have a percentage of community ownership in that.

The ownership is a really good way to engage the community indeed. So, is there anything else you would like to share?

No, I think that is very comprehensive. I think that is it. I think that we will be a leader. One of the reasons we are slightly behind, there was the financial crisis and we did not have the money for anything else. That did set us back years. I think we have the resources, we are opened to renewables, you know, we do not like to be relying on coal or burning coal. It is because it is there, it is cheaper, it is easier. Over the last few years we have seen a large jump, and I think
over the next ten years we will twice that jump. Because the technology will be there, the acceptance will be there. And hopefully the financing will be there as well.

Thank you so much for your contribution, Mr. Sutton. It was really helpful, not only for my dissertation but for my future as an energy engineer. It was my first interview and I am really satisfied with your answers. Do you have any questions for me?

No, that is it. Thank you too.
Appendix 8. - Interview Transcript No 2 of 5.

Mr. Clarke, you are currently working as the Energy Manager at Dublin Airport, could you give a short summary of your experience in the Irish energy sector?

I am a mechanical engineer by background. I would have worked for fifteen years to twenty years building utility plants, boiler houses, diesel generators, combined heating power and diesel generation. I left that about six years ago and came to Dublin airport, after completing a masters, where I am the energy manager, in charge of a team of five. Our responsibility, my responsibility, I suppose is kind of a few fold, we do all the energy management on site. So, from all the bills, we pay all the bills, we monitor all the bills. Dublin airport is strange in that the airport is its own grid, so we operate the medium voltage grid here and we recharge all the buildings, all the tenants. So we manage our own bills, we manage the bills for everyone else. That is one side of it. Number two, we do all the registry and compliance targets, so all the greenhouse gases permits, the public sector, and monitoring all the government targets. We report on that to SEAI, the EPA, the DTTAS and then some aviation stuff, like ICAO. That is the compliance and regulatory bit. Then there are projects, so we complete energy efficiency projects and renewable energy projects on site. And fourthly I suppose, what do we do? We act as the energy monitors on site. So we engage with all the projects and make sure there is energy efficiency design done, that there is ISO 50001, and just general energy monitoring. That is my background, five or six years at energy management here.

Interestingly, could you tell me how your department, or the Dublin Airport, is committed to the development of renewable energy in Ireland?

Dublin airport is part of DAA, it is a company that operates Cork Airport, Dublin Airport, and some other smaller businesses, retail businesses, and DAA international. I work for DAA, managing Dublin airport, but part of our job is also to do all the compliance and registry stuff for the entire DAA group. Because we are a commercial semi-state company, the Government owns us, but they do not fund us, we fund ourselves. So because of that, we are targeted to reaching 33% energy efficiency by 2020. We are also targeted with implementing exemplar performance its called, so whenever any of the new directives come down we have to try to implement them on-site. In terms of renewable energy, that might be, in particular what we have look at is solar PV, what is called FEGP, fixed electrical ground power for airplanes and
some different things. On a whole though, the airport, DAA, has a kind of an overarching sustainable strategy and energy policy. We have not necessarily implemented much renewable energy yet, we do maintain three CHPs on site, I know they are not renewable, but the primary energy offset from them is. We have completed a trial installation of a 110 kW solar PV farm here. We have planning in progress for three more on the roofs of various buildings and we have sought approval for a 10 MW solar farm. That’s kind where we are at. We have done studies on biomass, we have started to look at wind, biomass we have discounted for various reasons, wind has some issues with the radar we think, so we are just working through that. We are kind of only dipping our toe into it now, because we have to. All the new rules and laws.

All the countries are, right? Now, about renewable resources in Ireland. The renewable energy industry in Ireland is at an important moment. According to the Department of Communications Climate Action & Environment, Wind, bio-energy and solar energy could yield additional opportunities for Irish business and domestic consumers. Which renewable resources do you believe will be the main contributors to the Irish electricity, heat and transport sectors going forward into the future? What do you consider to be the main barriers to their development?

So personally what I think, if you take the three kinds of renewable sources for electricity, it is obviously onshore and offshore wind, obviously. Solar PV has started to raise its head up in terms of electricity. I think the way it is classed within Irish law, CHPs are still classed as renewable energy, so in terms of microgeneration CHPs will still have a role to play. Certainly on a scale of a place like this or on big campus buildings it will have a role to play, but listen, the resource is obvious, its huge, but its not implemented for electricity. In terms of heat, its a bit more difficult, the Government were very slow in implementing the RHI, the Renewable Heat Incentive. I mean there is capacity for it there, big district heating schemes, the likes of the Airport used to have one, 50, 60 years ago, it was gotten rid of, we might look at it again for some of the new builds. I suppose with renewable heat its going to be down to anaerobic digestion, essentially biogas and biomethane kind of efforts. In terms of transport, we have looked at it quite heavily, because the airport here is the biggest hub for transport in the country, so the biggest bus station in Ireland is here. So we have the biggest EV fleet in the country, Electric Vehicle fleet, so we have just under 20 EVs here. We are looking at purchasing another batch of EVs next year, we have a new bus coming, one new EV bus, one new CNG bus, so we are going to see which way to go, and a hybrid, sorry a hybrid bus as well. In terms of
transport its more difficult, its obviously EV but I mean, the commitment is not there, the funding to provide the infrastructure, yet. So we have got it there but its not quite where it needs to be. Of course for the three of them, the barriers to that, oh God, how long is your arm? I was just thinking of that before you came up, I was sitting down there, so I do a lot of stuff, kind of going in and out to IBEC and into the departments and talking but, as for the barriers to why there has not been as much renewable energy? So if you take it that the target is 16%, and whatever it will be after that, 20%, whatever, 27%, I was thinking there is kind of 3 or 4 main reasons why. One I think, is governance, so the Government itself, in terms of their policy and their strategy, it is very poor. In other words there is a lack of political will, or has been. The politicians, they talk but they are not doing a lot, so lack of political will. When you are a business like ours, where the big government departments are in charge, there is no departmental cohesion, they do not talk. The Department of Tourism, Transport and Sport are in charge of us but all of our figures are reported to DCCAE, they do not talk, they do not talk. Its the governance side of it. So what we see with that is the energy policies, the energy strategies that the government have are not strong, they are just not, they are poor. You can take that to be the National Mitigation Plan, or the National Renewable Energy Action Plan, all that stuff, it is bad. You look at the Renewable Energy Directive, the way its implemented here, it is bad too. They have not incentivised smaller businesses for microgeneration, all that stuff. So when I say why its bad, the first thing is the governance, no political will, no department cohesion, there is no clear plan, there is no definitive targets after 2020. Thats the first thing. Number two, I think it is probably society in general, people do not want to pay more. Thats it. People do not want to pay that green premium, not yet anyway, they have not been prepared to pay it. They do not want big solar panels or big wind generators in their back yard. What else did not help with society? The crash in 2008/09, no money, people were not going to invest, companies were not going to invest, it came at a bad time, so we have not invested. And then even so, a few months ago we did not take the chance to increase the carbon tax. That whole society thing, people will not pay more, people do not want it in their back yard, plus the crash meant people were not spending their money. There are probably technical reasons as well, some pretty big ones, the fact that Ireland is an island, while it gives us loads of resources it also means we have problems with the grid. We are connected to England with a small interconnector, but if we bring on loads of wind, theres issues with frequency. So from a technical point of view, we need to invest in the actual infrastructure to interconnect to Europe closer through the Celtic interconnector down in France, we need to upgrade all the lines around
Dublin, Cork, Galway, Limerick, they are not able to take all the intermittent energy. Other technical reasons I suppose would be the fuels. Bord na Mona, peat, is sitting there, we have always wanted to maintain some level of indigenous fuel, rightly or wrongly, that was Bord Na Mona, so with the levies the government have, the public sector stuff, the public sector obligation levies, a lot of that was pushed towards maintaining peat generation, coal generation on the island. Lastly then, the fourth reason, planning infrastructure. All big developments like that, they have to go to An Bord Pleanala to get pre-planning approval, then you have the local county council to get more, it takes time, it takes years, 1-3 years. So if you get that, well and good, then when you have that you have to try and get connected to the grid and thats expensive, you have to pay ESB Networks or Eirgrid a lot of money to get connected, but in a lot of instances you cannot connect because the cables are not big enough, for the technical reasons they are not big enough, they are old, all those issues. So if you get planning permission from An Bord Pleanala and the local council you then go to try and connect to the grid, you are maybe waiting 3, 4, 5, 6 years, so they are kind of the 4 reasons I think, the governance, the societal reasons, the technical reasons and planning.

Thank You. In relation to wind energy, presently, wind energy is the biggest contributor of renewable energy in Ireland and also the cheapest. Considering Ireland has excellent wind resources, do you believe the country can rely on its continuous growth?

Yes and no, I think you can rely on it up to a point, if there is investment. As far as I know, on any given day, there might be penetration on the grid of wind up to 40 or 50% of the capacity, that’s a lot for a small island and that might have problems for the safety on the grid, you know, without the thing crashing. But I think we can if we improve the network, yes, there is a huge resource still of the western seaboard for offshore, and even the eastern seaboard, yes, there is loads but we need to invest a lot more in the infrastructure and get some interconnection to Europe, better interconnection, so that when we are generating loads and we do not use it, we can send it over. So I think we can up to a point.

In the last few years, Ireland has made a meaningful improvement in expanding wind energy projects. Nevertheless, with all this potential, Ireland will still miss the 2020 renewable energy targets. In your opinion, what are the main challenges faced by Ireland to succeed in the deployment of wind energy technologies? How do you feel that these challenges can be overcome?
So yes we are not meeting the targets now, we will not meet the targets by 2020 I think. So in terms of wind, for us to get more wind, the challenge to get more wind on stream, one is to clear up the planning, is to get the planning applications correct, to streamline how planning is approved in the first instance. Two, there is a big delay in what they call the network connection, like I was saying to you the grid connection to that, that needs to be speeded up. It is very difficult for networks to do, ESB networks here to do so. So to enable more wind, whatever about the money side of it, I think the price is there and it is favourable, it needs more streamlined planning, for strategic planning, and more clear and quicker grid connection methods. Besides that, people do not seem to like the wind overly, onshore wind based stuff, so it is perhaps to move further out into offshore wind, both in the Irish Sea and Celtic Sea, and the Atlantic. But yes, there is potential there, but those are the three things I suppose. The planning approval needs to be streamlined, the grid connection approval streamlined, and moving offshore. In terms of planning, what I mean is the grid planning, what ESB seem to be doing now is waiting for a thing called a group processing average, so if we are in Dublin here, they will not tie in just one wind farm, they will wait until there is two or three of them together, then they will tie them in. So yeah, those three things.

Ok, thank you. In relation to Bio-energy, it is the largest contributor to Irish renewable energy through heat generation and it is expected to continue to play an important role in replacing fossil fuels, especially in the larger heat users, such as the industrial and commercial sector. With regard to the heat and transport sectors, what actions would you consider necessary for the further expansion of bioenergy in Ireland for these sectors? What are the barriers to its expansion, and how can they be overcome?

The first instance I can think of in my own head, I do not know a huge amount massively about it, but I query maybe, one, the new RHI and the new RESS, so the new Renewable Heat Incentive and the new Renewable Energy Support Scheme, I do not believe they support biofuels within the grant scheme, so straight away, why not? They are not incentivising people to do that, basic mistake, so in terms of heat, certainly, and transport, that needs to be included in the RHI, I am fairly sure it is not, so that needs to go into it. Two, to really make a meaningful difference, how much biofuel is needed and where would that biofuel come from? Is it the best use of land, to generate that biofuel within Ireland? Certainly when we rely so much on agriculture already for dairy and for different things, I do not know. For any of the main biofuels, rapeseed or whatever you might look at, there might not be huge portions of land to
generate it, so it may not be worth it from that point of view. That is the biofuel element of it.
In terms of biogas or biomethane, yeah, we only really have one incinerator here, for arguments sake. We do not really use a lot of our rubbish through AD and sewage and effluent. There is huge scope within that, certainly at the likes of the airport here, to maybe develop that side of it. Gas is going to play a big part of the next 10, 20, 30 years here, so why not inject biomethane into the natural gas network, do that at strategic points. That would allow, obviously, fuel burning, and will also facilitate, let’s say, CNG. So it has the double benefit of maybe doing the heat and the transport at the same time, as opposed to the biofuel maybe needing loads of land, not the best use of it, the refinement of it and the change. I think it can be easily done with the gas and methane, to retrofit what is here. So how that would be overcome? Again, incentivise. People will have to be incentivised, the government will have to invest in the infrastructure. I mean, to date there has been a PSO levy and different things, they have relied on business to invest and it has not. That is the reason, money and the payback in it. So they will need to invest in that, they will need to have clear plans and targets set out in line with the EU Directives to force people to do it. That is how it will be overcome. I say that in terms of biomethane and biogas, biofuel, I am not sold on it, I do not know, I do not think it would be worth it, I could be wrong.

Thank you. Ireland has a small but growing solar PV deployment industry. In your opinion, what are the main barriers to increasing Ireland's solar PV deployment?

So the main barriers to solar? There is loads of them! One has been cost. But cost is now way down, it is nearly grid neutral, so it is worthwhile. Up until very recently, there was no incentive grant scheme, there is now, in place certainly for domestic loads. So, cost in the first instance being a barrier, a grant scheme was not there, it is there now so it makes it more affordable, it is still dear. I suppose thats more on the domestic side of it. Three, people I suppose had a belief that there would be no solar PV potential in Ireland, but there is, or certainly below a certain line in the country its well worth doing. So that is why we probably have not used it, the cost, no grant scheme and people did not believe in it. Taking on from that, the new Renewable Energy Support Scheme, it is very difficult to export to the grid here, you cannot actually, certainly small domestic people cannot. On big scale, it is not great. The new Renewable Energy Support Scheme is there but it is only offering an auction based price which probably is not brilliant. So that is why it probably has not taken off as quickly as it has in other countries but it is starting to now. The cost has now come down, and RESS is there, but also the biggest
reason it might jump off soon is that there is the new building control, Part L...all buildings in Ireland have to be built to a standard and one of the standards is called Part L, so that is the energy performance in buildings. So the new building regulations as of this year for big buildings like this here, or maybe after 2020 for all buildings, they have to have some type of renewable energy, one of seven types. They have to be built to a certain minimum standard and they have to have a 20% renewable energy element within the building, so that renewable energy can be one of seven. It can be air source heat pumps, ground source heat pumps, CHP, biogas, solar, or wind, and something else, I forget. So, I think the way is going to go, not everybody will be able to put in a CHP or SRSC pumps, so I think it is part of it, what we will see is that a lot of people will start to install solar PV and in the next 1,2,3 years, a huge amount of people. So that is how it might be overcome, with the new legislation for the buildings, and they are there. Secondly, I suppose, the cost, I still think it is going to go down, but the new capacity market, if you break it into domestic, and businesses or large scale, do you know the Demand Side Unit Market? DSU or DS3? From Eirgrid. So, we make a lot of money out of that. So with that coming along, we have room, we would put in big PV, big battery, lots of money. That is it though. And that is what we are going to do. We do not need to export to the grid, because we are not going to get a good price for it, we do not want to do it. But what we can do is participate in the capacity and the frequency market with PV and the battery and it will pay real quick.

Thank you. Do you believe improvements in solar technology, combined with Irish strengths in the renewable energy sector, can turn solar PV into a more practicable option in Ireland?

In terms of the technologies, listen, I know there is the first, the second and the third generation, and it might be the silicon, the crystalline amorphous silicon and there is then the SIG type and all of that type of stuff, and the bio filling PV. That is all the fancy stuff. At the end of the day, I suppose the amorphous crystalline is still relatively cheap, good performing, the grades over 10, 20 years, down to 80%. That is good. So I think the PV technology has advanced to a point that is good, even the basic solar PV is good, and the outputs will stay relatively defined, over that period. So people know what they are going to invest in, so they will have more comfort. As I was saying, despite all the technology types, the basic one, the crystalline one, the silicone one, is fine, it is going to a lower price, and with the support scheme that is there to buy, I think
people will start too. And in a bigger business level, it is way down, the price is after almost halving more in the last year or two. So people will do it, yes.

And in relation to your area, the greenhouse gas emissions. Ireland is on the right path to achieve its commitment according to the Kyoto Protocol. However, it will miss the EU targets. What are the main obstacles you feel are preventing Ireland from meeting its target to reduce greenhouse gas emissions by 20%, according to its EU targets? What actions do you believe can be taken to help overcome these obstacles?

Ok, so greenhouse gas, carbon. One, so we are not going to meet it, that is fine. It is split into ETS and non-ETS. So this place would be greenhouse gas permitted, so all our emissions are covered under ETS. But all the non-ETS emissions, let’s say from, for argument sake, from transport, let’s say, or domestic heating and so on. The Government has overly relied on the ETS sector, big business, to provide the savings and has not focused on non-ETS, it is fairly obvious. So we take that way first, ETS has almost done as much as it could, there are improvements there, the big stuff. The Government has not tackled the other side of it, no political will, just they have not. So that is where we are at. So moving on, why separately we had an overlines, I suppose. Although wind has made big advances here, we still burn a lot of coal at Moneypoint, we still burn a lot of peat. Peat in particular, is very bad. I know it is being phased out but it certainly has not helped. When you move on from that in terms of carbon emissions, listen we are an island, we have to import a lot of our fuel, so in the absence of a renewable we still need base generating power and that can only be provided by fossil fuels. The sooner we get the gas the cleaner it will be, but coal is still there, oil is still there. You move down over to non-ETS, why there might be a lot of carbon emissions, in terms of the heating, the houses in Ireland are poorly built, they require a lot of heat that is inefficient, diesel oil, poor insulation, the building stock needs to be improved and that is expensive to do, people do not want to invest money so thats why that has not dropped. In terms of transport, public sector transport outside of Dublin and Cork is not good so people are stuck in cars and burning fuel that way. So for them to improve it, well in terms of the ETS, I know they are revising the ETS programme 2020 to 2030 and there are different things there, but I have not had to buy carbon emissions allowances for the airport, we were given allowances 10 years ago and we still have them, we were given too much. I would say every company in Ireland is the same. We will have enough until 2025. Carbon only cost E5 per tonne last year, it may be 20 or 25 now, that needs to go higher. Once it starts costing more money, people will look to change in
the ETS. In non-ETS, the government missed carbon tax, they did not take the opportunity to let people softly know that they need to pay for this stuff, so how are they going to tackle carbon emissions? In terms of transport, EV, CNG, I know they have incentivised that, there has not been a big take-up, but the EV network around the country needs to be improved, I know they are getting there. But more importantly the big public transport sections need to improve, Dublin Bus, Bus Eireann, Irish Rail need to be improved, invested in necessarily to improve for transport. That is it, ETS, non-ETS, transport and housing.

Ok, thank you. Ireland is part of the global green movement and will become the first country to remove investment in fossil fuels completely. How likely is Ireland to remove investment in fossil fuels completely? If you believe this likely, in what timeline could you see this happening?

Listen, Ireland is an island, that is it. We do not really have indigenous fuel. We have a little bit of gas, Kinsale has run out, Corrib will run out soon, there may be more off the Porcupine Bank or wherever the hell it is, but at the end of the day we are an island and we need to import fuel. I cannot see Ireland moving away from fossil fuels for 10, 20, 30, 40 years. I think we will have a heavy reliance on gas for a long time, we will have to. We need it, that is just it. What could we get to, reasonably? I mean if all the renewable energy stuff over the next 20, 30, 40 years is invested in and installed, we may be able to move. I have seen figures that we could move the fossil fuel burning down to maybe 20%, it might be 80% carbon free, that is as far as we will get. There will still be fossil fuels here in 50 years. And we cannot, because with the electricity grid, we do not have the interconnection, the renewable energy is too up and down, we need base electrical generation and that can only be given at the moment by gas.

Thank you. In your opinion, what the main reasons for Ireland failing to improve its energy efficiency at the desired rate in the residential, commercial and industrial sectors?

Well we do that here, we have to meet 33% on behalf of the Government, of the 20, but why in the residential sector? Fairly clear, building stock is poor. It takes a lot of money to invest in the envelope of a house and people are not prepared to do it. I know there are big incentives there, grants for housing insulation, for all that, for glazing and so on, but it still takes a big investment for somebody to spend 8-10,000 euro to do their house. The payback on it is quite long, so on a residential level, in terms of efficiency, that heating side of it is very slow. In terms of lighting, LEDs have come down in price, and I think people are starting to do it so there might be some improvement there. From a residential point of view people have started
to do that, but in terms then of the base heating source, people still heavily rely on diesel oil and peat. There is no infrastructure in a lot of places for that, or maybe LPG deliveries, so in residential terms, yes it has improved but to really meet it more, its really expensive for people to make those changes and they have not. In the commercial and industrial sectors, energy efficiency improvements, why have not they hit? Again, the financial crash, it hit at the wrong time, people lost jobs, companies did not have money. The green economy, green investment, it is a long payback on a lot of it, the money was not there. People did not see the value of it, they were more worried about keeping their businesses afloat and investing their money elsewhere. Plus I suppose, the level in design that was involved, certainly 10 years ago, it was not brilliant. Poor design, maybe not taking enough base energy efficiency into account. But I think some of the new regulations will change that. So yes, it is a big problem, the more that we had provided in energy efficiency savings, the less the target in renewable energy would have been. It is a pity, it is missed, we could have been closer to that 16% if the energy efficiency had been right.

Thank you. And in relation to the electricity sector. What are the main challenges to integrating more renewable energy resources into the electricity sector safely and efficiently?

The intermittency, the frequency, is the issue primarily. As we know, Ireland has massive wind penetration at certain times of the year, for such a small grid location I think the frequency can drop by 1 or 2 or maybe rise by 1 or 2 Hz, but any more than that and we could risk failure of the system. It is very good here, but to overcome that frequency issue there needs to be the inertia on the system, there needs to be the backup, so there needs to be the big fuel-burning plants sitting ready to go, there needs to be battery storage, so in terms of bringing more renewables, that frequency element is the biggest issue, and the intermittency. How is that addressed? That is addressed by having interconnection to bigger markets where it will not matter, so connecting to the UK and connecting to mainland Europe is the easy way out of that. And I think they are planning that, there is one to Northern Ireland, one to England, I think there is a new one being planned for France. Frequency is the biggest issue. Separately, like I said at the start, certainly in the main urban centres, if you take Dublin, the cabling, the distribution and transmission level infrastructure is under pressure, big time. There is a lot of data centres being built all around the city, there is a lot of development infrastructure being built. The system has not been upgraded over the last number of years enough to cope with
that, so the capacity within the main urban centres is not there to take the additional load. You could more or less argue that the load centres are primarily based in the east of Ireland, most of the resource is on the western seaboard. So to try and get the energy from here to here, we need the cables, and they are not there. The biggest issues to me are the frequency, the intermittency, and the backup to it, and the fact that the load centres and the resource are not in the same place.

Thank you. In your opinion, what would be the main required changes in the renewable transport sector in Ireland so it could stop relying on imported fossil fuels?

It should be sooner rather than later. So in the public transport area, let’s take, as I have said to you, the airport here, it is the biggest bus station in the country, so this is the most movements in the country, most buses in, most buses out, anywhere. So this is the biggest. We looked at talking, we spoke to the Public transport, to the Dublin city council, we spoke to Bus Éireann, Dublin Bus, all about what they want to do for the next 5, 10 years… they do not know, there is no plan, none. There is no plan, no clear plan. You hear stories that there is EV buses, we have done a big study on electric vehicle buses, and yes they will suit us possibly here, for our own use, for people going in and out. I do not believe Dublin Bus have any plans to do EV’s, none. I do not believe they do not think it is good enough. If they are going anywhere, they may go to CNG. But the difference, you know, if they use CNG, the savings from compressed natural gas are not as good as people think. That is Dublin Bus, so essentially they are allow to short haul trips, and they probably could work with the EV but they do not see a plan for that, plus the money. That is assuming that we could get the EV infrastructure into the country. I do not believe we can. Some of the studies we have looked at, you know, we might take 3,4,5,600 EV buses into Dublin more, but where are we going to get them from? I read a thing there recently, a city in China has ordered thousands, there are only so many of them that can be built. We are probably too late already. In terms of Bus Éireann, the regional bus routes, I mean, the infrastructure, again, is just not there for it. So until somebody gets a clear plan for the Government, because they are Government owned companies, or funded, but they have to do it, they will not do it. To do it, those companies need money. In terms of the rail, listen, the Dart and the Luas are electrified, but, there is no rail link here, the rail link is primarily, and outside Dublin is all diesel run, again, to make it electric, how do you fund it? All that stuff. So in transport terms, public transport, they need to make a move, have a clear plan, not so much incentivize but make the companies use either the EV’s
or CNG if they want. But what I can see, there is no plan there. We went to Schiphol Airport in the Netherlands a few months ago and the city, Amsterdam, and the airport made an agreement that all the taxis from the airport going to the city have to EV, they said: "no more diesel, no more petrol, you are not allowed". That would never happen in here. The airport themselves bought 300 Tesla cars and made the taxis use them. So when the EV taxis come up, they get priority, they get everywhere, all the other taxis, they cannot, they are not allowed. The city does not let them in unless you are electric, you cannot come in from the airport. That would never be done here. We tried, we asked, that is why I said nobody talks, remember the Government departments? They do not talk. We look at trying to put in some bus charging for Dublin buses. No money. Different companies, even though they are all doing the same thing. We were supposed to talk to TII, Transport Infrastructure Ireland because they are meant to be doing all that, but they have no interest in. For transport, unless somebody makes a plan and makes people do that plan. So far we have nothing, the Government has not done that, they have skipped and dodged away. It will not happen, transport is bad.

Thank you. What do you believe to be the main challenges for the use of more renewable resources in the Irish renewable heat sector?

In terms of renewable resources for domestic heat, people rely on solid fuel or gas, where they have gas that is ok, it is cleaner than the other stuff, that is not too bad. There are incentives there to go for gas condensing, that is ok. But if you are going to have someone to move from diesel oil or peat to a renewable or greener kind of heating source, what is that going to be? Is it going to be a heating pump? That is expensive. Are you going to put in a heating pumps into a building that is built bad, with no isolation? No... your electricity bill will be higher. In terms of heat for domestic, I know there are incentives there, but again, it comes back to the point that is expensive for people to do it. Very expensive. They will not do it unless there are maybe tax incentives or some more grant issued for it. So for heat then, maybe in the commercial, industrial and in a larger scale, I think they are getting there, I think it started to change a little bit. I think, the renewable heat incentive is there, district heating schemes. We are starting to come around with it. Ireland is not like Germany or England, we are not a very industrialized country over the years, so we do not have all that big, heavy industrial centres, you know? For us to do district heating on a big scale, I do not think it would happen as much as we would like. I think, over time, heat will improve, but in the commercial and industrial sectors, I do not know. The new building regulation, I think they will do it, but it is going to take time. I think
it will improve, but it would be, 5, 10, 20 years before it improves, it will not be two years, I think for 2030, 2040, not in the timeline for this one. It will take to do it, for sure.

**Ok, thank you. You were talking about this before, do you consider energy storage capabilities to be a barrier to the development of clean technologies in Ireland?**

For Ireland is a much bigger problem than it is for England, Germany or France because they are all connected and they are huge load. Ireland is not, only small connection frequency. But we are very good at managing the wind in the country, like I said, to get penetration of 40% or 50% on into the grid, I think only Denmark in the World has done more. So, we are good at it, but you can only go so far, and then you need the storage, or you need to have the interconnection, you just have to have it. We do not have nuclear and we are not going to have nuclear. That is it, that is the barrier.

**We were talking about this before, it is an inevitability that Ireland will fail to meet its 2020 targets. So do you think is it likely that Ireland will have to purchase energy credits to avoid heavy fines?**

I think yes, undoubtedly. I have seen figures, maybe 250 to 600 million euros. We will miss it and we will have penalties. That is a problem. There will be penalties post-2020. The new targets the 2030, the EU targets are there, but the Government has not put those targets told to companies in Ireland what the targets are going to be. We need to invest now, or not, because we do not know. I do not know where the money is going to come from, yes they are going to purchase. They either are going to have to pay the fine or purchase. I think that will be 250 to 600, I have seen different figures, up to 600 million euros. They will have to I do not know where they are going to get that money from, taxes? Taxes on businesses. They are not going to tax you or me, because then they are going to be in trouble. But they are going to get from somewhere and it will only get worse as we get to 2030, because the targets will be higher. It will be a big problem.

**Ok, thank you. What do you believe can be done to overcome the barriers Ireland faces in meeting its EU 2020 targets?**

I think it is too late, nothing can be done now, but if the Government could improve the energy efficiency figures, that would pull down the requirement for the renewable energy 16%. I think they are talking about that, they are trying to do that, but it is very slow. So if they can improve the energy efficiency, reduce the base load, it makes the targets better. I think they are doing a
little bit of it, but still, we will not meet it. It is too late. It might make it smaller, but we will not get there.

You were talking about Denmark, what can Ireland learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets? What can be done to avoid shortfalls when attempting to meet targets in the future?

In terms of Europe, our results are very poor. Why are they very poor? One we are an Island, grand, that is too easy. Two, agriculture. We rely heavily on agriculture. Three, we have not fully made that investment, it was all focus on wind. They need to branch it out further, they are starting to do that with the RESS, Renewable Electricity Support Scheme, the RHI and different things. But maybe too little, too late. They need to keep that going. Similarly, they need to tackle agriculture, they need to do something if we are going to meet the targets, it has to be more sustainable. I do not know how that would be done, because politically, I do not think that anybody would do that, would go near to the farmers. We are very poor, we come from a very bad spot, tackle agriculture. I suppose, improve the incentive schemes, implementing the new technology awareness. They need to really make legally binding targets, they need to make companies and industries responsible for their energy consumption. If I do not meet 2020, for the airport, there is no penalty, there is no problem. I just do not meet it. I get that, no problem. For 2030, as far as I know, there is no stick to tell people to do it. The new directives that are coming down, they need to enforce them locally and nationally within Ireland and make the industry, in particular, and people meet the targets. However, they may need to do that legally, they may need to do it through additional taxes, or avoided taxes, if you are good you do not pay as much tax. They need to do more of that, really make people do it.

Thank you. And in your opinion, how likely is it that Ireland will become a world leader in the use of renewable energy resources, and eventually, a net exporter of energy?

I think we can do it, but I think we are on a time scale of 50 years, 30 to 50 years, 30 years minimum. So I think maybe in 30 years time, yes, we will be better. Will we be a world leader? I think we could be better, I think we will be closer, I think we will improve. I think it will start to gather momentum. Again, as I keep saying to you, we need to look after, because we are on the Western sea border of Europe, we need to make sure that our own electric grid network is resilient strong. We rely on imported fuels, so for whatever reason, natural disaster, war, something happens, we have no fuel coming in. So, I think there is different incentives, over a long period of time. Yes, I think, while we will not we be the World leader, we will improve,
but it will be 30, 40 years at least. I do not think we will ever remove the need for fossil fuels, when I say ever, certainly in 30 to 50 years, we will still need fossil fuels at some degree. Can we become a net exporter? Yes, I think we can. Will we? That depends on how we are connected to Europe if we can exporter, and similarly then when we are not generating electricity, how much we can import from Europe, from whatever, nuclear or their more efficient plants. So yes, I think we will become an exporter of energy? Yes, no problem. A net exporter? Yes, eventually, but that will take time.

**Interesting, thank you. Do you feel there are potential pitfalls to becoming highly dependent on renewable energy resources, and if so, what are those potential pitfalls?**

Climate change. How much of that technical expertise within the country at the moment, do we manufacture that stuff? No, not really. We do some of it, some of the wind turbines we manufacture, some of the wave stuff has been developed. But on an industrial scale? Probably not. So, climate change, probably the technical capacity to manufacture some of it ourselves. Other pitfalls? I was going to say Brexit, but Brexit has no effect on that. There is an inherent thing, for us to be entirely reliant on it, how do we do that not connected to Europe? We have to be connected to Europe, that assumes that has to be strong kind of security within Europe, social security, there is no trouble in Europe if you know what I mean. I do not mean war, I just mean social trouble, no social upheaval, it needs that. Because we can never probably fully disconnect from a big load like that, the storage is not there, or it would be very expensive. How do you do it? I don't think there are too many pitfalls for renewable energy. If we really look at it, it just takes money and time. The frequency and the technical stuff, but no.

**That is good then, there are not many pitfalls. So, in your opinion, what are the main actions required to engage and empower communities and businesses to contribute to Ireland's energy transformation?**

In terms of community, it starts to see it now, it started to change. I think the SEAI has this thing, the SEC, the Sustainable Energy Communities, have you seen that? That probably needs to be grown, for want of a better word, if you go to Europe, certainly Germany or parts of some of the other Scandinavian countries, they very much manage energy on a city or town basis and share it out well, that is not done here. Again, they are very industrial aware. I mean the whole idea of a sustainable energy community it is to advance that and make those communities, businesses, towns, cities or different groups. Can that be done? Yes, I think it can and it will probably have to be done over the next 10 or 20 years to do that. For businesses, the CSR,
Corporate social responsibility is huge, I mean, here we have big issues, aviation carbon emissions, crazy, mad. Here I think we emit, maybe, in ETS 10,000 tons of carbon, in overall, maybe 45,000 tons from all our activity. You go to the airlines, the airlines for Dublin airport would emit 1.5 million tons compared to our 45,000. In terms of businesses, while businesses might have a Corporate social responsibility, they will do certain things, The likes of the big global and international companies are good. We are a little bit slower, we have announced, you know, the low emission vehicle policy, we are going to go carbon neutral by 2020, but that is buying offsets, useless. I think it is making carbon emissions, making, I suppose, sustainability a core issue. Once, the likes of you and me, and everybody else in the country wants it- we start looking at where our energy comes from, where our services and products come from, we will start to only spend our money where good companies do that. As people become more aware, companies will may be doing for the CSR, PR, how they look, how they are visible. It is starting to happen, you can see some of the big companies already changing. I think that would filter down. But again, it is about forcing businesses, unless there is a capital return or an incentive to do that, it does not need to be money, it could be CSR, that is what I mean, it could be tax avoidance schemes, they are there, accelerated capital allowance different things are there, but it make it more worthwhile for people to do that.

**Thank you so much, and is there anything else you would like to share?**

Barriers to it… I think for renewable energy in Ireland, leaving aside the crash and all that stuff, the Government has dropped the ball, they have relied too much on business to meet the targets, by forcing big businesses to pay more public service obligation levies, PSO levies to implement more of the change. They have been too slow to act. I suppose it was sorry to see that, they did not take the opportunity for carbon tax, that in the renewable heat incentive, they missed the chance to put in biofuel, for argument sake, maybe deliberately, maybe not. In terms of the renewable energy support scheme, they did not incentivise microgeneration too much. They are still slow to do the right things. I think they are going to have to, they have been dodging. /but until Europe gets really stern with them. I think it will be slow, it will middle or late 2020’s, 2025, when we really get any better, we will be in trouble.

**Thank you so much, Mr. Clarke, you did contribute a lot in my research. I appreciate your help. Do you have any questions for me?**

No, interesting though. Tough essay. There is a lot of stuff there, the targets are changing so much, all that stuff. It is really interesting.
Appendix 9. - Interview Transcript No 3 of 5.

You are currently working at EirGrid, could you give a short summary of your experience in the Irish energy sector?

I work within the Innovation team at EirGrid Group, who are responsible for projects such as DS3, EU-SysFlex and Power Off and Save. I have previous experience as a substation design engineer and worked on many large scale primary and secondary design projects. I have first class honours as a master of electrical engineering.

Could you tell me how EirGrid is committed to the development of renewable energy in Ireland?

EirGrid Group, as TSO for Ireland and Northern Ireland, has a key role to play in facilitating the government’s renewable targets for electricity. EirGrid Group created the DS3 program 10 years ago in order to transform the operation of the Ireland and Northern Ireland power system in order to meet the ambitious renewable targets. In seeking to meet public policy and the renewable energy targets, the Ireland and Northern Ireland power system would need to be capable of operating with significantly high penetrations of variable wind and solar generations. This means that, at times, the power system would need to be capable of operating at 75% SNSP (system non-synchronous penetration). Some power systems around the world operate at high levels of renewable generation. However, no power system in the world operates with such unprecedented levels of non-synchronous renewable generation. This makes the DS3 program and the Ireland and Northern Ireland power system the world leader in incorporating non-synchronous renewable generation.

Which renewable resources do you believe will be the main contributors to the Irish electricity, heat and transport sectors going forward into the future? What do you consider to be the main barriers to their development?

Wind and hydro, which is very closely followed by solar, are the main renewable resources for electricity generation in Ireland. There is currently more than 5000 MW of wind and solar generation installed in Ireland and Northern Ireland, and about 200 MW of hydro generation. Therefore, renewable resources for electricity generation are readily available. In relation to the heat and transport sectors, greater levels of electrification of heat and transport could assist us in getting closer to our targets. Electric Vehicles currently sit at just 0.2% of total vehicles
in Ireland, with similar statistics for heat pump uptake. Similarly, the use of biofuels in both the heat and transport sectors could have potential to contribute in the future.

**Considering Ireland has excellent wind resources, do you believe the country can rely on its continuous growth?**

Wind as an energy resource is highly dependent on its ability to be incorporated into the power system. Its uncertain and variable nature is just one factor. Another is the fact that it is electrically decoupled from the system and not synchronously connected – hence wind generators do not provide the same necessary system services, for example synchronous inertial response, that are typically, and historically, provided by conventional generators. Thus, with increasing levels of wind generation, and the consequential decreasing levels of conventional generators, there are technical scarcities and challenges being revealed on the Ireland and Northern Ireland power that have not been encountered elsewhere. Future power systems will still require some level of synchronous generation, thus there is a technical limit on the amount of wind generation that can be incorporated. However, the transformational innovations that have been brought about as a result of EirGrid’s DS3 program continue to allow increasing levels of wind generation on the power system, up to the technical limit and, as already stated, this is way beyond any other synchronous power system in the world.

**In your opinion, what are the main challenges faced by Ireland to succeed in the deployment of wind energy technologies? How do you feel that these challenges can be overcome?**

The main challenges are the technical challenges associated with incorporating wind generation into the power system as explained above. The DS3 program is pushing the boundaries on overcoming these challenges currently. Public opposition to wind generation could also be a major challenge. There is a need for wind farm developers to work in conjunction with local communities from early in the planning phase.

**With regard to the heat and transport sectors, what actions would you consider necessary for the further expansion of bioenergy in Ireland for these sectors? What are the barriers to its expansion, and how can they be overcome?**
Unfortunately, bioenergy would not be our area of expertise, so we can only comment on electrification of heat and transport. The main barrier to the uptake of electric heat and transport is consumer choices and opinions, as ultimately the electrification of heat and transport will be driven by the consumer. Other barriers include technology barriers, for example battery range limitations and lack of charging infrastructure for Electric Vehicles. Why should people downgrade themselves to a car that is more inconvenient than the original alternative in a conventional car? To overcome this it is important that the government has the right subsidies in place and that it continues to push uptake of electric vehicles. Electrification of heat and transport will improve but this takes time, requiring individual home owners and car owners to make active decisions to do so.

Ireland has a small but growing solar PV deployment industry. In your opinion, what are the main barriers to increasing Ireland's solar PV deployment?

To begin with, the weather! Ireland gets much less sun and less intense sun. PV is also electrically decoupled from the grid and thus, like wind, there are technical challenges of integration into the power system. In addition, while it is appreciated that the costs of PV are trending downwards, the high costs of PV are still a barrier.

Do you believe improvements in solar technology, combined with Irish strengths in the renewable energy sector, can turn solar PV into a more practicable option in Ireland?

While the efficiency of the PV panels may improve with time, it is not possible to improve Irelands geographical location and hence its exposure to the sun. Ireland has one of the lowest solar irradiance values in Europe and therefore the capacity factor of PV in Ireland is comparatively low. Subsidies have made PV attractive so the practicality of PV is dependent on these and on the continued decreasing of solar PV costs. Over time, the cost of the technology will make solar PV viable, but this will take time.

What are the main obstacles you feel are preventing Ireland from meeting its target to reduce greenhouse gas emissions by 20%, according to its EU targets? What actions do you believe can be taken to help overcome these obstacles?

It is clear that the electricity sector is leading the way and that the heat and transport sectors are holding us back from meeting the targets set by the EU. Ireland's most significant progress in recent years has been in increasing wind energy deployment with renewable energy in 2017 accounting for 30 per cent of our electricity usage. However, electricity accounts for just 20
per cent of our overall energy use. Significant increases in renewable electricity will not provide a significant short-term increase in renewable energy because of the low share of overall energy that electricity represents. Transport and heat make up the other 80% of Ireland's energy usage and so these are the two areas that Ireland has failed to improve most in order to meet 2020 targets.

**How likely is Ireland to remove investment in fossil fuels completely? If you believe this likely, in what timeline could you see this happening?**

It is likely that fossil fuel generation (i.e. conventional, synchronous generation) of some sort will be required in future power systems. Thus, it is unlikely the investment signal for fossil fuel plants will disappear completely. That being said, it is unlikely that there will be further investment in fossil fuel plant in the near future as there is already a large amount of fossil fuel fired generation plants, even with some of the coal powered plants scheduled for closure in the near future.

**In your opinion, what the main reasons for Ireland failing to improve its energy efficiency at the desired rate in the residential, commercial and industrial sectors?**

The rate of uptake of electric vehicles and electric heating are the main reasons. Although this can be heavily influenced by government subsidy schemes it is ultimately the residential consumer who makes the decision to change. They are unlikely to change unless the change is economically favourable.

**What are the main challenges to integrating more renewable energy resources into the electricity sector safely and efficiently?**

There are significant technical challenges associated with the integration of renewable energy resources. These challenges relate to the variable and uncertain nature of the underlying wind resource but also to the technical characteristics of the wind turbines themselves. Unfortunately, these challenges are too many and complex to discuss in a few lines. However, EirGrid have published many reports outlining these challenges, for example the All-Island Facilitation of Renewables Studies which can be found on the EirGrid Group website. The DS3 webpage is available at: [http://www.eirgridgroup.com/how-the-grid-works/ds3-programme/](http://www.eirgridgroup.com/how-the-grid-works/ds3-programme/)

**In your opinion, what would be the main required changes in the renewable transport sector in Ireland so it could stop relying on imported fossil fuels?**
Attractive subsidies and a broader choice of electric vehicle are now available, meaning that the rate of uptake is expected to increase significantly over the coming years. In one of EirGrid’s Tomorrows Energy Scenarios 2017, Consumer Action puts forward a possibility of up to 25% of the vehicle fleet being electric by 2030. However, a change on such a large scale will take time, so patience is required, and again we are reliant on the consumer making the choice.

**What do you believe to be the main challenges for the use of more renewable resources in the Irish renewable heat sector?**

Aside from new builds, it is difficult to get house owners to change from oil or gas heating, which is tried and tested, to something new like heat pumps, without having economic reason to do so. This would suggest that it will be a gradual transition to electric heating.

**Do you consider energy storage capabilities to be a barrier to the development of clean technologies in Ireland?**

No energy storage capabilities are an enabler to the development of clean technologies since they allow intermittent renewable generation like wind and solar to be stored at times of low demand and then used during times of peak demand. In addition, storage devices could provide system services that are needed to securely operate the power system. A lack of energy storage capabilities may be considered a barrier to the development of clean technologies in Ireland.

**Do you believe it is an inevitability that Ireland will fail to meet its 2020 targets? Is it likely that Ireland will have to purchase energy credits to avoid heavy fines?**

It is unlikely that the heat and transport sectors will change quickly enough to meet the 2020 targets, since we are just a few weeks away from 2019. However, we are very well placed to meet the renewable electricity targets.

**What do you believe can be done to overcome the barriers Ireland faces in meeting its EU 2020 targets?**

No answer.

**What can Ireland learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets? What can be done to avoid shortfalls when attempting to meet targets in the future?**
Norway is the world leader in electrification of transport with 39% of vehicle sales being electric in 2017. Therefore, this would be a good place to look at as regards learning how to incorporate high numbers of EV’s. In Norway, EV’s are backed by attractive subsidies, including financial and non-financial incentives such as low vehicle licence fees, bus lane access and free parking. Perhaps the Irish government could adopt similar incentives, and also apply comparable logic to the electrification of heat.

**How likely is it that Ireland will become a world leader in the use of renewable energy resources, and eventually, a net exporter of energy?**

Ireland is already a world leader in the renewable energy generation sector, and there is no reason why we cannot set an example to the world in the areas of heat and transport also. This will require careful management and co-operation between multiple stakeholders including government, system operators, industry representatives and particularly the consumer.

**Do you feel there are potential pitfalls to becoming highly dependent on renewable energy resources, and if so, what are those potential pitfalls?**

There are associated technical challenges that require careful consideration and with careful consideration can be resolved. The challenges are too great to list but, as previously mentioned, are discussed in the All-Island Facilitation of Renewables Studies which can be found on the EirGrid Group website. Please also see the DS3 brochure which should give an indication of some of the challenges and potential pitfalls associated with renewable energy resources.

**In your opinion, what are the main actions required to engage and empower communities and businesses to contribute to Ireland's energy transformation?**

No answer.

**Is there anything else you would like to share?**

No. Good luck with your dissertation.

**Do you have any questions for me?**

No.
You are currently working at PM Group, could you give a short summary of your experience in the Irish energy sector?

20 years consulting engineering experience with private sector industry (Food sector; Pharmaceutical sector; Energy Sector) developing environmental engineering projects including energy efficiency and renewables.

Could you tell me how PM Group is committed to the development of renewable energy in Ireland?

PM Group is a consulting engineering firm. We are committed to ensuring sustainable design and project delivery are part of our customer service. We work with our clients to encourage sustainability in their projects, including renewable energy where possible.

Which renewable resources do you believe will be the main contributors to the Irish electricity, heat and transport sectors going forward into the future? What do you consider to be the main barriers to their development?

Wind; solar/PV and biomass (renewable gas / biofuel). Government tariffs will need to be increased to incentivise development; especially in industry. Long payments on investment do not encourage industry (i.e. > 5-6 years). Carbon tax on fossil fuels will further be needed to encourage greater use of renewables. In the longer term, wave technology if developed could have potential with Ireland’s coasts.

Considering Ireland has excellent wind resources, do you believe the country can rely on its continuous growth?

No. No one technology is the solution for renewable energy. It is not always windy, and energy storage is poor. A diverse range of renewables including storage is required to secure renewables as a reliable energy source.

In your opinion, what are the main challenges faced by Ireland to succeed in the deployment of wind energy technologies? How do you feel that these challenges can be overcome?
On land wind will face increasing planning objections due to the location; size and scale of the turbines. Greater provision of a portion of this renewable energy to local communities where the developments are located, demonstrating their financial benefit will ease objections. Greater multi use of the wind farm sites, where possible, may also demonstrated greater community benefits of them e.g. parkland walks within and around the turbines etc

**With regard to the heat and transport sectors, what actions would you consider necessary for the further expansion of bioenergy in Ireland for these sectors? What are the barriers to its expansion, and how can they be overcome?**

Biofuel development requires a reliable biomass source at large scale. I exclude crop growth to biofuel from this as this is not a sustainable approach to renewable bioenergy / biofuel. Organic waste conversion to biogas / biomethane is more sustainable. For this to happen – there needs to be: segregation of organic waste at source at domestic homes / commercial business; government initiative to encourage / incentivise biogas projects; Biomethane conversion targets and injection to gas grid / upgrading of existing service stations to provide biomethane.

**Ireland has a small but growing solar PV deployment industry. In your opinion, what are the main barriers to increasing Ireland's solar PV deployment?**

Cost of PV technology to install; lower efficiency rates in Ireland; low incentive tariff

**Do you believe improvements in solar technology, combined with Irish strengths in the renewable energy sector, can turn solar PV into a more practicable option in Ireland?**

Yes. But greater incentive requried to domestic homes etc to install them.

**What are the main obstacles you feel are preventing Ireland from meeting its target to reduce greenhouse gas emissions by 20%, according to its EU targets? What actions do you believe can be taken to help overcome these obstacles?**

Government, Government, Government and the fear of not being relected. There is no consistent approach from government to government i.e. the country does not have an overall strategy that cannot be changed from one government regime to another.

**How likely is Ireland to remove investment in fossil fuels completely? If you believe this likely, in what timeline could you see this happening?**

Unlikely.
In your opinion, what are the main reasons for Ireland failing to improve its energy efficiency at the desired rate in the residential, commercial and industrial sectors?

Government strategy and fear of reducing market competitiveness with respect to foreign direct investment.

What are the main challenges to integrating more renewable energy resources into the electricity sector safely and efficiently?

No answer.

In your opinion, what would be the main required changes in the renewable transport sector in Ireland so it could stop relying on imported fossil fuels?

See Q6

What do you believe to be the main challenges for the use of more renewable resources in the Irish renewable heat sector?

Greater encouragement/planning requirement for district heating systems and reuse of excess heat from industry. Eg. The Netherlands; Denmark etc successfully apply district heating systems.

Do you consider energy storage capabilities to be a barrier to the development of clean technologies in Ireland?

Yes

Do you believe it is an inevitability that Ireland will fail to meet its 2020 targets? Is it likely that Ireland will have to purchase energy credits to avoid heavy fines?

Absolutely, yes.

What do you believe can be done to overcome the barriers Ireland faces in meeting its EU 2020 targets?

No answer.

What can Ireland learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets? What can be done to avoid shortfalls when attempting to meet targets in the future?
No answer.

**How likely is it that Ireland will become a world leader in the use of renewable energy resources, and eventually, a net exporter of energy?**

Unlikely at the present. But the potential is there to be a leading user and exporter.

**Do you feel there are potential pitfalls to becoming highly dependent on renewable energy resources, and if so, what are those potential pitfalls?**

Renewables rely on an integrated system approach for overall success e.g. for bioenergy you need waste; wind must blow; PV relies on light transmission etc. Energy storage; fuel cells etc and a diverse range of renewable supply will be key.

**In your opinion, what are the main actions required to engage and empower communities and businesses to contribute to Ireland’s energy transformation?**

Greater awareness of the potential for renewables including success case studies from other countries is required. Community development will push government to act. Government has not demonstrated the ability to act on its own. Tax relief / incentives / carbon credits etc are the main drivers for business. For business to demonstrate the use of “green” energy is also becoming increasingly important so this may also be something to encourage more business use.
Appendix 11. - Interview Transcript No 5 of 5.

Which renewable resources do you believe will be the main contributors to the Irish electricity, heat and transport sectors going forward into the future? What do you consider to be the main barriers to their development?

Interviewee 5: The targets are down for renewable electricity is 40%, heat is 12%, transport 10% and there is an overall 16% of energy coming from renewable resources. Currently, in renewable electricity, we are at 30.1%, renewable heat we are at 6.9% and we have to get to 12%, transport we are at 7.2% and we have to get to 10%. This is at the end of 2017 figures I am putting here, we are at 10.6%, we have to get to 16%. To date the main contributor has been renewable electricity. Solar electricity is beginning to improve, but the main contributor has been electricity. Some renewable electricity may have to contribute to the renewable heat side.

Interviewee 6: You were asking about resources, onshore wind is the primary resource, that accounts for around 85% of all of our renewable electricity. There is some hydro, there is some landfill gas, some biomass, there is a small bit of solar PV, there is a small bit of offshore wind, but it is primarily onshore wind, because it has been the cheapest. Our policies have tended to support onshore wind primarily, we have had three REFIT schemes where it has been a feed-in tariff available to different technologies to contribute towards those 2020 targets. And those schemes were designed to meet these targets. Obviously, on heat and transport, there have been challenges in meeting the targets that were set with the first Renewable Energy Directive. But within renewable electricity, we think that by 2020 we will be very close actually to the 40% target. But onshore wind is the main resource for us.

Interviewee 5: In relation to barriers... currently, the barriers we are having in relation to onshore wind tend to be in relation to planning, objectors and that kind of thing, sensitive receptors I think is another name for them! So there is a lot of issues being referred to the Planning authorities, and An Bord Pleanala, so that is slowing things down a bit on that side. Other barriers include that we have a limited supply of biomass in the country, some options are importing that for bioenergy and heat. I suppose there is the cost of the technologies, which are expensive, like onshore wind and solar, they need subsidy. In relation to offshore wind, a grid policy needs to be developed for that. We have not had too much offshore wind to date.
Interviewee 6: The other thing to point out is that we did go through a very deep recession over the last decade and there was not a huge amount of capital funding available for the likes of large infrastructure projects. That is starting to change now and in project Ireland 2040, there is going to be 20 billion euros set aside for decarbonizing the economy. So money is starting to flowing into the sector now, which has not been there in the past. There are other barriers, Ireland has a very dispersed population, it has probably got more one-off houses per capita than any other country in Europe, I think probably within the OECD as well. So some of the solutions that might be suitable in other countries they are more challenging to implementing in Ireland, like district heating, and things like that. The structure of the population and the way it is dispersed just make some of those solutions more challenging to implement in Ireland.

**Considering Ireland has excellent wind resources, do you believe the country can rely on its continuous growth?**

Interviewee 5: As I said in the earlier question, onshore wind has been the biggest contributor to date, but because we are coming up against issues in relation to planning, the wind energy development guidelines of 2006 are being rewritten at the moment, revised, to take into consideration changes, turbines have increased in size, and various things like that. That is a currently a bit of a barrier to the development of onshore wind. In relation to offshore, it is more expensive and we have not done a lot offshore to date, there are planning issues there as well, and a grid development policy to be developed. There will be subsidies required for this and we are currently developing a renewable energy support scheme to put an auction structure in place to develop these types of technologies further.

Interviewee 6: I think there is definitely a risk that we may not be able to rely on wind for our continued growth within renewable electricity given, as my colleague has pointed out, that the wind energy development guidelines may restrict the available land that we can use for wind turbines, for the likes of noise and shadow flicker and set-back distances. And also there are other directives within Europe around special areas of conservation, some of our current wind farms are actually located within areas that are now designated as special areas of conservation, so we may not be able to repower those when the time comes. Over half of the current onshore wind turbine fleet that we have will come out of financial support in the next decade. So, whether or not they continue to produce electricity will depend on whether they can get support through repowering and there is a risk that a large percentage of that capacity will not be able to get repowering because of where they are located. So that is certainly a challenge, there is a
risk to the current stock that we have in place. As my colleague has pointed out, on the offshore wind side, we have not developed really that at all in Ireland. We have one small offshore wind farm. The current scheme that we are developing to support renewable electricity for 2030, the RESS, that is just one part of what is needed for offshore wind. We also need to develop a grid connection policy for offshore wind. The current planning and consent regime that is in place for offshore wind does not extend out beyond 12 nautical miles, so wind farms that are 12 miles beyond the offshore cannot get planning permission. So there are three things the support scheme, grid and planning and consent. So we are now turning to address all of those three. So offshore wind is more likely to play a role as a wind resource in the future more than it has in the past. Onshore may actually reduce because of the wind energy guidelines, another European directive, that reduce the area available to us to have onshore wind.

Interviewee 5: Do you understand repowering? Repowering a wind farm involves taking out the existing turbines, where there might be a small installed capacity and putting in large ones, increasing the total generated capacity of the wind farm.

Interviewee 6: For example, you might have a wind farm with 20 wind turbines, 1 MW each, they might have a life expectancy of 20 years. At the end of the 20 years, the developer can decide to just close down the wind farm or he can apply to repower. That might mean replacing the 20 wind turbines maybe with 5 turbines that are bigger, of 4 MW each, but he may not be able to do that, because his wind farm might now be located in an area where it is not possible to have larger wind turbines, for lots of different reasons. So repowering is something that we are looking at, trying to figure out what is the best way that we can keep the existing capacity generating while still adhering to the new guidelines that are coming at us, the new energy guidelines.

**In your opinion, what are the main challenges faced by Ireland to succeed in the deployment of wind energy technologies? How do you feel that these challenges can be overcome?**

Interviewee 5: As we said in the previous question, a large challenge at the moment is these national guidelines that are being revised, they have been out to consultation, and we have been taking different views from developers and the population into consideration. So we expected those to be published next year.
Interviewee 6: Yes, early next year. The main challenges, the wind energy guidelines, what they might do for where wind farms can be located, repowering of existing wind farms is going to be a challenge and then the development of offshore in terms of the grid, the consent, and the support scheme. Just another point on the challenges, the new Renewable Electricity Support Scheme, the RESS, that is going to target community ownership and bring communities more into the renewable electricity generation sector in general. So we feel that that might remove some of the barriers that have been there in the past in terms of objections that people might have had to the location of wind turbines close to their homes.

Interviewee 5: That aligns with the new directive that is almost agreed to be transposed, and as part of that communities have to be brought on board for any new schemes in future and for any develops.

**With regard to the heat and transport sectors, what actions would you consider necessary for the further expansion of bioenergy in Ireland for these sectors? What are the barriers to its expansion, and how can they be overcome?**

Interviewee 7: First, we have to tackle the issue of demand for bioenergy, we have to put in place supports for the production of bioenergy. We also need to look at the supply side as well. So, on the demand side, we are looking at certain schemes, in the heat sector we are looking at the support scheme for renewable heat, part of that is opened already for heat pumps, but we are also looking at a scheme that will run over for a number of years, where companies can apply for support to convert to a renewable form of heat, including bioenergy. On supply side then, we actually have, considering the amount of land we have in the country, a very low level of forestation. So, the big issue we have is trying to build up the supply of biomass we have in the country, so we need to increase forestation. Another area in the supply chain will be waste products, we need to make better use of our waste, so build more anaerobic digestion, build more waste energy plants, all that sort of thing. Then the main actions that are necessary to increase the amount of bioenergy in the heat sector... in the transport sector, we already have an obligation on fuel suppliers to include 8% biofuel in the tank. About 85% of that biofuel is imported, so we need to increase that obligation, we are actually going to be increasing it up to 10% at the beginning of the next year, 11% from the first of January 2020. That will get us quite close to our 10% RESS target 2020, which is about 9%. It would be great if we could maybe reduce the amount of imported biofuel we have, by providing opportunities for indigenous production of biofuel. In the transport sector, it is all petrol and diesel. Obviously,
we are looking at electrifying some of the transport, that would work for the smaller fleet. For the larger fleet, there are other solutions we are looking at as well, such as moving over to compressed natural gas, Gas Networks Ireland are in the process now of rolling out a number of filling stations, rolling out infrastructure in a number of filling stations around the country. The first one will open very shortly in Dublin Port, where heavy goods vehicles can roll up and top up with natural gas. International freight can come in, bring their gas trucks in, some of the capital fleets here can convert over to natural gas. That also provides us the opportunity to get biomethane into the grid and use biomethane in the transport sector. They are all the things we are looking at. Hydrogen is another option, as it starting to be talked about now. There are groups looking at it at the moment. In the alternative fuel directive. The National Policy Framework, we thought it would not be until 2025, but it looks it could actually happen before then. It has started to happen a bit in the UK, there are industry groups that are very interested in it, we will see how that progresses, but hydrogen could be another option. That is not bioenergy though, but they are all the little options that can happen in the heat sector and transport sector. Another thing, another area we are looking at getting into is district heating as well the use of waste heat. There is a waste to energy plant about a mile down the road from us here down in Poolbeg, an incinerator that burns waste. They have pipes in the ground around in the whole area and by the next decade, it is expected that heat from that plant will be used in nearby buildings. They are talking about developing a couple of thousand houses up around the old glass bottle site, where they had a glass bottle factory. They are talking about redeveloping that area, putting social housing in, and using the heat from the waste energy plant. So all those things are going on and I think they will have a big impact here over the next few years.

**Ireland has a small but growing solar PV deployment industry. In your opinion, what are the main barriers to increasing Ireland's solar PV deployment?**

Interviewee 5: Currently, for domestic solar, there are planning restrictions, the amount of solar PV panels that you can put on a house, I think it is up to 12 square meters. The current thinking is, at this point in time, that that is too small and needs to be increased. We are liaising with the Department of Housing, Planning and Local Government, who are responsible for those regulations, to try to increase that. So that is a restriction at the moment on the domestic side. The cost of solar has come down, so that is positive. There is no support scheme generally
available for solar at the moment, apart from microgeneration, which is on the domestic side. That will be a possibility under the RESS scheme, one of the technologies.

Interviewee 6: Yes, that is a fair point. Cost, I suppose, is probably one of the main reasons why solar was not included in the three REFIT schemes I mentioned earlier. The solar cost has come down by 80% over the past five years and it is predicted to come down by a further 50% over the next two or three years. So it could be that Ireland is actually starting to embrace solar at the right time, you know, that we have not locked into higher costs for solar technologies, that other countries have done. As we have seen, we are going to get quite close to our renewable electricity targets with onshore wind, so maybe that is not a bad thing in terms of timing. So cost was certainly one of the major barriers for us not moving on solar in the past. We are starting now, as my colleague said, at the micro level for domestics, we have a pilot scheme opened for microgeneration. There is also a potential for solar to bid into auctions within the renewable electricity support scheme and the design of that scheme was approved by the government over the summer. One of the policies that was included in that scheme is to broaden the technology mix, to diversify away from just onshore wind. So, there is definitely potential and there is support for solar to be included in Ireland's renewable mix in the future. We are definitely moving in that direction.

Do you believe improvements in solar technology, combined with Irish strengths in the renewable energy sector, can turn solar PV into a more practicable option in Ireland?

Interviewee 5: As my colleague was saying because the cost has come down now, it is likely to be a contender for a support scheme which we did not have previously under the old Refit scheme. We have recently, I think it was July, we have introduced a microgeneration scheme for solar PV in residences. That is going to be evaluated after six months to see what the demand is. There are possibilities under the renewable electricity support scheme that solar could be supported as a technology. These are the issues we are looking at at the moment, in regard to increasing solar as a technology within the country for generation.

Interviewee 6: Yes, it is definitely going to happen. As part of the renewable energy directive, the Recast Renewable Energy Directive, Ireland will need to set out what its ambitions are for 2030, so targets basically for heating, transport, and electricity through the National Energy And Climate Plan. So given what we talked about onshore wind and the reduced amount of land available for onshore wind, solar will naturally become more prevalent because we are going to increase our demand for renewable electricity, our overall demand for electricity will
increase as well as my colleague has mentioned. So solar will come in into that mix naturally. What we might do with the RESS scheme though is try to accelerate how quickly solar comes into the mix by providing incentives to attract solar into the scheme and to make possible to it to win some of the auctions by using certain levers within the auction system that we implement. But as things stand, solar in terms of cost, will still be more expensive than onshore wind for the next decade. So it cannot compete if you are just looking at a cost basis. We are looking at what are the other benefits of bringing solar into the mix and the benefits are, you know, that are more accessible for communities, for citizens to participate in the transition if they can access it. It is definitely something that is part of our policy objective is to increase solar through the next decade.

**What are the main obstacles you feel are preventing Ireland from meeting its target to reduce greenhouse gas emissions by 20%, according to its EU targets? What actions do you believe can be taken to help overcome these obstacles?**

Interviewee 5: I think the main obstacles are transport emissions, agriculture emissions, which are almost a third of the emissions, and then there is some from the electricity generation, like oil, gas, coal, and peat, fossil fuel generation. The actions we are taking are, as my colleague was saying, in relation to biofuels, we brought in this obligation rate. the current levels are 8%/volume and it is going to 10% at the beginning of 2019 and 11% at the beginning of 2020. And also within the transport sector, there are incentives now for electric vehicles and they are beginning to increase year by year.

Interviewee 7: We have doubled the amount, there was 3800 on Irish roads last year, there is now around 7500, so we almost doubled the number of EVs within a matter of a year. They have started to become more accepted, so we think that momentum is going to continue as well, so that will help.

Interviewee 5: On the renewable heat side, we have recently introduced this renewable heat support scheme, where the commercial operators get 30% of the installation cost grant. Then there is also been a climate action fund introduced in July this year, with quite a number of different projects that will stick to reduce greenhouse gases emissions.

Interviewee 7: 97 applications, 7 projects approved, seven or eight projects. There is a press release on the Department’s website, from about two weeks ago, that explains what the projects are, it includes things like, charging infrastructure for electric vehicles, street lighting,
swapping out of the old halogen streetlights, or whatever type of light bulbs they have to LED lighting, all these kind of things. The successful projects are up on our website, you can take a look at them.

Interviewee 5: The last point in there was the new renewable electricity support scheme, which is due to be introduced next year. They are the main actions.

Interviewee 6: Agriculture is a huge part of our industry in Ireland and GDP probably more so than most other member states within the European Union. And again, just to go back to the nature of the dispersed population makes it more difficult, it has made it more difficult in the past to implement some of the transport solutions that other countries may have had. Again, the fact that we went through that deep recession over the last decade, there is more money coming into the system now, and the National Development Plan will provide an awful lot more funding for us to tackle some of these challenges that we have not been able to address in the past.

**How likely is Ireland to remove investment in fossil fuels completely? If you believe this likely, in what timeline could you see this happening?**

Interviewee 5: We think it is going to be very slow to remove fossil fuels completely mainly because the renewable electricity which mostly we get of wind and wind is not blowing all the time, so you need an energy mix so that when the wind farms are not generating electricity, you get it from another source, such as natural gas or oil. The business model of the main generation companies, like Eirgrid and ESB Networks, are based on that. We see there is going to be a mix there for quite a while.

Interviewee 6: That is fair to say. We do not have any other dispatchable sources of energy, we do not have nuclear, we do not have much hydro that lots of other European countries might have that would help that to get closer to higher renewable electricity targets. But the ambition is there, the Energy White Paper does say that by 2050 we want to have removed fossil fuels from the energy sector. I suppose the challenge we have now is how we can try to accelerate that. There is a lot of work that the system operators have done to bring a more renewable generation into the system. The new Minister has more ambition for us to move quicker and show greater ambition in that space as well. So I think, the National Energy And Climate Plan when it comes out of the draft, and it goes to the European Union at the end of this month and
gets finalised next year, that will set out what our roadmap is for 2030 and that should show significant more ambition than we have undertaken in the past.

**In your opinion, what are the main reasons for Ireland failing to improve its energy efficiency at the desired rate in the residential, commercial and industrial sectors?**

Interviewee 5: We have an energy efficiency division here, so I got some information from them on that. They are of the view that there has been considerable progress and we are projected to achieve 16% of the 20% national target. The public sector has already achieved 24% in improved efficiency. They see the appetite as a key factor in being below potential performance. In the commercial and residential sectors, energy efficiency upgrades require decision makers to devote time and often money to making changes. They need to be persuaded that these changes are worth it. Businesses are focused on productivity, they often do not have the time or the capacity to devote to making the changes or investments to improve their energy efficiency. And that is where we see more value in reaching out to business to improve awareness, making them aware of the potential gains and some of the supports available. We are also investing more in understanding decision-making behaviour through a new initiative called the Behavioural Economics Unit in the SEAI, which is the Sustainable Energy Authority of Ireland. Getting the attention of decision-makers can bring multiples benefits, and persuading them to make changes can be the key to achievement of the potential. That is what they have to say about the energy efficiency side.

Interviewee 6: Money as well has probably been a factor. There was a decade where there was not a huge amount of funding available for energy efficiency and now that is starting to change again, so we can send you on some links to documents such as the National Development Plan, which sets out how much Ireland is going to spend over the next decade on lot of these initiatives.

**What are the main challenges to integrating more renewable energy resources into the electricity sector safely and efficiently?**

Interviewee 5: Like we mentioned in relation to a previous question, challenges in relation to planning and national wind energy guidelines, and development of grid policy offshore. There is also a challenge in relation to getting the actual renewable electricity into the grid. Eirgrid, which are the national grid operator, have introduced a new program of work called DS3, which is delivering a secure, sustainable system. So they have been rolling out various projects and
they have been working with a lot of the generators to make modifications to their plants so that they are more controllable. So far the DS3 program has enabled Eirgrid to increase levels of renewable generation possible on the system at any given time from 50% to 60%, and they are aiming to increase this to 75% over the coming years. That work is still ongoing, and it has been quite successful.

Interviewee 6: Yes, I mean that is considered a world leading program, DS3, so they can take up to 75%, they have at times this year from intermittent generation sources onto the grid. So Eirgrid is focused heavily on that. They are going to need to extend that DS3 program for the next decade, because that was designed for us to have a 40% renewable electricity target by 2020. Obviously it can go higher than that on occasion, but if we are looking to get 55% renewable electricity by 2030, they are going to need to increase the work that they have done on that DS3 program. So we work very closely with the system operators to make sure they are firmly focused on the work they need to do to make that happen.

**In your opinion, what would be the main required changes to the renewable transport sector in Ireland so it could stop relying on imported fossil fuels?**

Interviewee 7: Well currently what we have at the moment, practically all of our transport fleet is either petrol or diesel. We actually don’t have any indigenous fossil fuels other than natural gas that we could possibly use. I think what we should actually be looking at is removing our reliance on fossil fuels altogether. That is ultimately what we would hope to achieve. We would need to move more to use of electrification, particularly in the small car fleet, perhaps in the rail fleet. There are plans to extend the DART network to Balbriggan, to build a few metro lines, but I think electrification will probably have a limited impact in that really. Technologically, it will probably only apply to public transport or to smaller vehicles. So what else can we use? I think we can possibly convert the larger vehicles to natural gas, and substitute biomethane in there. Hydrogen is a possibility, that looks a little bit further down the road. We have biofuels in place but at the moment they are limited by the fact that there still has to be fossil fuels in the tank. There are whats known as blend walls, so you can only blend certain types of biofuels up to a certain amount. Currently, the blend walls in Ireland are 5% biofuels in petrol and 7% in diesel. So thats not to say that cars cannot run on higher blends, most cars are actually warranted to run on 10% in petrol. The problem is there are older cars in the fleet that may not be able to use the C10 so we will have to place whats known as “protective grade” on the market and thats going to be a big challenge for us. And thats not going to happen until
early in the next decade, after 2020. There are developments of biofuels where, there is particularly a biofuel called hydrogenated vegetable oil (HVO) which does not suffer from a blend wall, you can actually use it direct substitute for diesel. But at the moment it is limited and expensive. We expect that production of that will start to ramp up in the coming years and hopefully bring the price down. On the petrol side we have that blend wall, E5/E10, hopefully a lot of that will be replaced by electrification, because petrol is only used really in smaller vehicles. So there are options out there, but it is going to take a while, I mean we have 2.5 million vehicles in Ireland and people don’t change their vehicles overnight so it will take time. From 2030 the government has a stated ambition that all new passenger cars sold in Ireland after 2030 will be zero emissions capable, so they will either be an electric vehicle or a plug-in electric hybrid. So that might sort out the smaller vehicles in the fleet but the larger vehicles are going to be the issue. And when I am talking about larger vehicles I am not talking about aviation or shipping, thats another matter again. But there are solutions there as well in the aviation sector and the maritime sector. But they seem to be still a long way off.

What do you believe to be the main challenges for the use of more renewable resources in the Irish renewable heat sector?

Interviewee 7: My colleague has mentioned before that we have a very dispersed population, and about 52% of our heat sector is fuelled by oil. Bioenergy, heat pumps, are expensive. The cost of investment in them is expensive and they do not give a quick payback, so even though they will pay back after time there is a lot of big capital investment so for somebody to throw out their oil boiler for bioenergy or a heat pump, they are going to have to pay a lot of money up front and wait a long time to actually get payback for that. Another issue is that gas. which is another popular fuel in Ireland, particularly in the urban areas, is quite inexpensive, it is affordable for most of our population. It is hard for bioenergy to compete where gas is. We have to make sure that our energy is affordable for all of our population so we have to keep that in mind. Energy efficiency is going to play a huge part, we need to put more energy efficient systems in. Again, there is a cost there and I have heard before that the people most in need of energy efficiency upgrades are the people who really cannot afford to pay for themselves. I mean we do have schemes like the Better Energy, Warmer Homes Scheme where poorer people in Ireland can get energy upgrades and communities can get energy upgrades. Things like that hopefully will help in that regard but that’s a big challenge, we have to try and
bring everybody along, we cannot price anybody out of this market and that is one of our main challenges in the heat sector.

**Do you consider energy storage capabilities to be a barrier to the development of clean technologies in Ireland?**

Interviewee 5: To date we had not really considered energy storage to be a problem but it is a useful tool going forward and it has significant potential. Having looked into this recently, it can facilitate decarbonisation so that when we get to a certain level of our targets, and moving from 2020 to 2025 it will give greater flexibility to the grid and it will also assist the transport sector in facilitating the development of that sector. Electricity storage in the home is part of the microgeneration scheme which we have rolled out recently, and batteries can be obtained on that scheme for charging electric vehicles at home. The processes of connecting energy storage to the grid are complex enough and Eirgrid has introduced it as part of the DS3 scheme and they are procuring that as a system service. We have noticed that there is storage plants beginning to be set up in various parts of the country recently so regulations will have to be put in place for those. They will facilitate new connections on the grid and that type of thing, and they have a lot of positives in that they will improve reliability of supply. They can contribute to wholesale electricity prices coming down, that kind of thing, so they are the main points I think in relation to energy storage.

Interviewee 6: Just to add to that, it has not been a barrier in the past as the system has been able to take up to the 40% that we have targeted and indeed, higher than that, but as our ambition increases it is going to become part of the solution more and more, storage. As my colleague says, we are looking at it at the moment on a micro level, for domestic properties, but again as my colleague said, Eirgrid have introduced auctions for system services. The CRU which is the Commission for the Regulation of Utilities, they have developed a connection policy for generators as part of their enduring connection policy 1. They allocated just under half of the capacity to systems services and storage type solutions. So between this department, the system operators and the regulator, we are all moving together now to develop policies to support battery storage more and more.

Interviewee 7: Personal ownership of electric vehicles will help too. If we can encourage people who own electric vehicles to charge at those times of day where there is not so much demand on the system that will help too. Overnight when there is wind for example, that can help towards storage. Basically electric vehicles are a big battery, they have capacity to store
electricity. Even in the future, they are talking about electric vehicles, if you charge your electric vehicle one night and there is a demand on the system the following night, you can actually plug your electric vehicle into the grid and use discharge your car into the grid and get paid for it. They are the sort of ideas being looked at, maybe not here but all over the world, and that could be a possibility for the future.

**Do you believe it is an inevitability that Ireland will fail to meet its 2020 targets? Is it likely that Ireland will have to purchase energy credits to avoid heavy fines?**

Interviewee 5: We have a modelling group in SEAI, the Sustainable Energy Authority of Ireland, and they think we can meet 80 to 90% of the 2020 targets. We are likely to meet 16%, so we are likely to be in the region of between 12.8 to 14% of that. In relation to the fines and energy credits, under the 2009 Renewable Directives, there are mechanisms called statistic transfer mechanism, you can put just credits and maybe wear this. We have been doing some continuous planning in relation to that and, other member states that will have a surplus we can purchase credits from them. That is being looked at, at the moment.

Interviewee 6: Just to add to that, we are doing everything in our power to meet those targets, the schemes that we have introduced this year, the SSRH, the RESS, the microgeneration scheme, we are still continuing to try and meet those targets, that is our ambition. However, as my colleague says, there are alternative ways within the directive of meeting the targets other than by deploying new generation. Just to add to that, when the target was set we were at something like 3% renewable energy, we are now going to end up between 12.8% and 14%, so that is quadrupling the deployment over that decade. And that is at a time when energy demand has shot up with the likes of data centres etc. deployed in Ireland. So the energy demand in Ireland has increased and the renewable energy portion of that has increased at the same time. So that is something that we are very conscious of, the increased energy demand from data centres in particular, and large energy users and that has been one of the challenges I suppose that has led to us getting close to 2020 and being short of where we need to be.

**What do you believe can be done to overcome the barriers Ireland faces in meeting its EU 2020 targets?** Interviewee 5: At the moment, we have been looking at current connection policy to the grid because that has become a but of an issue recently. There used to be a gate process involved which is like a queuing system and that was administered by the CRU, so that system has been in operation and a new system needs to be put in place now and they recently came out with a decision relating to that, for connecting new generators to the grid. This is to
prioritise “shovel ready” projects and facilitate new connections, and there are quite a lot of them in relation to solar out there, so these need to be facilitated too. There are potential cost savings associated with resetting the existing grid connection process, and this might translate into lower energy bills for consumers. The object is to prioritise connections for new flexible technologies and increase renewable generation in the grid. **What can Ireland learn from its own progress and the progress of other countries in attempting to reach the EU 2020 targets? What can be done to avoid shortfalls when attempting to meet targets in the future?**

Interviewee 5: We have had to look at what other states are doing in relation to this, and in relation to support schemes and whatever other schemes that have been out there, and we have gone along and done similar schemes.

Interviewee 6: Yes exactly, so we are starting to implement now support schemes whether its for heat or electricity, that other states have already done. I would say just on the energy demand piece and the data centres, we are moving more towards a planned out approach, so we published a petition paper on data centres over the summer, so we are going to try incentivise them to locate in areas where there is existing grid capacity rather than where there is grid shortage, which would place less of a demand on the system itself. We are looking to bring communities and citizens more into the energy transition in terms of generation. The new directive is going to support our ambition in doing that. So there are lots of things that we are moving toward that are going to help us avoid the shortfalls of the past. And there is more money available too.

Interviewee 5: In the National Development Plan, it commits to almost 22 billion euros to address the transition to low carbon and a climate resilient society.

Interviewee 7: There are networks available, there is concerted action groups around Europe, there is one for renewable energy, one for energy efficiency, all those networks exist, so we have a network there where we can speak to other member states and find out how they are doing and try and learn from them as well.

Interviewee 6: Yes, we do participate in those, we were over in Austria last week actually at the concerted action group for renewable electricity.

**How likely is it that Ireland will become a world leader in the use of renewable energy resources, and eventually, a net exporter of energy?**
Interviewee 5: The 2015 white paper presented a long term vision that is intended to guide the direction of our energy policy out to 2030. The white paper identifies the importance of diversifying Ireland’s energy generation portfolio and decarbonising the energy sector by 2050. We have attempted to go along this as far as we possibly can, and when it comes to integrating renewable electricity to the grid, we are one of the leaders up there with the DS3 program. So in a lot of other countries, they have been looking at what we have been doing in that respect. Our energy policy is fully aligned with the EU climate and energy objectives and this transition to decarbonisation and we are continually reviewing our policies to reduce emissions and improve efficiency also. We have said there is a target set of reducing greenhouse gases by 80-95% by 2050 so we just have to implement that.

Interviewee 6: We have very limited interconnection in Ireland, its just between ourselves and the UK, so there are two new interconnectors planned for the middle of the next decade, one to the UK and one to France, so they may help us in terms of exporting energy. Just in terms of becoming a world leader, that is something our minister has spoken about in the last few weeks, so he has recently gotten approval from the government for an all-government approach. So previously this department may have been acting on its own in developing some of these policies, the Department of Transport was doing its own thing, Agriculture was doing its own thing, he wants to bring all of the departments together and have a government approach to tackling climate change with Ireland becoming a leader, so that is very much his ambition to help us meet our 2030 targets and to get to decarbonisation by 2050. So I think things are changing actually in that it is becoming more of a government priority and not just individual departments doing their own thing.

Interviewee 7: We are still over-reliant on imported energy and thats a fact, although we have made strides. I heard Matthew Clancy on the TV the other night saying something like 69% of our energy is imported, so we have a long way to go. We definitely need to move away from that.

**Do you feel there are potential pitfalls to becoming highly dependent on renewable energy resources, and if so, what are those potential pitfalls?**

Interviewee 5: As I said in the previous question, Eirgrid has a major program called DS3 to try and integrate the renewable electricity produced into the grid and thats a big focus with them and they are committing quite a lot of resources to it, so we don ´t intend to waste too much of it and make sure that anything that is produced goes into the grid.
Interviewer 6: As I said, in the energy white paper, there is a plan laid out to 2050, so coal and peat will be replaced and gas will probably be the transition fuel that provides that reliability while we build the system to cater for more renewables. So if we were just to go to all renewables overnight, yes that would be a risk, but that's not the plan, the plan is to have gas as one of the backup fuels as part of that transition. And storage is part of that journey as well.

Interviewee 5: One of the other pitfalls is that we do not have a lot of manufacturing plant for turbines here, so we are very much dependent on those being brought in from abroad.

Interviewee 6: And I suppose more interconnection would probably reduce some of that risk as well, so those two projects going ahead in the next decade will probably reduce that risk.

**In your opinion, what are the main actions required to engage and empower communities and businesses to contribute to Ireland's energy transformation?**

Interviewee 5: There is a code of practice now for developers for implementing wind farms and part of that is community engagement, and that has become a huge factor in the development of new projects going forward, and that will seek to integrate communities and business into any projects that are happening in various parts of the country. The new RESS scheme that is due to come out late next year, community engagement and participation is a big component of that, and we have had quite a bit of work done on that.

Interviewee 6: In relation to RESS...community participation. So there are two different types of projects that will be supported under that scheme- developer led projects where they will have to offer an equity investment opportunity to people who live in the area to buy into the project; and then also community led, so we will support communities bringing their own renewable electricity projects forward. So that's one piece. Like we mentioned earlier, we've got a pilot system grant scheme open at the moment for microgeneration; and then the new directive, articles 21 and 22 of the Recast Renewable Energy Directive say that we must support renewable self-consumers and renewable energy communities. So that's coming at us from a European level but we are also moving that direction ourselves anyway. So we are putting in place through the new RESS scheme supports for communities and citizens to be part of the energy transition. So it's one of the departments main priorities actually in terms of developing new energy policy, is to bring communities and bring the prosumer into the transition.
Interviewee 7: There is also a better energy community scheme as well, where communities can apply for grants and supports to upgrade the energy efficiency of their community. SEAI would have all the details of that on their website.

Interviewee 6: So through that, there is a sustainable energy communities subsection to the better energy communities and there is about 205 sustainable energy communities in Ireland at the moment and they are expecting to have over 500 by 2020, so they support communities to look at their own energy usage and how to reduce it and look at energy efficiency, and ultimately it might mean that they end up doing some sort of generation at the end of that. But they look at efficiency first, and reducing their energy demand in the first instance because that's where the real cost savings are, deep retrofit and things like that are kind of programs that they are involved in.

Interviewee 7: Tipperary Energy Agency are kind of a pioneer that they are ahead of the game in that sort of stuff.
Appendix 12. - Informed Consent No 1 of 7.

Informed Consent Form

Research Title
The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Project Summary
Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable energy resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland to meet its target and researching the main barriers to achieving this target is the aim of this research.

By signing this informed consent form, you are agreeing that:
(1) You have received and read the Participant Information Sheet;
(2) Any questions you might have asked about your participation in this research have been properly answered;
(3) You were informed that all data you provide during the interview will be confidential and available only to the student undertaking this dissertation;
(4) You are participating in this research voluntarily;
(5) You are aware of any risks (if any) involved in participating in this dissertation.

Participant’s signature: __________________________  Participant’s Name: __________________________

Student’s signature: __________________________  Student Name: __________________________

Date: 04/12/15

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[Signature]
Participant’s signature

[Signature]
Participant’s Name

[Signature]
Student’s signature

[Signature]
Student Name

[Date]
Date
Appendix 14. - Informed Consent No 3 of 7.

Informed Consent Form

Research Title

The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Project Summary

Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable energy resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland meet to its target and researching the main barriers to achieving this target is the aim of this research.

By signing this informed consent form, you are agreeing that:
(1) You have received and read the Participant Information Sheet;
(2) Any questions you might have asked about your participation in this research have been properly answered;
(3) You were informed that all data you provide during the interview will be confidential and available only to the student undertaking this dissertation;
(4) You are participating in this research voluntarily;
(5) You are aware of any risks (if any) involved in participating in this dissertation.

Participant’s signature

Participant’s Name

Student’s signature

Student Name

Date
Appendix 15. - Informed Consent No 4 of 7.

Informed Consent Form

Research Title

The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Project Summary

Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable energy resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland meet to its target and researching the main barriers to achieving this target is the aim of this research.

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4. You are participating in this research voluntarily;
5. You are aware of any risks (if any) involved in participating in this dissertation.

Barry McDermott

Participant’s signature

Participant’s Name

Beatriz Fernandes

Student’s Signature

Student Name

12 December 2018

Date

Informed Consent Form

Research Title
The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Project Summary
Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable energy resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland meet to its target and researching the main barriers to achieving this target is the aim of this research.

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(4) You are participating in this research voluntarily;
(5) You are aware of any risks (if any) involved in participating in this dissertation.

Participant’s signature: Gerald McManus
Participant’s Name: Gerald McTierney

Student’s signature: Beatrice Fernando
Student Name: Beatrice Fernandes

Date: 12/12/2018
Appendix 17. - Informed Consent No 6 of 7.

Informed Consent Form

Research Title
The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Project Summary
Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable energy resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland meet to its target and researching the main barriers to achieving this target is the aim of this research.

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(3) You were informed that all data you provide during the interview will be confidential and available only to the student undertaking this dissertation;
(4) You are participating in this research voluntarily;
(5) You are aware of any risks (if any) involved in participating in this dissertation.

Participant’s signature ___________________________
Participant’s Name ___________________________

Student’s signature ___________________________
Student Name ___________________________

Date ___________________________

12/12/2018
Appendix 18. - Informed Consent No 7 of 7.

Informed Consent Form

Research Title

The research involves an exploratory study into the main barriers that are preventing Ireland from achieving the EU Renewable Energy Directive targets, considering its renewable resources.

Project Summary

Ireland is well known for having magnificent renewable energy resources, which are crucial suppliers for the Irish energy grid. Regarding renewable energy targets, by 2020, the Irish government is committed to produce at least 16% of all energy consumed through renewable energy resources, in accordance with the EU Renewable Energy Directive. Considering the short time frame, it is a challenge for Ireland meet to its target and researching the main barriers to achieving this target is the aim of this research.

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(2) Any questions you might have asked about your participation in this research have been properly answered;
(3) You were informed that all data you provide during the interview will be confidential and available only to the student undertaking this dissertation;
(4) You are participating in this research voluntarily;
(5) You are aware of any risks (if any) involved in participating in this dissertation.

Participant’s signature ___________________________ Participant’s Name ___________________________

Student’s signature ___________________________ Student Name ___________________________

Date ____________

12/12/2018