RENEWABLE ENERGY POLICY TRANSITIONS: UK & IRELAND 1995-2015

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DECLARATION

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Abstract

A radical departure from existing socio-technical pathways is required across the world's energy systems if we are to achieve sustainability and low-carbon goals. This transformation is being driven by the world's need to reduce global greenhouse gas emissions and to avoid the most profound consequences of climate change. Motivations also include national security risks associated with the dependence on hydrocarbon-based energy sources and a wish to increase the competitive position of renewable energy generation in the energy system. The search for an ambitious energy system transformation has highlighted the significant implementation gap between sustainability objectives and present unsustainable paths. This transition presents a systemic challenge to our societies, encompassing complex and overlapping socio-technical, economic, and cultural processes, but it is increasingly framed as a policy challenge. Over the last 30 years, the European Union (EU) and its member states have been engaged in that challenge by implementing policies to increase renewable energy use as a power-generation source. Understanding what policies have been most effective in advancing renewable energy is critically important in designing new schemes, yet a comprehensive contextual and comparative analysis of policies has not been completed to date. In response, this thesis analyses renewable energy policies' effectiveness in encouraging renewable energy generation across the EU from 1995 to 2015, with a comparative perspective involving two case study countries of contrasting contexts: Ireland and the UK, focusing on solar and wind power. It utilises the framework of the multi-level perspective to examine the policy outcomes by assessing how those policies have performed and who benefited from them. Qualitative studies that use interviews with policy makers to explore their decision-making process and hoped-for results are surprisingly hard to find and represent a significant gap in energy policy literature. To close this gap, a series of interviews were carried out with many of the key actors in Ireland, the UK, and Europe to shed light on policy formulation and implementation from industry, NGO, finance, and government perspectives. An analysis of the policy documents produced by policy makers was also undertaken. This thesis highlights that policy makers have been too focused on the power of the markets to implement change, that Ireland has been slow to use of key mechanisms such as auctions and that the power of incumbents, such as utilities, needs to be more carefully considered when designing policy and attempting to change pathways.

Contents

List of Figures and Tables

List of Abbreviations and Acronyms

AER: Alternative Energy Requirement
BEIS: Department for Business, Energy & Industrial Strategy
CCC: Committee on Climate Change
CER: Commission for Energy Regulation
CfD: Contract for Difference
CO2: Carbon dioxide
DECC: Department of Energy and Climate Change
DSO: Distribution system operator
EC: European Commission
EEA: European Environment Agency
EIA: U.S. Energy Information Agency
EIB: European Investment Bank
ESB: Electricity Supply Board
ESG: Environmental, Social and Corporate Governance
ESO: Electricity system operator
EU: European Union
FiT: Feed-in Tariff
GDP: Gross Domestic Product
GHG: Greenhouse gases
GW: Gigawatt
GWh: Gigawatt-hour
IEA: International Energy Agency
IPCC: Intergovernmental Panel on Climate Change
IRENA: International Renewable Energy Agency
IRL: Ireland
IS: Innovation systems
IT: Institutional theory
LCF: Levy Control Framework

LCoE: Levelised Cost of Energy

MLP: Multi-level perspective

MW: Megawatt

MW h: Megawatt-hour

NFFO: Non-Fossil Fuel Obligation

NGO: Non-governmental organisation

OFGEM: Office of Gas and Electricity Markets

OMC: Open method of coordination

PPA: Power Purchase Agreement

PSO: Public service obligation

PV: Photovoltaics

R&D: Research & development

REFiT: Renewable Energy Feed-in Tariff

RE: Renewable Energy

RES: Renewable energy sources

RESS: Renewable Electricity Support Scheme

RO: Renewables Obligation

ROC: Renewables Obligation Certificate

ROI: Republic of Ireland

RPS: Renewable portfolio standard

SEAI: Sustainable Energy Authority of Ireland

SET Plan: Strategic Energy Technology Plan

SNM: Strategic niche management

SRO: Scottish Renewable Obligation

STS: Science and Technology Studies

SWF: Sovereign Wealth Fund

TGC: Tradable Green Certificate

TIS: Technological innovation system

UK: United Kingdom

UKERC: UK Energy Research Centre

UNFCCC: United Nations Framework Convention on Climate Change

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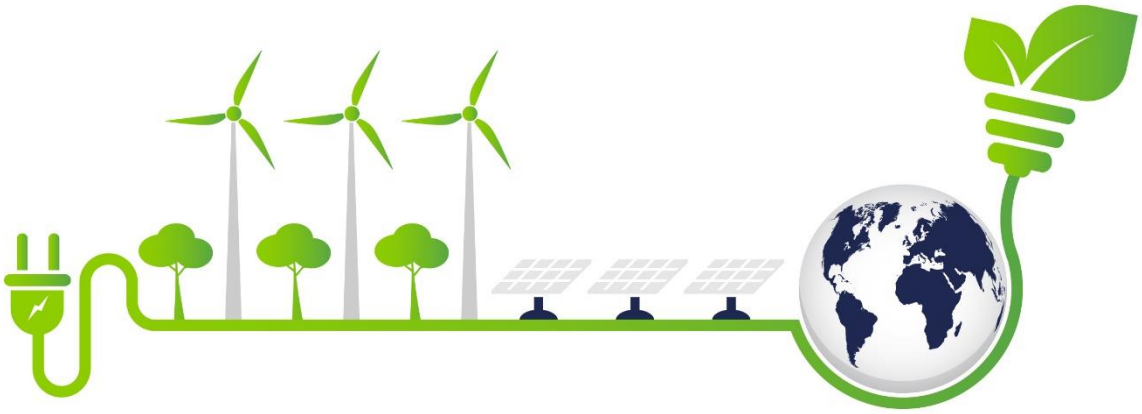
Finally, to Maeve, who so loved to read, I dedicate this to you.



1. Introduction

Renewable energy policies have been created and implemented across the EU, including Ireland and the UK, for much of the last 30 years (Helm, 2014). Although those policies are often treated as dry legal documents, they are the critical rules of the energy system, which are replicated and changed by constant exchanges between actors, institutions, and new technologies and business models. This introductory chapter first highlights the challenges facing society due to climate change. It then describes some of the levers available as society works to transition to an energy system that reduces the world's damage from carbon emissions. It subsequently offers a synopsis of EU policies on energy and climate change and EU renewable energy investment and presents both the case study countries and the theoretical framework through which the research questions are addressed.

> *I think policymaking is a very, it's very hard to make it generic, that's what I would say. It's very hard to say policies go through the same life of development. In other words, they're always typically so unique to the people involved, the process involved, the political environment at the time. There are so many discernible factors that vary from one policy or regulation to the next (Interview LR13).*

The above statement from the CEO of the entity, which controls a critical part of Ireland's energy infrastructure system, emphasizes the importance of this research. A transition to a sustainable low carbon society requires the invention and implementation of new energy generation sources that will provide safe, secure and low-carbon electricity across society, with a broader transformation in the companies and economies that provide that energy and services to support it (International Renewable Energy Agency [IRENA], 2017a). Approaches are needed to develop on this profound interaction of technologies and innovation with sociocultural, political, and economic factors, thus framing the problem of the energy transition as a socio-technical challenge. This thesis aims to establish how socio-technical changes interact with renewable energy policy, its creation and implementation, and based on this, to determine how those policies feature in our transition to a sustainable and low-carbon society. In the process, this thesis explores the relationship between incentives and efficacy in renewable energy policy in the EU explicitly, with an in-depth analysis of two contrasting case study countries: Ireland and the UK.

The problems faced by society in dealing with the effects of climate change are significant and addressing them involves fundamental changes in how we organise multiple aspects of peoples' lives. The transformation of how electricity is generated has been prioritised by governments across the globe, acknowledging the role energy generation has played in climate change (Gielen et al., 2019; Solomon & Krishna, 2011). Over the last 30 years, throughout the EU, a series of policies have been put in place that changes the grid's process and makeup. Yet, there is a scarcity of academic studies on how renewable energy policy has been decided upon and the effects of particular policies on various actors. This thesis aims to work to fill this gap.

To achieve its aims, this thesis will examine the complicated socio-technical developments that underlie the promotion of different renewable energy policies and asses their consequences on the transition to a low-carbon society. This research, therefore, will contribute to the conceptual understanding of energy transitions by bridging traditional policy analysis (Gilliland, 1975), which focuses on economic impacts, and transition approaches, which include socio-political dimensions (Miller et al., 2015). It also aims to add to future policy design by showing how EU renewable energy policies were developed and then implemented in the UK and Ireland, whilst offering an analysis of how different actors fared during this transition and what can be

learned from each case. Therefore, it can inform policy makers on energy policy decisions as they consider options within their contextual variables.

1.1 Climate Change

> *But as a friend of mine often says to me, when people talk about climate change – even relatively progressive people – they seem to think it's a problem that lies in the future, to be dealt with by somebody else at some other time (Interview GU13).*

The above quote by an ex-minister of energy highlights how even within what we imagine is an educated and aware social set, the causes and problems of climate change are extremely hard for individuals to fully appreciate. Climate change is frequently referred to as a 'wicked' problem (Head, 2008; Incropera, 2016), an issue which, for many individuals, is regarded as in the distant future, with solutions required to combat it being wide-ranging and multi-decade. Today's effects are hard to properly consider, while the necessary solutions to be enacted will generate significant changes to people's lifestyles. All this means that officials charged with determining policies in reaction to climate change have many significant challenges. It is one of the most immense dangers confronting global civilisation, with the consequences of climate change anticipated to place considerable stress on our critical supply chains in the areas of food, water, and energy. Tackling climate change is, therefore, an existential necessity for humankind (C. D. Butler, 2018). The Intergovernmental Panel on Climate Change [IPCC] (IPCC, 2007a), based on numerous scientific papers and research carried out on climate change (IPCC, 2007a; IPCC, 2007b; IPCC, 2014), emphasises that climate change, which the earth is experiencing is due to human activities. The most significant factor in the rise in temperature globally is our use of hydrocarbon fuels, namely coal, oil and gas, for energy use (IPCC, 2014). This energy use creates various greenhouse gases (GHGs) as a by-product, which have been gathering in the atmosphere, trapping more heat and increasing worldwide temperatures (T. R. Anderson et al., 2016).

The IPCC went further and clarified the scale of the tasks confronting elected officials and civil servants in designing policy initiatives to combat climate change (Moomaw et al., 2012).This scale shows that we are faced with a global catastrophe that necessitates both national and international policies — policies that must be multi-disciplinary, wide-ranging and comprehensive; with a limited timeframe to implement (Denny & Weiss, 2015), covering areas such as agriculture, fisheries, industry, transport, water and, as described in this research, energy (Rogelj et al., 2018), to combat the effects of climate change.

1.2 Energy Transition

The task ahead of society is significant, therefore. Indeed, as an ex-minister for energy remarks, *'It is going to require a hell of a lot of adaptation in terms of how we manage that [energy transition], how we engineer it and do all of that' (Interview GR15).* As has been underscored by reports such as those produced by the IPCC, achieving a successful energy transition is critical to meeting that task. It has also been noted that this energy transition faces multiple challenges, including ageing infrastructure, limited energy resources and a range of factors that are affecting energy generation, including climate change itself, demographic movements and new demand profiles (Jaeger, 2014). These, and many more, are stated as critical areas to be addressed in global and national energy systems (Morris & Pehnt, 2012; Johansson et al., 2012; O'Sullivan et al., 2017). These challenges that countries face in transforming their energy systems to sustainable low-carbon systems also give rise to areas that support that transition (Araújo, 2014). In moving from the energy systems that created these critical problems and developing a new energy system, thereby transforming how our societies manage and consume energy, we give rise to a fundamental change of energy systems (IRENA, 2017a). This change of energy systems is a transition in which members of society reorientate to new frameworks of interaction.

The definition of energy transition used in this thesis has been taken from IRENA, which states that it is a pathway toward transforming the global energy sector from fossil-based to zero-carbon by the second half of this century (IRENA et al., 2018). Such a transition involves the

ongoing substitution of hydrocarbon fuel sources with renewable energy generation across multiple areas of society, not just the energy sector. Therefore the energy transition is the spread of non-carbon energy sources by utilising new and existing energy production technologies (Tagliapietra et al., 2019).

Many researchers (Jefferson, 2008; Solomon & Krishna, 2011) discuss how several factors shape an energy transition. First, the need to understand the social context of energy transitions and define and implement an approach taking account of that context. Second, the recurrent clashes of multiple actors in communities, national governments, or internationally, are often on behalf of various stakeholders involved with energy projects, both hydrocarbon and renewable. And finally, multi-level aspects of spatial planning, which, given that generation must occur in a physical space, play an integral role in shaping and enacting energy transition processes. All of these factors are present in the EU, Irish and UK contexts.

1.3 EU Energy Policy

> *Well, you know, the thing that is going to be interesting now is that Europe has the most developed and most complex electricity market in the world (Interview PI22).*

As the ex-deputy director of a critical renewables UN agency states above, the complexity of the EU's energy system presents a challenging starting point for the transition. Even with that complexity in its internal organisation of the energy market, the EU has established itself as a global leader on climate change and has worked to bring about international agreements on the issue (Wurzel & Connelly, 2010). Without showing that its own internal energy transition policy initiatives are of prominence, the EU could not be regarded as a policy leader by its international peers. Therefore, its internal activities needed to match its international positions. Those activities and the energy system's acknowledged complexity entailed searching for solutions for that complexity through technology development and significant changes to the arrangements of the member states energy systems, which are highlighted in this research.

There is a recognition that policy is interlinked with the development of technology roadmaps, as a senior UN policymaker states,

> *So, policy needs to change and dynamically evolve with technology, and that is not an easy thing because we just don't know what will be the technology in 10, 15 years from now that might make a difference. So, I think policy is beyond, you know, free market and what have you, will still remain important and needs to adapt to technology and that is not an easy thing (Interview PI22).*

In 2009, EU policy makers had set the goal of achieving 20% total energy use generated by renewable energy forms by 2020 (European Parliament, 2009) and at least 32% by 2030 (European Parliament, 2009). The roadmap supported these targets to 2050 (European Commission [EC], 2012), the goal being for the whole of the EU energy market to be decarbonised. These EU-level targets are shared across member states and determined regarding each member state's baseline. For instance, the UK has a much stricter CO2 target than Ireland in terms of the absolute amount. However, what constitutes a 'tougher' target or greater ambition is disputed.

The transition to a low-carbon society involves a massive investment in renewable energy, which governments seem unable to fund alone; renewable energy expansion necessitates the mobilisation of finance from the private sector. This mobilisation means that efficient policies must sustain renewable energy build-out (Reuter et al., 2012; Wüstenhagen & Menichetti, 2012). Thus, we should not presume that the conditions of energy policy enactment will be static, or that the same policies will be successful in different countries, or that different actors are willing to contribute to the costs of the energy transition, or that what policy makers understand today on technology will be valid over time.

1.4 Renewable Energy Investment

> *To increase the amount of investment….which was needed with lower risk and lower returns, which was needed to get that into cost curve and to deploy stuff at scale. So, it was very clear that …. private capital is the answer (Interview FU12).*

So speaks, perhaps unsurprisingly, the ex-CEO of one of the largest funds globally investing in renewables, calling for the importance of private capital in renewable energy investment. Large renewable energy investments have materially enabled the energy transition in many countries and across the EU. But to meet the targets in the Paris Agreement, much larger investments are required. The IRENA report *Global Energy Transformation: A Roadmap to 2050* (IRENA, 2018) states that for global targets to be achieved which meet the requirements of the Paris Agreement, total capital invested into renewable energy generation has to be USD 27 trillion by 2050. This large requirement for renewable energy investment is presently enabled by various policies, which come about through variations in a state's socio-economic makeup, geographic resources, the history of its energy systems, and the policies that gave rise to these (Fouquet, 2013). However, to date, a comprehensive assessment of how successful existing renewable energy policy is has not been made, nor has a complete institutional analysis been carried out to understand what role current energy policy instruments play in investment decisions. However, policy makers must decide which policies will most likely succeed in increasing renewable energy production as a percentage of the grid and whether they would result in a more significant percentage increase than would have occurred without those policies, as well as a range of other contexts in which those policies operate.

Policies are required to enable renewable energy investments from the private sector to take place at scale across the EU .

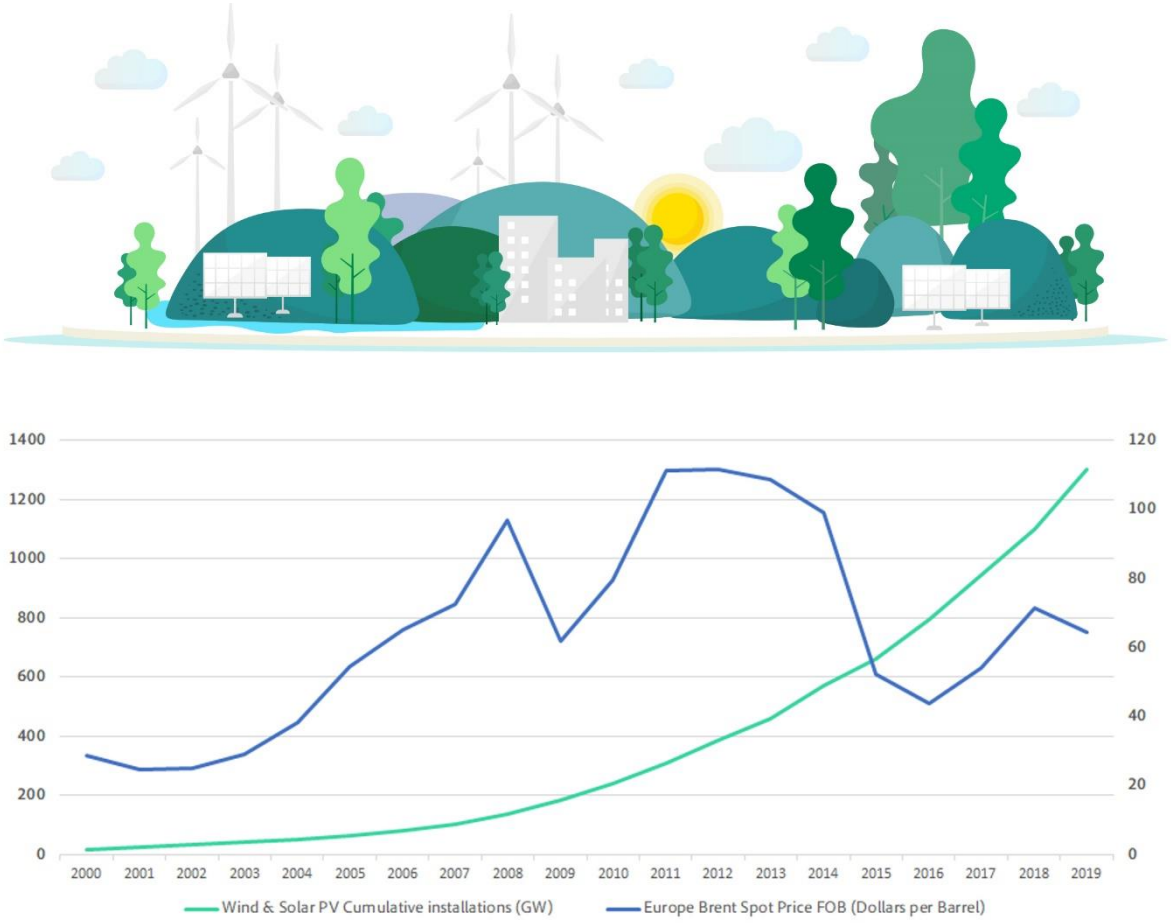


Figure 1.1 EU investment in PV & wind 2000-2019 (source: Wood Mackenzie (2020); EIA (2020))

That private-sector financing is an ongoing aspect of the development of renewable power in Europe is taken as a fact, and though much work has been done on whether capitalism is an appropriate governing principle (Foster et al., 2010; Vancouver, 2018)) through which to fight climate change, this research focuses on the necessity of examining the context in which investment takes place.

1.5 Case Study Countries and the Theoretical Framework

As is illustrated by statements from policy makers from both of the case study countries, from the UK '*[…] but the UK believed in competition, it believed in markets, it believed in market*

mechanisms….even for the entire energy sector now it's a set of basic government choices, more or less' (Interview PU21) and here from Ireland, *'But we need to take ownership of this big time and come up with the solutions for Ireland, because Ireland's got challenges. It's got a unique location; it's got the impacts.' (Interview GR22)*, radically different contextual factors exist in each country. These factors have subsequently been amplified by the Brexit vote of 2016 and the UK's departure in 2020 from the EU. The selection of these states was based on their geographical proximity and their distinct institutions, renewable energy consumption trends, environmental standards and energy policy history, and the different approaches to policy frameworks each have implemented (Grubb & Newbery, 2018). This research will provide critical new insights on the impact of renewable energy policies and the factors that affect the relative success of renewable energy strategies in different places, testing and informing theories of low-carbon transitions through detailed comparative research.

Both the UK and Ireland have embarked upon a sequence of renewable energy programmes enabled by a series of policy initiatives. They have approached these programmes in remarkably different ways (Newbery, 2017), reflecting their differing economic, social and cultural structures and histories. This difference of approach has brought about significantly different outcomes, which this thesis attempts to examine.

This thesis uses multi-level governance concepts and the transition management (TM) method for this research's fundamental analytical work. The multi-level perspective (MLP), which grew out of science, technology and innovation literature (Markard & Truffer, 2008; Weber & Rohracher, 2012), has developed a framework for socio-technical transitions related to energy (Geels, 2011; A. Smith et al, 2010). The MLP implies that to comprehend a technology transition, that transition must be viewed through the concept of three interlinked levels. Interactions between the landscape, regimes and niches can be seen in Figure 1.2. Politics and policy changes are instrumental in how socio-technical transitions occur as the codification of themes effecting regime actors, in which established sectors such as energy undergo fundamental changes (Kern & A. Smith, 2008a; A. Smith et al, 2010), and as such, this framework is well suited to this research.

Figure 1.2: Multi-level approach (derived from Geels (2002))

This energy transition framework will facilitate the exploration and comparison of EU governments' renewable energy policies' effectiveness, thereby answering the research questions set out below.

1.6 Research Questions

The main goal of this research is to examine renewable energy policy in the UK and Ireland, employing the MLP, and to thereby determine what were the policy results, as measured by

who benefited and how those policies have performed over a range of metrics, including equality, effectiveness, institutional feasibility, and efficiency. This thesis aims, therefore, to answer the research questions set out in Table 1.1. The research questions have been determined so that this research begins from a rich description of the history of EU, UK and Irish policies, the context in which those polices were enacted, and the factors that influenced design and execution. The questions then develop this line of thought by exploring what has affected the effectiveness of policies, who has benefited and then, finally, what can we learn from this empirical research to guide future policymakers.

Research Questions	
RQ1	How did renewable energy policies develop, what are the categories of national renewable energy policies and what policies were implemented in the UK and Ireland?
RQ2	What factors influenced the design and implementation of those policies?
RQ3	What are the main determinations which have defined policy effectiveness?
RQ4	Which groups benefited most from the implementation of policy instruments?
RQ5	What can be learned from the analysis to enable policy makers to better design, formulate and implement appropriate policy in their jurisdiction?

Table 1.1: Research questions

1.7 Structure of the Thesis

In order to address the above research questions, the thesis is organised as follows. Chapter 2 examines the interactions between different actors, organisations and technology in the renewable energy regime and protected niches through a review of existing literature and research. The chapter questions how the research frames institutions and their changing role and the interactions among actors and their broader context in determining the energy transition. It is contended that whilst the current literature provides valuable guidance, it lacks

a satisfactory discussion of governance of the renewable energy sector. Therefore, the chapter presents and considers the governance literature focused on relations between a country, the market and civil society.

Chapter 3 builds on discussions from Chapter 2 and outlines an analytical framework for this research. It describes the research design used to analyse the socio-technical aspects of renewable energy policy and outlines and discusses the methodology used in this thesis. In addition to drawing on insights from Chapter 2, the framework uses work taken from multiple disciplines and their assessment of how institutions function (their governance) to be then able to describe the interaction between actors, institutions and technologies. It describes the qualitative methodology underpinning this research. It explains how data has been gathered and analysed.

Chapter 4 addresses Research Question 1, by outlining what types of national renewable energy policies for solar and wind power have been put in place across EU countries between 1995 and 2015, and how were they implemented. The chapter presents the contextual backdrop to Ireland and the UK and the EU framework in which they operate. This includes the technological and institutional framework of the renewable energy sectors in those countries and at the EU level and a brief history of their evolution. The relation between each of the levels of niche, regime and the landscape are discussed.

Chapters 5 and 6 introduce several inductive themes that emerged from the interviews. The empirical findings address Research Questions 2 and 3, by examining how interactions took place between prominent actors, the development of policy affecting renewable energy expansion and how institutions interacted. The research shows the consequences of the various interlinking characteristics of socio-technical components, the factors influencing the design and implementation of those policies, and the effects and opportunity of the same policies.

Finally, Chapters 7 and 8 present the findings related to Research Questions 4 and 5, by assessing which groups have benefited from implementing policies, followed by a discussion of what policy makers can learn from this research.

Chapter 9 is the concluding chapter, in which the policy implications of the research are discussed, and from those implications, specific policy proposals are put forward. It additionally highlights the central contribution of the study, discusses its limitations and outlines possible areas for future work.

2. Literature Review

2.1 Introduction

As set out in the previous chapter, this research aims to establish how distinct socio-technical changes interact with renewable energy policy, its creation and implementation; and from there, to establish how those policies feature in our transition to a sustainable and low-carbon society. This research therefore aims to establish how socio-technical changes that are distinct from renewable energy policy interact with that policy, its creation and implementation This literature review will demonstrate what makes successful existing renewable energy policy has been incompletely answered by existing research. It will also highlight the limited nature of institutional analyses to understand renewable energy policy instruments' role in energy transitions. This review emphasises where present literature is lacking and outlines significant investigation avenues for this research. Those investigations, in turn, will not only help build a set of tools for researchers and policymakers going forward but will also aid our understanding of transitions and further develop the framework and usefulness of the MLP, outlined and explained in Chapter 1.

Therefore, this research fulfils a critical function in expanding our knowledge of successful policy and the formation of such an approach. Policymakers need to know which strategies will succeed in the primary goal of increasing renewable energy production as a percentage of the grid versus what would have happened if that approach had not been in place; they must

also be able to react to changes in context driven by the falling cost of technology or different utilisation of energy. Attending to the context in which those policies operate is crucial.

The outcome of efforts to increase the electricity supply from renewables is easily visible through the measurement of absolute output and the growing share of renewable energy in national energy supply systems. How policymaking, which is viewed as a significant influence, affects these trends is much harder to detect and explain. Comparisons through the use of a case study approach between countries in renewables policymaking are limited and reveal a lack of empirical work in this area (Groba et al., 2011; Marques et al., 2010; Schmidt & Sewerin, 2018). Much of the research has examined renewable energy outputs and share of the energy system (Bersalli et al., 2020; Jenner et al., 2013; Marques et al., 2010; Ragwitz et al., 2012; M. G. Smith & Urpelainen, 2013), instead of having a focus on the policy-making process itself. Interesting studies have examined renewable energy policy formation and implementation in North America (Jenner et al., 2013; Menz & Vachon, 2006) or on more broadly defined policy instruments, such as energy taxes (Ward & Cao, 2012).

Multiple studies have assessed how individual energy policy instruments in individual countries have developed (Dermont et al., 2017; Haas et al., 2011; L. M. H. Hall & Buckley, 2016; Jacobsson & Bergek, 2011; M. G. Smith & Urpelainen, 2013). These have provided several significant findings on the efficiency and effectiveness of policy instruments for promoting renewable energy. Still, they do not account for how these policies have changed over time nor in general on their success relative to other countries. Therefore, this review of the existing literature is, by necessity, wide-ranging and addresses questions of renewable energy policymaking, first in the abstract and then at the EU and the case study countries levels. A review of the treatment of policies implemented to support the energy transition is then completed, followed by a discussion of how evaluation of those policies' success is understood.

2.2 Methodology of the Review

There are multiple guidelines for conducting literature reviews, such as narrative or integrative reviews (Torraco, 2016; Wong et al., 2013), systematic reviews, or meta-analysis (Davis et al.,

2014). The term ‘rapid systematic’ refers to an approach that systematically assesses the available literature, in this case investigating the determinants of renewable energy deployment, exploring and evaluating the literature in a defined way to discover the evidence for and about the issue (Speirs et al., 2015). This approach was developed by the UKERC’s Technology Policy Assessment group (Speirs et al., 2015). Unlike typical narrative literature reviews, this method depends on a specific and thorough procedure to detect materials and generate an examination of the existing literature. Specifically, a decision is made on a combination of keywords for a search string which is then utilised. Using particular criteria and devising detailed research questions, this methodology limits selection and analysis bias (Pickering & Byrne, 2014). This approach clarifies the most important subjects and variables for future research by recognising a wide range of literature gaps. The Technology Policy Assessment has been created explicitly with the requirements of energy policy in mind, utilising techniques from a broader field of evidence-based policy (P. C. Smith et al., 2000). Researchers who are working on transdisciplinary studies have found the ‘rapid systematic’ flexibility in reviewing that a systematic review supports, across both quantitative and qualitative literature, especially helpfully (Petticrew, 2001).

A significant issue that affects all literature review methods relates to the introduction of possible biases in how the search for relevant literature is undertaken. The employment of a systematic approach, cannot entirely, but somewhat reduce those biases. Limiting the search to only research published in one language, in this case, English, or only using electronic databases for the search, for example, can introduce bias.

Each of the 14 search terms was combined in different searches. These search terms were selected given their applicability to the research questions and are as follows:

‘Renewable energy’ combined with the following: ‘policy’; ‘evaluation’; ‘EU’; ‘UK’; ‘Ireland’; ‘criteria’; ‘analysis’; ‘framework’; ‘support’; ‘transition’; ‘effectiveness’; ‘multilevel’; ‘perspective’; ‘wind’; ‘solar’.

The search terms above were entered into Google Scholar, in various combinations to generate results that could be examined in the empirical research.
For example, ‘transition’ and ‘Ireland’ and ‘energy’ represents one search string. In total, this method generated a significant number of results, 24,170,200 in total. Ireland and multi-level

generated the least number of results; from this search, multiple titles were then selected for additional analysis, after analysing individual titles, abstracts, citation, and works' keywords. These various keywords were selected based on the objective and aims of this research, which is to help establish how socio-technical changes that are distinct from renewable energy policy interact with that policy, its creation and implementation, in different geographies. From that, the determination of keywords such as policy, Ireland and words related to the major types of technologies implemented, as well policy itself became clear.

The research was focused on renewable energy policy and, in particular, solar PV and wind. These represent the systematic review element of the literature review. Further material, from recommendation, was additionally incorporated. This was required to capture expert opinion on the material which did not come to light through keyword searches or was placed too far down the results pages to be recognised as important.

2.2 From Policy Theory to Policy Implementation

This section will build from an explanation of theories of policy to a discussion on policy within the EU, which then supports a description of policies enacted in the UK and Ireland. That progression is outlined in Figure 2.1.

Figure 2.1: Case study countries policy progression

Definitions of Policy & Policy Making Process

'[Policy is a] course or principle of action adopted or proposed by an organisation or individual.[1]'

Researchers working in policy analysis have examined and proposed methods to communicate clearly how the complex structure of policy-making processes work (Dermont et al., 2017), whilst accounting for polity, which focuses on the institutional forms of a political system (Knill & Tosun, 2012). Kingdon (2003), in his work on U.S. policymaking, sitting in that political system, gives a characterisation of policymaking as a set of procedures, involving at a minimum those steps laid out in Figure 2.2. Politics is viewed as how the dynamics of policymaking take place (Weible & Sabatier, 2018). There exist multiple theories to guide analysis on understanding the design, execution and effects of policy (Rosenow et al., 2017). These range from concepts ranging from the multiple streams theory (Kingdon, 2003), or the Advocacy Coalition Framework (ACF) (Sabatier, 1988), to the punctuated equilibrium (Baumgartner & Jones, 1991).

Figure 2.2: Processes of policymaking (derived from Kingdon (2003))

A widespread method for describing the total policy-making lifecycle is the 'policy cycle' tool (Barkenbus, 1998; Cosmo, 2005; Everett, 2003; Bridgman & Davis, 2003; Howlett et al., 2017; Janssen & Helbig, 2018), used to help classify various steps in the process. This concept imagines policy-making as a circle, going from one policy-making activity onto another and continuing and repeating. Crabb and Leroy (2008) have made the point that this is a relatively simple description of a very complicated and detailed process. Multiple sub-points need to be

[1] https://en.oxforddictionaries.com/definition/policy#policy_Noun_100

addressed to agree on individual policy actions, including how they are executed. In contrast, a wide-ranging dialogue among decision-making organisations is required. Crabb and Leroy (2008) then attempt to develop the tool to make it more robust, broadening the description of the phases in the policy cycle and accounting because these phases often overlap, either sequentially or simultaneously. Even accounting for these gaps and acknowledging that a policy cycle is an imperfect tool for policy analysis remains a useful heuristic device for organising thoughts as one addresses the extensive framework of the numerous individual points in the policy process. In this study, the tool, illustrated in Figure 2.3, is useful for reviewing policy in the EU, UK, and Ireland.

Figure 2.3: Policy Cycle (derived from Cairney et al., (2019))

Policymaking in the EU

The policy cycle described above gives a greater understanding of policy formation. To understand how the policy was developed in the EU, the UK and Ireland, it is necessary first to examine how policy is determined at the EU level before addressing individual member states, for, in many material ways, EU member states are policy takers, not policy setters (Matthijs, 2020). Policymaking in the EU and individual member states is frequently regarded as a complicated process involving many different incumbents and new emerging actors and operating in a regime of existing policy and history. Many different theories describe the policy processes in the EU and how the processes affect individual member states, encompassing both the UK and Ireland (Clancy et al., 2012; Hauser, 2011). This research defines the EU multinational policy-making level as being made up mainly, but not entirely, of the Commission, Parliament and Council. They are not, though, creating policies in isolation; instead, those policies are collectively determined alongside the different actors and lobby groups whose purpose is to influence the policy-making institutions (Coen & Richardson, 2009; Dür et al., 2015).

Procedures such as the co-decision procedure, the intergovernmental method and the open method of coordination (OMC) are some of the main policy development mechanisms used by EU entities (Vaughan, 2011). The intergovernmental method makes the individual member countries key to policy development, with the European Commission (EC) maintaining the right to propose new laws on the treaties' matters. In this process, the Parliament is put into a position of advising rather than actioning (Buti & Krobath, 2019). The OMC seeks to foster policy coordination with member countries (Princen, 2007) and is not used to produce binding regulation; rather, it is a process that hopes to generate new policy development initiatives.

The Case Study Country Contexts: EU

How, then, does policymaking in the case study countries develop? It is important to understand that EU member states' evaluation of their policy developments is being made regarding the implementation of the renewable energy policy defined at the EU level. That EU policy, containing a set of targets for individual member states, is governed by a series of treaties to support that policy. For example, the Lisbon Treaty (Treaty on European Union

(TEU) Treaty of Lisbon (2007), 2008) identifies specific EU capabilities in energy policy (Article 194, (Treaty on European Union (TEU) Treaty of Lisbon (2007), 2008)). It details four objectives of an EU-wide energy policy:

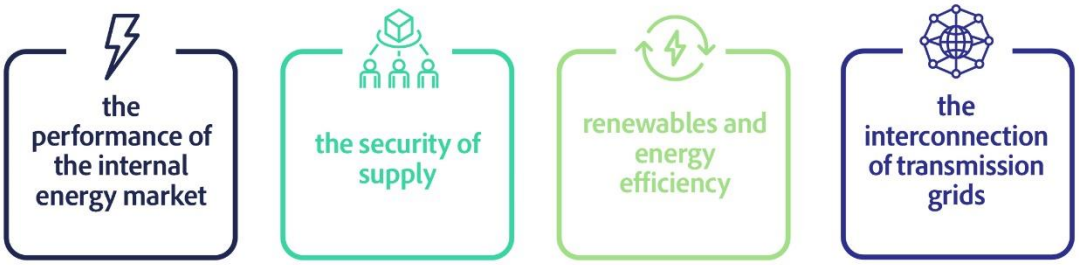


Figure 2.4: Objectives of an EU-wide energy policy (from European Union (2007))

Within this common energy policy, one can see the trilemma of energy policy challenges: energy security, energy sustainability, and energy affordability (Santos, 2018). Although both the European Council and the European Parliament 'shall establish the measures necessary to achieve the objectives' (European Union, 2012), specific safeguards allowing for individual member countries' rights to control how they choose to use their domestic energy capabilities, what decisions they make between technologies or different types of generation, plus the organisation of their energy supply system (European Union, 2012). Though institutions operating at the EU level define EU energy policy, individual countries maintain the power to determine policy on critical issues such as the energy mix within their systems, following top-down guidance and targets from the EU. This collective governance, containing multiple regulations and decrees to guide how the individual member states plan to support renewables, are then the EU's primary mechanisms to impact those countries energy policies. The OMC, on the other hand, creates a valuable secondary tool in which the EU can influence states renewable energy policy (Borrás & Jacobsson, 2004). It depends on individual member countries working together on their own policy choices, with the Commission acting as a convening agent. Here, the EU fosters indirect methods to enable a bottom-up convergence across member countries to promote homogeneous policies. In contrast, Lindberg et al. (2019) usefully show how the current EU energy policy mix is heterogeneous with respect to the area of decentralisation, and go on to propose how actors and policy choices can be incorporated in

the study of policy mixes. Calliess et al. (2013) helpfully summarise the above by stating that 'The EU impact on the national energy mix is predominantly indirect, yet powerful' (p.88).

2.3 Theories of Energy Transitions

A key objective of this research is to frame better the relevant institutions, their goals and the macro-environment in which they operate, considering how they do or do not support a transition to a low-carbon society. Understanding the various theories developed to understand better how these changes occur is required to underpin this research's arguments. This work benefits from the significant amount of work around the ideas of transitions, energy transitions, and sustainable energy transitions that have already been carried out (Geels, 2012, 2018; Jacobsson & Bergek, 2011; Lindberg et al., 2019; Spaargaren, 2011; Valkenburg & Cotella, 2016). This work, completed over many decades, has been approached through the lenses of various subject specialists (e.g. geographers, economists, historians, political scientists and environmental lawyers (Antal & Van Den Bergh, 2013; Bolton & Foxon, 2015; Johnstone & Newell, 2018)), which, in many cases, review a series of historical transitions (Martínez Arranz, 2017) to help guide analysis. From the commonalities of these transitions (Markard & Truffer, 2008), several derivative theories have been formulated (Table 2.1) to help frame and explain transitions. Generally, these studies are more explicit about the role of technology in transitions than, for instance, the use of policy as a driver (Cherp et al., 2018) , though researchers have recently been to consider more politics in the sustainability transitions literature (Roberts et al., 2018). Socio-technical transitions consist of changes in society that are technical and economical, and therefore involving a wide range of actors from different backgrounds (Köhler et al., 2019). Socio-technical changes are thus affected by multiple, often conflicting, priorities and preferences, making strong path-dependencies a factor in the speed of the transition. Areas such as institutional inertia, technological lock-ins and actor resistance (Verbong & Loorbach, 2012) are factors to be understood. As established socio-technical systems are rooted in society's mechanisms, researchers have contended that a fundamental trait of all sustainability transitions is that they are normative processes involving assistance and policy navigation. On that basis, work has also shown that they are contested strategies

involving multiple actors (Bosman et al., 2014; Hess, 2014; Rosenbloom, 2020). In a series of studies, Cherp et al. (2018) have combined their theoretical categorisations of energy transitions with a set of detailed empirical models to build a well-developed group of cases, which reinforces these discussions on contested spaces.

Approach	Key concepts	Policy view
Innovation systems	System failures, innovation, institutions, national and sector systems, supply chain, social,	Detect system failures and rectify through environmental directives and technology-specific policies
Multi-level perspective	Multiple (competing) technologies, structural change, multiple levels (niche, regime, landscape), multiple phases, coevolution, networks, transformation	Align technologies and user practices. Strategic niche management (SNM)
Complex systems & Transition Management	Variation, selection, attractors, feedback, emergence, coevolution, self-organization	Transition management transition tests, imagining for sustainable futures
Evolutionary systems	Population, diversity, cumulative change, multiple election factors, adaptation, group (multilevel) selection, path-dependence and lock-in, coevolution	Account for all selection forces (market, institutions, norms, regulation), optimal diversity, policies to escape lock-in

Table 2.1: Approaches to research on sustainability transitions

The renewable energy technologies needed to replace hydrocarbon generation in our energy system are available and cost-effective, but governments globally have not as yet taken all of the actions needed for the transition to a low-carbon society. This lack of action can be somewhat explained due to the power of incumbent actors to oppose transition, given their position in the regime (Geels, 2014). Entrenched interests who are unaligned with the pathways of the transition to a low-carbon society, will mean that countries could lack sufficient political will to deliver upon those transitions. However, the role of politics in accelerating energy transitions involves more than increasing the 'political will' of incumbent actors. In addition to purposeful policy steering, successful sustainable energy transitions also require consideration of other 'political lock-ins' that hinder their progress. The various political lock-ins can occur, for example, as conceptualised by Rosenbloom et al. (2016), in interactions between ideas, interests, institutions and infrastructure, or, as Roberts et al. (2018) suggest, in the coalitions shaping policy, processes of policy feedback or in the broader contexts that

condition decision-making. Combined with the urgency to accelerate transitions, work must be undertaken to examine different facets of the politics of sustainable energy transitions (Markard et al., 2020).

One facet of sustainability transitions is that they are geographical processes, and researchers in the field of energy transitions have begun to take into account the work of geographers on scale and territory (Cowell et al., 2017). The next section addresses those efforts.

2.4 Scale and Territory in Transition Studies

Studies on energy and on energy transitions, in particular, have in the past attracted wide criticism for not accounting for spatial concepts (Sovacool, 2016). This has changed over the last decade, with many researchers working in energy geography's broad space (Robison, 2018). Space, scale and territory are vital terms within transitions literature as a whole and can point to the value geographers have to contribute to transitions scholarship (Hansen & Coenen, 2014). Much of the original theory development that underpins transitions studies came from researchers working in evolutionary economics combining their practices with the more constructivist methods of technology and science (Science and Technology Studies [STS]), which led onto new theoretical frameworks of strategic niche management (SNM), technological innovation systems (TIS) and the MLP. Geographers have contributed to theoretical development with both the TIS frameworks (Bergek et al., 2015) and, within the MLP, for sustainability transitions (Grant et al., 2020; Verbong & Geels, 2007). In both theoretical frameworks, scale and space are emphasised as key to an understanding of transition pathways. Spatial research as it relates to energy, then, has developed into a fast-expanding field (Calvert et al., 2017; Caprotti et al., 2020; Nicholls et al., 2014), with many empirical studies evaluating the critical function of spaces and working to delineate the particular spatiality of energy transitions (Baptista, 2018; Hill & Connelly, 2018; Sareen & Haarstad, 2018). These studies show the complexity of modern energy systems.

Modern society relies on the safe, secure, cost-effective delivery of electricity. That essential nature of energy means multiple groups have an opinion on how to use and plan its generation,

transmission and payment; and a just society will account for those groups in the design for a just energy system. Energy is a commodity fuel source, a series of new and different technologies, a transmission network, an essential need, and an economic product. All of those characteristics of energy require that it also has to encompass social justice ideas, which require an understanding of energy justice (Williams & Doyon, 2019). Raven et al. (2012) argue for incorporating a theorised conception of spatial scale into the MLP, which includes spatially distributed actors, institutions and economic structures, whose interactions, it is argued, are required in any just transition. This sets up a discussion of the context, space, and time from which these actors view the transition. Therefore, the authors propose a multi-scalar MLP, including progression over time, ideas on structuration, and spatial relationships. Jacco et al. (2012) continues to reinforce geography's role as a valuable viewpoint to transition studies, adding the concepts of socio-spatial and socio-technical embeddedness to that of multi-scalarity proposed by Raven et al. (2012). Scholars such as Bridge et al. (2013) have analysed the interactions between energy and society and how those interactions are affected by different regional, national and international levels given energy infrastructures and their specific physical positions. Therefore, energy transitions change multiple spatial relationships in spheres such as the social, cultural or economic. These policies cause significant spatial changes for landscapes and infrastructures, creating contested interactions between various actors (Bouzarovski & Petrova, 2015; Mattes et al., 2015; Pasqualetti & Stremke, 2018).

Bridge et al. (2013) provide six classifications: spatial differentiation, scaling, location, landscape, territoriality, and spatial embeddedness, to explain and evaluate various consequences of the low-carbon energy transition through a geographical lens. This theoretical structure (Bridge et al., 2013) allows the spatial components of energy transitions to be delineated through adopting the concept of ‘energy landscape’. This concept focuses on how energy use and generation take place in reality and includes analysis of resource, economic, infrastructural, and geopolitical landscapes. Following this work, Faller (2015), through the use of case study from Beckerich in Luxembourg, usefully discusses four areas: the production of space; how energy transitions take place unequally; the rescaling of energy governance; and the spatial materiality of energy transitions.

The introduction and interpretation of new traditions of the study of energy and energy transitions have been described as, at times, delivering a somewhat disorganised and ambiguous conceptualisation of the work (Lagendijk, 2006). This is shown by the use of

different geographical descriptions common in the MLP, like landscape (Verbong & Geels, 2007). Bridge et al. (2013) point out that though these ideas were initially introduced in transition studies with no connection to a direct spatial meaning, they are easily misunderstood considering the use of these terms by scholars within the discipline of geography.

Scale	Definition	Areas of Focus
Landscape	Long-term macro-drivers	Political system International energy governance organizations Climate change Security of Supply
Regime	Actors, and regulatory, financial and political systems	Energy generation assets Configuration of energy systems, cost; legal and institutional frameworks Consumption patterns, environmental awareness Regime-level governance structures
Niche	Protected spaces	Industry structures, R&D New Technological developments

Table 2.2: MLP levels (derived from Verbong and Geels (2007))

2.5 Multi-level Perspective and Energy

This section discusses one of the most prominent theories applied to energy policy, the MLP.

Innovation Systems Theory

Innovation systems theory (IS), which is a progenitor to MLP, focuses on how elements of a system are enabled (passively or actively), producing a complex innovation system dynamic that links actors, institutions and networks (Fagerberg & Verspagen, 2009; Hanusch & Pyka, 2006; Jaffe et al., 2002). Much work has been done, for instance, by Jacobsson and Bergek (2011) and K. Smith (2000), proposing different methods (such as the TIS framework) that policy makers can use to analyse the empirical data extracted from those studies of innovation. The IS approach stresses the value of enhancing firms' ability to innovate and the surrounding institutional framework in which they function. This literature review demonstrates that the IS approach is not appropriate in managing the significant challenges faced in attempting to transform how innovation, production and consumption take place within a complex system; and therefore, with the 'wicked' nature and long-term challenges of climate change and our transition to a low-carbon society. The MLP, containing a much broader framework, is better suited to the research questions at hand.

An important concept to mention, transition management is based on complex systems analysis (Allen et al., 2010; de Haan & Rotmans, 2011; Loorbach, 2010) as well as evolutionary-economic views and multi-agent modelling of transitions (Ayres et al., 2013; Sgouridis & Csala, 2014).

Multi-level Perspective

Work from Geels. (2004b), Budde et al. (2012) and Markard and Truffer (2008) proposes taking insights from IS and placing those insights in the framework of the MLP to better analyse those events. This latter theory, which grew out of the science, technology and innovation literature, is a multi-level view of socio-technical transitions related to energy.

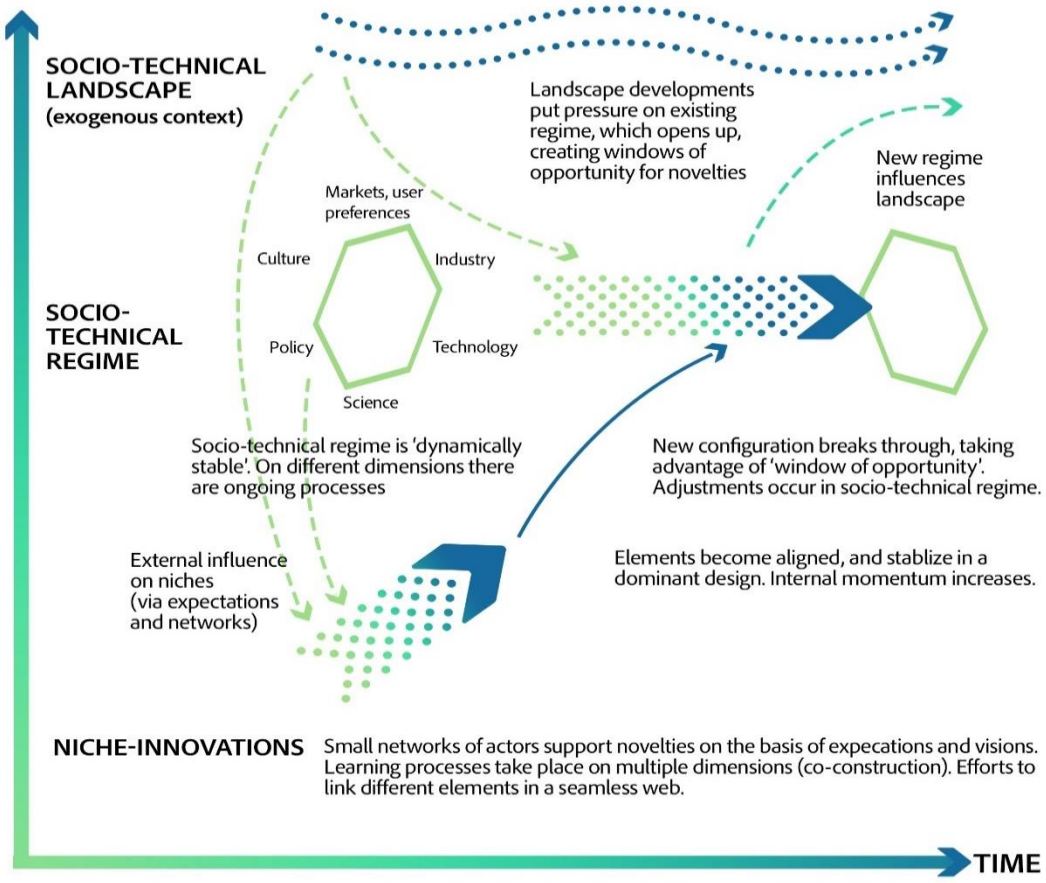


Figure 2.5: Transition management as a multi-level, multi-phase approach (Geels, 2002)).

Transition theory literature emphasises the interdependence of institutions and structures comprising societal systems and subsystems (A. Smith, 2007), and the MLP continues that emphasis. Supported by several cases, studies including Haxeltine et al. (2017); Johnstone and Newell (2018); Martínez Arranz (2017); Verbong and Geels (2007), have developed a framework for analysing transitions and describing interdependencies over time. Figure 2.5 shows the interactions between different levels over different phases in the MLP, with the links between niche, regime and landscape levels shown. Within the framework of MLP, transitions are believed to occur when weakened economic and cultural linkages between incumbent social groups and institutions (the regime level) allow the creation of new linkages. These new linkages are formed at both the regime level and at the landscape level, where broader social, economic, political and cultural changes occur. A regime could be considered as a particular collection of practices, rules and shared understandings that govern the system and its actors (Avelino & Rotmans, 2011). These new linkages are created, notably, by new technologies that have already succeeded in a growing number of niche-level activities (Geels, 2011; Kern, 2010; Nykvist & Whitmarsh, 2008). Societal systems comprised of interlocking economic, social, cultural and infrastructural subsystems have a range of social groups whose behaviours are created and supported through cognitive, normative and regulative institutions (Geels, 2005).

The MLP does not consider economic drivers as much as other approaches on energy transitions, focusing instead on social groups and actors, and how their interactions affect a transition. For this research, which is also focused on interactions among different groups, the MLP's focus on social actors does mean that economic incentives are not assessed as strongly as other interactions. Even so, the MLP balances, through its positioning as an overall framework, different approaches and offers insights into the progress of renewable energy development. In particular, MLP has developed in parallel with the concept of SNM, in which governments and other entities protect the development and use of promising technologies (Kemp et al., 1998; K. Smith, 2000). Alongside MLP, SNM reflects a central pillar of the argument for successfully transitioning to renewable energy sources and technologies, through an emphasis on the value of building supporting linkages and networks, both amongst niches and to the regime and landscape levels (Geels & Schot, 2007).

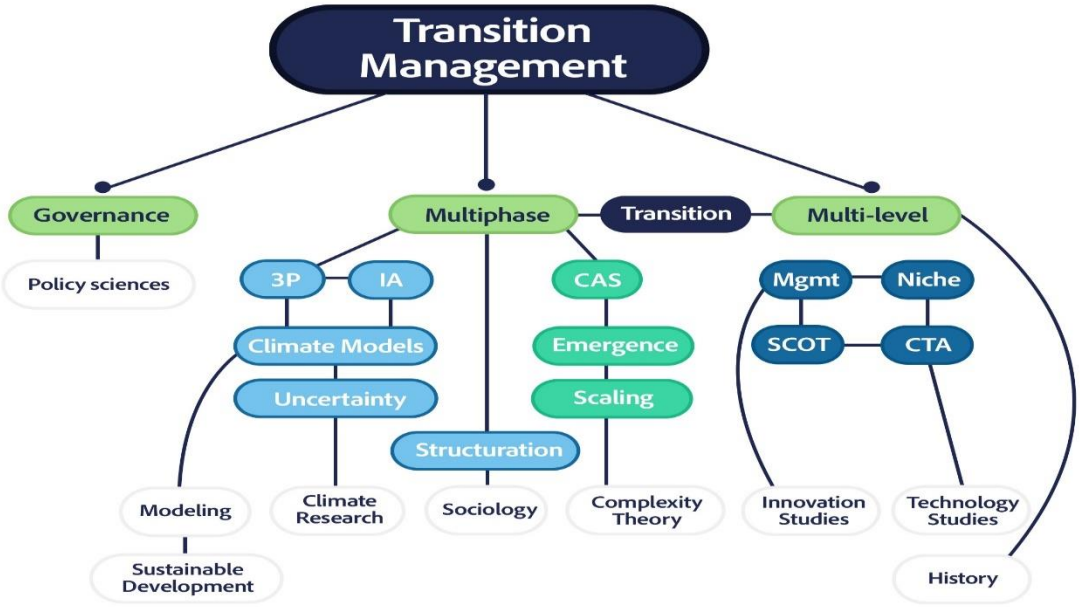


Figure 2.6: The multi-discipline journey to MLP (derived from Loorbach (2010))

Researchers have built on MLP and other approaches (e.g., economic modelling, institutional analysis, management and sociological studies) to create an active debate over the enacting of an energy transition; for example, through social psychology (Miller et al., 2015), discussions of the concept of societal transition (de Haan & Rotmans, 2011) or geography (Bridge et al., 2013). Modelling research has endeavoured to extrapolate innovation processes to find which policies, social or economic levers could promote sustainable transitions. Köhler et al. (2009), for example, created a connected system dynamics and agent-based model to simulate various mobility transitions, which had both technological and behavioural-change pathways. Concepts around the feasibility of sustainability transitions pathways (STP) have been worked on by researchers such as Turnheim and Nykvist (2019), who identify analytical dimensions needed to address transitions governance challenges. They discuss what the feasibility needs to be, and what circumstances can give the greatest possibility of an STP coming into existence. How those change governance processes and what actions need to be taken has also been debated (Geels et al., 2016; Rosenbloom, 2017; Turnheim & Nykvist, 2019).

Innovation is viewed as an essential driver of fundamental changes in different industries, and studies on transitions have typically concentrated on the regime level. A. Smith and Raven

(2012) discuss how the idea of a protected space and nurturing of niches has not been thoroughly discussed. They use the example of solar PV technology being protected (through government subsidies and programmes) and nurtured by the satellite programmes of the 1960s and various public research programmes, which thereby allowed solar PV to become a mature component of the social-technology regime. Their work goes on to state that efficient enablement of a niche requires a combination of three different characteristics; shielding, nurturing and empowerment. This combination empowers niche innovations to develop so as to create a new pathway, as well as how the clustering of different niches to support their growth into technologies or business models supports them operating at the regime level (Davies, 2014). Involved in that new pathway's development are idealistic enthusiasts whose role in creating sustainability initiatives in niches has been recognised as important (Polzin, 2017). Changes to the regime that occur whilst niches are protected, for instance through pressures from landscape factors, or from tensions between incumbent actors, have also been identified as giving niches opportunities to develop into the regimes (Rut & Davies, 2018; A. Smith, 2007).

A related research area works to explore how various actor's agency affects the transition pathways (Berkhout et al., 2011; Garud & Karnøe, 2003; Markard & Truffer, 2008c; van Rijnsoever & Farla, 2014)(Berkhout et al., 2011; Garud & Karnøe, 2003; Markard & Truffer, 2008a; van Rijnsoever & Farla, 2014)(Berkhout et al., 2011; Garud & Karnøe, 2003; Markard & Truffer, 2008a; van Rijnsoever & Farla, 2014)(Berkhout et al., 2011; Garud & Karnøe, 2003; Markard & Truffer, 2008a; van Rijnsoever & Farla, 2014). Both civil society and cultural movements, for example, are key actors (Penna & Geels, 2012; Seyfang et al., 2014) whose strategies deserve further study. There has been an increased amount of research on how regime configurations are formed and altered through the interaction of multiple actor types (Musiolik & Markard, 2011). A critical gap exists in the literature on actors' role and agency, which has not been fully explored in different energy transitions.

Scholars have addressed the concept of collaborations between new entrants and incumbents by comparing different systems trajectories, allowing for identifying a generic pattern in niche development and niche-regime interactions (Bui et al., 2016). It is convenient to discuss the incumbents as supporters of prevailing technologies which are in operation throughout regime level, and emerging competitors developing niches containing new technologies and business models; but this is not always the case. In their studies of Germany and the UK of how different

energy sector transitions are occurring, Geels et al., (2016) demonstrate that, given the right set of circumstances, incumbent actors can also accelerate the transition to a low-carbon society. Understanding how different policy links innovation niches to the regime, taking into account the incumbents actions, and considering how technology develops are important for determining future pathways (Kuzemko et al., 2016) . Most transition studies are historical and fail to arrive at prospective conclusions about the future (Kern et al., 2019; Kern & Rogge, 2018; Lee & Hess, 2019) (Berggren et al., 2015; van Waes et al., 2018). This thesis will further an understanding of those critical aspects of transitions, as a component of this work is the evaluation of various key actors' actions, not least through an understanding of behavioural characteristics.

2.6 Energy Policy and Transition Design

The government acts as the rule setter in public policy matters by creating and executing policy instruments. A primary goal of the development and use of public policy is to develop a set of circumstances in which actors carry out actions in a way that fulfils the government's goals, with those same actors also working to achieve their preferences within that context. If a policy is to be used by the government to lead to significant fundamental shifts in the energy system, a system transition is probably necessary. Following that, a metric for the worth of a policy required for this fundamental shift is only successful when it starts a transition to a required outcome; how the pathways are enabled need to be understood for a successful transition. The requirements of the transition pathway, not just the end outcome requirements, need to be addressed, and this adds a new element to the challenge of renewable energy policy design.

A shared perspective across researchers who are utilising the MLP in their work is that they regard power as being dispersed among a range of different actors, and no individual actor can change system development pathways independently (Avelino et al., 2015, 2016; Fischer & Newig, 2016). Meanwhile, the regime level is seen as the influential critical layer in understanding the current environment (Upham et al., 2014). Niche levels are viewed as the layer in which different types of systems innovations arise (Geddes & Schmidt, 2020), given

that the regimes are established and organised through the procedures that actors within them have created and are, therefore, relatively static in the absence of external forces. The probability of success for innovations, which have been made and protected in a niche, is related to the interaction of different variables and whether the overall conditions in both the regime and landscape levels are supportive (Geels, 2002). Active policy design using TM as a reference focuses on encouraging innovation through protected niches and taking those inventions, once developed, into the regime, from where changes to system development pathways take place (Lovell, 2007). For renewable energy policy, in particular, supporters of the use of the MLP emphasise that niches are critical to foster innovation.

Foxon and Pearson (2008) describe government, firms and other stakeholders as having a central role in a system change and the diffusion of low-carbon technologies. Van den Bergh et al. (2011) stress the need for policymakers to manage the dynamics of possible transitions, avoiding early lock-ins. This point begs the question of how policy can be best set up to develop the transition on a 'least regret' basis. Foxon (2013) lays out paths to a low-carbon UK in 2050 by focusing on various actors' interactions, who they group into the market, government and civil society, a grouping which this researcher finds helpful in this work. Mitchell (2008) argues that the UK's political and ideological paradigm needs to change before a transition to a low carbon society is completed. As the requirement for a successful transition is immediate, this robust work does not help us define routes to a transition but simply highlights the challenges faced at the landscape level. Gross et al. (2018) discuss how long technologies applicable to energy and the energy system have taken to grow from a protected niche and become established in the regime. They find that there is possibly a significant period to take technology from a niche to the regime and that innovation policy should accelerate the deployment of existing technologies and research into new ones. Jefferson (2008) emphasises the longevity of the policy challenges we face by underlining the time between a policy being implemented and witnessing the effects of that policy, and therefore the conclusion of a transition to a low-carbon economy. Johnstone and Kivimaa (2018) discuss green industrial policies and their possible role in managing the changes to the energy system through the acceptance of new technologies.

As socio-technical regimes are often interconnected, to be fruitful, an analysis of socio-technical change on multiple levels must avoid concluding with a group of individual factors with no logical connection. A selection process must be performed to understand the system's limits correctly, as it is often not clear how the borders in MLP analysis should be drawn. This thesis, undertaking as it does an analysis of renewable energy policy in the EU, Ireland and the UK, works to achieve that. The research overall can be summarised as utilising the levels of the MLP as shown in Table 2.2.

2.7 Institutional Theory

Literature relating to socio-technical and energy transitions makes frequent reference to the importance of 'institutions', taking ideas from organisational and sociological institutionalism, rather than from rational choice and historical institutionalism (Fuenfschilling & Truffer, 2016; Genus & Coles, 2008; Quitzow, 2015). There is a widespread perception that energy, as a national security issue, makes the low-carbon energy transition an essentially political activity. There are, therefore, powerful interests and actors involved in energy and in the patterns of energy use that are deeply embedded in societies (Burke & Stephens, 2018a; Goldthau, 2014).

Researchers use institutional theory (IT) to identify and examine stimuli that promote durability and soundness of organisational practices across a wide range of aspects, from environmental practices, to regulation and economic incentives (Chu et al, 2018; Bruton et al., 2010; Baumol et al., 2007). IT has, in the main, been focused on how groups and organisations reinforce their existing positions as they operate in various social constructs (Dimaggio & Powell, 1983; Scott et al., 2004). The theory has also been a useful tool for researchers to discuss how variations in social principles and technological developments could affect decisions regarding sustainable policies (Ball & Craig, 2010) and environmental management (Hoffman & Ventresca, 1999). Isomorphism in IT is a key concept, describing how different organisations

share similar characteristics. Several drivers create similarity of strategies, processes, and structure between one organisation and another; those drivers have been identified as coercive, normative and mimetic (Dimaggio & Powell, 1983) :

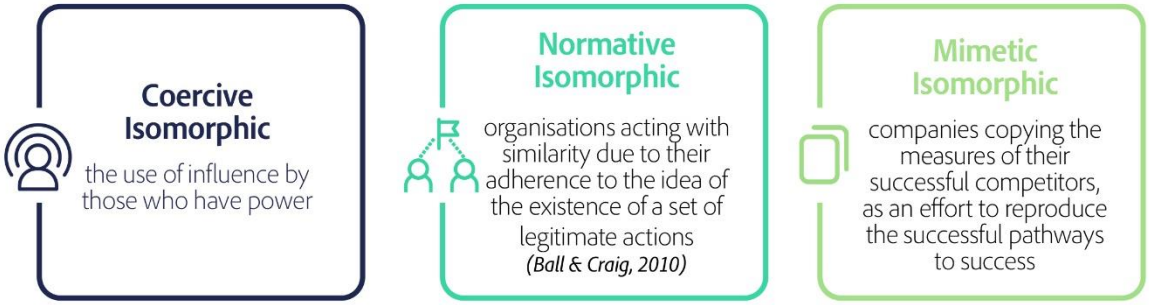


Figure 2.7: Different forms of isomorphism (Dimaggio & Powell (1983))

Institutions and actors themselves can define a group of rules that determine which actions are acceptable for organisations to carry out (Meyer & Rowan, 1977) and the rationality by which laws, regulations and behaviours seem normal (Meadowcroft, 2009; Tolbert & Zucker, 1983). Consequently, institutions can define what is appropriate (Scott et al., 2015), making other behaviours unacceptable (Dimaggio & Powell, 1983), as there exists outside impetus for the institutions to make these rules, an impetus coming through from the various landscape themes such as cultural, social and economic. How organisations, therefore, make decisions is determined by that appropriateness. This approach is useful for researchers in assessing some of the most important theoretical ideas in transition theory, such as the description of different structures within socio-technical systems and the interaction between different actors in those structures. This gives rise to various questions on the general nature of embedded institutions and the dominant institutional environment. In particular, what influence does the context have on policy discourse, making and implementation, and what is the role of actors in such a context (Andrews-Speed, 2016)?

2.8 Renewable Energy Policies Implemented in Support of Low-Carbon Transitions

These different frameworks, energy transitions theories and institutional theory can contribute to an understanding of how policies that support renewable energy have become a foundation of how the EU approaches its goals around climate and energy. Many researchers have pointed out the lack of empirical data in many of these works and across governance studies as a whole (S. M. Hall et al., 2013). The literature, therefore, as Jordan et al. (2013) state, is over-reliant on theoretical models and lacking in empirical grounding. Yet, when reviewing the work of energy economists (for example, the work of Del Río and Cerdá (2014); Del Río and Mir-Artigues (2014); Ragwitz et al. (2009)), and their examination of policy effectiveness as a driver of renewable energy growth, very little space is given to theories of the energy transition. Here, the reverse seems to hold true: the work addresses empirical data in isolation without reference to theory, again, as Jordan et al. (2013) point out. Transition studies, working to explain the dynamics and pathways of various transitions, has allowed researchers to deploy a framework to describe transition trajectories in the domains of energy (Geels, 2005; Verbong & Geels, 2007), mobility (Köhler et al., 2009; Whitmarsh, 2012) and urban infrastructure and transition (Farrelly & Brown, 2011; Murphy & Carmody, 2019). National and regional fiscal policies and instruments seek long-term and sustainable transitions, but as Hamilton et al. (2009) state, these are not enough for what is required over the long term. One must also consider the areas of conflict; not only could there be conflict from actors in the regime level, but different niches could also be in conflict, and as the transition continues, niche experiments may take different routes. The sooner the renewable energy niches are developed to substitute the incumbent fossil fuel-based regime generators, and become successful parts of the regime, the faster the transition to a sustainable energy system.

Linking to Theory

To date, each EU member state has instituted some form of renewable energy support or a combination of support policies (IRENA et al., 2018). These policies have delivered a change in the percentage of renewable energy from 14.3% in 2004 to 25.4% in 2013 (Pacesila et al., 2016). The policies enacted to support this transition to a low-carbon society have, in general, been fiscal instruments that are national in nature, with EU-wide targets enforcing and spurring their formation (through competition between member states).

The EU in 2001 chose to support renewable energy as a key generation source, driven by serious concerns on energy security and its commitments under the Kyoto Protocol. The European Directive of 2001 (European Parliament and the Council of the European Union, 2001) obligated the EU to change the energy generation's percentage derived from renewable energy assets from 14% to 22% by 2010. Consecutively, through the Brussels European Council Act 7224/1/07 (EC, 2007), a new target was set of 20% from renewable energy output in relation to the total European energy production by 2020. This goal was enforced when the European Directive 2009/28/EC (EC, 2009) was brought in. The key goals within the Directive were a carbon decrease of at least 20% with respect to those of 1990, and the increase of low carbon generation through renewable energy generators to 20% of the EU's energy use by 2020.

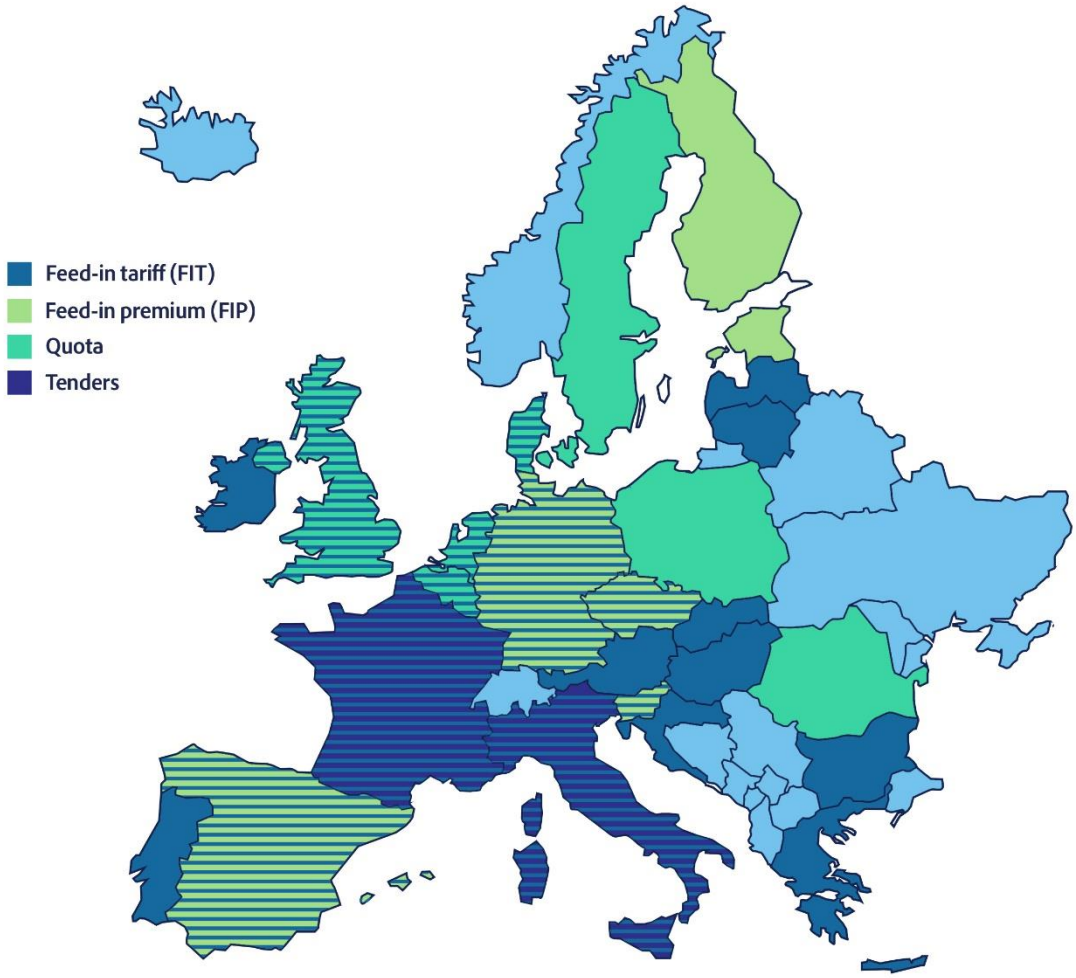


Figure 2.8: Electricity from renewable energy is backed by various methods in the EU member states (Klessmann (2014)).

The rationale for the use of fiscal instruments in managing things such as local pollutants is well-established theoretically (D. W. Pearce & Turner, 1990) and also empirically (IPCC, 2007a; IPCC, 2014). The creation of experiments and niche management through fiscal instruments is done in the expectation that new and existing actors will look positively at low-carbon options. Therefore, this incumbent energy regime will support sustainability measures in anticipation of high expected returns, enabling the transition to a low-carbon regime. The addition of new technology and R&D development, if matched with social measures through policy design, can enable that transition by allowing protected niches to move to a regime over the long run (Barker, 2007; Verbong & Geels, 2007).

Renewable energy fiscal instruments, in general, have been designed to allow niches to develop whilst allowing an increase in the number of actors who are willing to provide support for those niche activities. This expanding of investment volume, through the creation of a set of conditions necessary to attract a range of actors and institutions, is vital because of the capital requirements that society has in creating new socio-technical configurations (Hamilton et al., 2009; IPCC, 2007a). Within that, different instruments have been then created and implemented which vary in nature but are underpinned by the willingness of the state to support them through bridging from the market price for energy and the cost of the energy produced from renewable energy.

Fiscal Instruments

The discussion on the establishment of policy instruments leads one to review what form these support schemes have taken. In general, they have been either quantity-driven (the government sets the quantity of new renewable energy production and lets the market determine the subsidy level) or price-driven (the government sets the subsidy level and lets the market choose the quantity) (Del Río, 2014; Reiche & Bechberger, 2004). An example of a quantity-driven scheme is a quota system, in which green certificates are issued to producers in proportion to the volume of renewable energy generated. These are then traded to satisfy a quota for renewable energy. Other standard terms for the same concept are 'renewable portfolio standard' (RPS) and 'renewables obligation' (RO). A feed-in scheme is an example of a price-driven scheme, and it can be implemented as either a tariff that replaces the electricity price or as a price premium paid on top of this price. As of 2013, 71 countries had implemented price-driven support schemes and 24 countries had implemented quantity-driven schemes (Kitzing et al., 2012).

Since 1997, when the EU′s renewable energy policy was initiated, various European states have introduced a series of support schemes to increase energy from renewable sources. Such schemes include feed-in tariffs (FiT), allocations of tradable green certificates (TGC) (both discussed above), bids and /tenders programmes, attractive credit, financing grants, and various other instruments and supports (Dusonchet & Telaretti, 2010). The use of a FiT has

become one of the more extensively applied schemes, closely followed by the use of a quota combined with a TGC (IRENA et al., 2018). A FiT is comprised off an extra payment to RE suppliers on a per unit supplied basis, sometimes linked to procurement requirements that power generation companies need to meet. Quotas then create TGCs, allowing the utility (or industrial entity) to generate credit from every MW h of renewable electricity they produce, which enables those firms to gain additional income. The need for TGCs derives through a requirement imposed upon energy generators to give up a quantity of those TGCs as a portion of their yearly use, without which a fine is imposed.

These quotas (which is a regulation on suppliers) and FiTs (which is a contracting mechanism) are deployed differently across the globe and in the EU. As mentioned above, FiTs are the dominant policy tool implemented by 71 nations globally. Quotas have been employed in ten nations and at a minimum fifty territories (Timilsina et al., 2012). Grants to encourage private-sector financing have been employed , again on a per unit basis, and, as with the FiT, they are widely used either in combination or on their own, with the other two schemes (Energy, 2015).

2.9 Different Aspects of Evaluation

Determining the criteria for judging the success of renewable energy policy has been an extensive area of research. There are multiple ongoing and systemic surveys highlighting the progress of each member state of the European Union in renewable energy (García-Álvarez et al., 2016; Helm, 2014; Kilinc-Ata, 2016; Menegaki, 2013). These surveys have generally shown output and resource data on the major renewable energy technologies: solar thermal, solar power, photovoltaic, solid biomass, heat pumps and biofuels (Pacesila et al., 2016). Comparative analyses regarding electricity production from renewables and heat consumption in the EU member states have also been presented (Langsdorf, 2011). The elaboration of these surveys has involved collecting data and information obtained from surveys and EU reports and guides on renewable energy sources and calculation and comparative analysis methods. These indicators have been analysed to reveal key trends in the development of renewable energy across the EU to see what progress is made by each country against the Europe 2020 target.

An example of these are the reports developed by IRENA. These provide an overview of 26 countries worldwide on the share of renewable energy (2010–2020), the relation between each country's renewables potential and substitution costs from government and business perspectives, and the contribution of individual countries to total renewable energy use (Buchner at al , 2018). The reports are based on data collected from official government sources with national experts from 42 countries. Renewable energy technologies, funding, policy makers,′ intentions, skills and competencies are also mentioned. The studies have an exploratory nature using analytical methods, and their results are globally valid. Their purpose is to help policymakers better understand the opportunities and challenges in this area and enable citizens to easily obtain objective, transparent information.

Worldwide production from renewable energy sources has also been analysed by experts from the Renewable Energy Policy Network for the Twenty-first Century (REN21) (REN21, 2018). The results provide country rankings by renewable energy production capacity and electricity and heat generation from renewables. The analysis was made using the following criteria: geothermal power capacity, global hydropower capacity, solar PV global capacity, solar water heating collector's global capacity, wind power capacity, electricity generation from renewables, heating and cooling from modern renewable technologies, etc. The reports elaborated by REN21 also give insight into current renewable energy market conditions and investments and research and development in developing and industrial countries, but without giving policy recommendations (REN21, 2018).

A comprehensive comparison of the electricity generated from wind, solar, geothermal, tidal and wave in the G20 countries has been elaborated by REN21 and the International Energy Agency (IEA) (IEA, 2018; Zervos, 2019). A listing of G20 countries that have consistently been invested in renewable energy worldwide since 2011 has been made by Bloomberg New Energy Finance. As regards data collection, the calculation of electrical power was performed using Eurostat data, the monthly reports of the IEA. For the period 2002–2010, the information consists of data supplied from the Energy Information Administration and the International Energy Statistics. These documents highlight that the share of electricity from renewable energy sources represented 80 per cent of global electricity generated from renewables in 2010 in the G20 countries.

A quarterly classification of countries by level of renewable energy market development and attractiveness in terms of investment has been developed by the accounting firm Ernst & Young. They have analysed the 40 most attractive countries globally and created a preference ranking based on the different types of renewable energy sources (Ernst & Young, 2020). The evaluation of the 40 countries has been made according to the following criteria: the growth potential of the renewable energy market, energy infrastructure, quality of resources, legislation, etc.

The studies that examine the drivers of renewable energy growth through statistical analysis from reports such as those discussed above fall into distinct areas. First, those examining a set of studies using cross-section regression to examine the effect of different policies and their characteristics on renewable power capacity growth (Dong, 2012; Menz & Vachon, 2006); and second, studies rely on descriptive statistics only (Alagappan et al., 2011). These both find a positive correlation between renewable energy policy and renewable energy growth. What these studies fail to account for are individual country factors or an assessment over a period.

Other researchers have worked with fixed effects models, which increase the validity of the results by including more variables and thereby correcting for the omission of critical causal factors (Marques et al., 2010; Shrimali and Kniefel, 2011). These extra variables are correlated with both policy choices and renewable energy growth, and with their inclusion, one does not see the same positive outcomes between renewable energy policies and implementation. Research has also been carried out in which policy (in this case, RPS) has been shown to lower the amount of renewable power capacity once factors other than policy have been accounted for (Shrimali & Kniefel, 2011). Hanna and Gross (2021) investigate how distinct energy systems models and scenarios account for and plan for possible further events. Their focus is on a forward-looking scenario and modelling exercises to enable policymakers to prepare for social, economic, and political dimensions of disruptive change in energy systems. They highlight policy makers' value building knowledge and expertise from a range of backgrounds, scenario and modelling methods.

Many researchers have used sophisticated models to understand better the complexity of renewable power growth (Groba et al., 2011; Marques & Fuinhas, 2011; H. Yin & Powers, 2010), which have shown that sensitivity to economic and social drivers varies extensively between countries which start with unequal levels of renewable energy on their grids. Groba et al. (2011) develop a technology-specific model while assessing the effect of FiT policies in Europe. H. Yin and Powers (2010) examined policy design at the individual state level in the U.S., which they deemed accounted for policy design characteristics differing by state. By then applying a fixed-effects model, their paper shows the use of RPS as a policy framework has a positive effect on the growth of renewable energy development. Crucially for the questions to be addressed in this research, they verified that this impact would not be seen if characteristics of different policy designs were ignored. Kitzing et al., (2020) use ideas from system innovation and evolutionary theories combined with economics to analyse cost and the impact of different mechanisms; they put forward that by combining a particular choice of mechanism with an understanding of the overall transition society is engaged in, policymakers can design operative policy containing individual mechanisms while retaining awareness of the complexity of of a low carbon transformation. An analysis of renewable energy development in the EU is undertaken by Marques in two papers (Marques et al., 2010; Marques & Fuinhas, 2011). These papers, perhaps unsurprisingly, find that the strength of the hydrocarbon firms is unhelpful to the growth of renewable energy. In contrast, the use of these schemes and mandatory renewable energy targets for EU member countries are positive drivers.

Policy Metrics

There has been an increased importance placed on studying the effectiveness, efficiency, and equity of various incentive policies for renewable energy. The focus points of the debate have been the effect of using mechanisms to influence the private sector for an expansion of investment in renewable energy assets at what cost to the public of different methods. To correctly engage in this debate, the metric of success of differing policies needs to be defined. Huber et al. (2007) summarise the complete effects of various design fundamentals of renewable energy policy mechanisms. The key points are, unsurprisingly, that how policy has been designed is by far the most important feature. Additionally, they argue that FiTs have been more effective and cost-efficient than other incentive systems to date. Savvidis et al., (2019) discuss the absence of transparency and standards, which makes the evaluation of which

economic models to use for what policy choices challenging. They systematically assess the ability of those models in answering major energy policy questions.

Effectiveness

The assessment of policy effectiveness is focused on the degree to which planned goals are met. What, for example, is the tangible growth in renewable energy created or the percentage of renewable energy across the economy during the period examined? Much of the research on the concept of effectiveness has been focused on the EU, with studies undertaking comparative policy evaluations across countries within the context of successive directives and targets. The IEA has carried out an assortment of policy assessments and comparisons and is a major source of work in this area, responsible, alongside the EU's research organisations, for the majority of the work undertaken on this topic (IEA, 2018). Academic research has underserved this area to date.

All the effectiveness indicators reviewed have significant gaps in their usefulness, and even the most complex does not help the researcher on key questions such as why a certain build was successful, what its longevity is likely to be, was it the best use of capital or did it fulfil the requirements of the community where it was located. This measuring of implementation can, therefore, only be a first step in assessing effectiveness.

Efficiency

With policy efficiency, more useful measures of whether a policy has been efficient in relation to financial funds spent in delivering renewable energy can be considered, both in terms of basic economic metrics and social costs/impacts (Buonocore et al., 2019). This includes measurements such as outcome to input ratios, which provide useful benchmarks to track across policies, whether it be the price per MW or price per MWh. The literature utilising this measure of efficiency is mainly restricted to case studies (Andor & Voss, 2016), and has mostly concentrated on the effect of various devices on overall increases in generation size and static efficiency for European states, the U.S. (Abdmouleh et al., 2015). This literature shows that FiTs generally perform better than TGCs in terms of effectiveness and static efficiency because they allow for a reduced risk for the private sector (García-Álvarez et al., 2017; IEA, 2011). If one looks at TGC arrangements, ambiguous and unpredictable TGC costs include a risk premium that raises the cost of finance and inhibits investment. The use of a quota combined with a TGC has been seen to be especially challenging when used to promote

a sizable expansion in solar generation. With a TGC, the lowest cost technology are favoured more than high-priced technology a situation which exits within multiple countries (Kilinc-Ata, 2016). In the EU, nearly 100 per cent of the new PV capacity since 1997 was installed in states using FiTs and the majority of those states with expanding PV generation employ FiTs (IRENA, 2016). When relative evaluation of mechanisms with a concentration on effectiveness and cost-effectiveness, the research has shown that the use of a FiT are both more effective and efficient. That success led to a growing funding cost of the expanded build in reaction to that mechanism in several countries (France, Germany, Spain and Italy in particular), which focused attention on the scheme's total costs. The goal of how to bring together expanding the penetration of renewables whilst reducing the overall cost was therefore taken up by policymakers (Climate Change Committee of the United Kingdom, 2019)

Researchers propose two different aspects of efficiency: static, or cost-effectiveness, and dynamic, which contains a temporal measure. While Debizet et al. (2015) and Verbruggen et al. (2010) discuss static efficiency as a qualitative concept, the majority define it with some form of quantitative metric (Held et al., 2010; IEA, 2008). Dynamic efficiency is addressed in the abstract, and its use of the pace of innovation within a market still lacks quantitative values, which remain unspecified (Van Dijk et al., 2003; Verbruggen & Lauber, 2009).

Equity

Work on the concept of equity related to renewable energy policy brings to the fore issues around the distribution of policy impacts. Principles such as ‘the polluter pays,’ the distribution of profits and expenses, the occurrence and distribution of excess returns, and different actors’ capacity to bear that cost becomes key to the understanding of the outcomes (Jenkins et al., 2016; Pellegrini-Masini et al., 2020; Sovacool et al., 2020; Williams & Doyon, 2019).

Social, sectoral, intergenerational and international combinations of actors are frequently studied (M. Bazilian & Nussbaumer, 2010; Jacobson et al., 2005; Macintosh & Wilkinson, 2010). Assessments of different renewable energy policies generally subscribe to the principles above while debating equity. A limited number of papers relate to the particular indicator or method feeding into decisions, and they are focused on the allocation of different advantages

among customers (Alkire et al., 2013; Morgan Bazilian et al., 2010; Fuss et al., 2012; Macintosh & Wilkinson, 2010).

Institutional Feasibility

The various elements that combine to influence and drive different policies involved in the transition to a low-carbon society do not operate in isolation from the institutions' quality. The literature, in general, discusses institutional feasibility in the context of environmental policy rather than renewable energy policy. Other research offers only a summary of possible methods to allow readers to understand its strength or otherwise (Clean Technology Fund, 2009; Woodman & Mitchell, 2011), or inspects the results of institutional feasibility assessments, not including how their methodology supports their work (Haas et al., 2011;). The viability and experience of an institution and how policies perform are not fully proved in the research but can assist in understanding why particular policies succeeded or failed or the original design of a policy.

Behavioural research helps in understanding the connection between institutional feasibility, policy and renewable energy development. Bürer & Wüstenhagen (2009) analysed investors in both the U.S. and the EU and attempted to determine which policy design achieved a higher quantum of capital invested in renewable energy. Their research found that the private-sector market players prefer FiTs compared to all other policy types, in the main since they lower investment risk more than other policies. Bergek et al., (2013) point out that investor-related factors such as their motives, background, resources and individual characteristics; needs to be accounted for to understand the willingness of investors to take on certain risks. They will make an individual decisions which will affect the success of different policies . Held et al. (2010) and Masini and Menichetti (2013) use surveys to explore the social aspects that impact the private sector’s interest in investing in a renewable energy asset. Stable and transparent indicators as factors in supporting investments are also highlighted, and the private sector preference for FiTs compared to other renewable energy policies. Again, Held et al. (2010) and Masini and Menichetti (2013) discovered that the private sector considers the amount of the subsidy and length that the FiT is in operation equally, and they asked participants about how the political and market environment influences their decision. Key variables from that research are the amounts of tariff available, the market value of the energy produced, the duration available of the FiT, and the renewable energy asset's capital and operational costs.

Studies that document and interview policymakers on their decision-making process and hoped-for outcomes are surprisingly hard to find and represent a significant gap in this area.

The range of different arrangements, including FiTs, used to promote renewable energy is described by Haas et al. (2011) and Klessman (2012), where it is put forward that a policy that relies on the motivation of the market must solve the preference of short-term profits through putting in place a longer-term solution. Researchers have also commented on the short timeframe in which we have to evaluate these support mechanisms' success in both Europe and North America (Steg et al., 2015). An analysis carried out by Dinica and Arentsen (2003) on different renewable energy technology distributions assessed how private-sector interactions changed the distribution. They argued that a stable investment environment that allows appropriate return for the risk taken is essential for a large growth in renewable energy. Mitchell and Connor (2004) evaluate the UK ROC framework considering the FiT policies in Germany and how the German approach changes investors and policy effectiveness risks. They state that the policy effectiveness of the German system lowers the risk for the investor and, therefore, increases the development of renewable energy. This assessment somewhat ignores the attractiveness of the German government support, in terms of the different level of sovereign risk, versus that of the UK. Held et al. (2010) consider the success of different policy approaches in the EU to support renewable energy as a percentage of the grid. Additionally, they determine that support mechanisms that have stable policy characteristics are valued at a higher level by the private sector, requiring a lower return. Butler and Neuhoff (2008) determine that the burden to the public of FiTs is less than utilising green credits. Haas et al. (2011) evaluate various renewable energy support mechanisms. One of the most important findings of their research is that those policy frameworks which ‘offer long-term investment continuity produce better results’ (pg.3). Lastly, Klessman (2012) explores wind power developments, both onshore and offshore, in the European Union. The research points to the failure to put in place a consistent policy framework as the driver of poor deployment of renewable energy in the case study countries. This stability of policy framework is highlighted by Karneyeva and Wüstenhagen, (2017) in their work which places the context of a decreased in new solar PV capacity in Germany, Italy and Switzerland, and argues for stable policy environments with low returns as a means to achieve best outcomes.

2.10 Summary

This literature review highlights the increasing scope and depth of the research addressing transitions to a low-carbon economy whilst also demonstrating the scholars' multi-disciplinary nature in this field. This chapter has first examined the work undertaken in institutional theory, then introduces policy theory concepts, and then how policy is undertaken across the EU. There exists a complex interplay of various actors, which this research, to fulfil its objectives, will identify and assess. This research will build and deepen the existing policy theory work as it relates not only to renewable energy policy but also to formulations around the development of policy in general, in the EU and the case study countries. The MLP is discussed and is identified as an appropriate framework within which to work, but it is an open question as to whether researchers, given the issue of choosing between different frameworks, should be developing a meta approach within which the various methods are mapped as specific sub-sets, or, if compatible, should each of the theories operate together (Geels, 2010; Stirling, 2011)? The established concepts and frameworks developed from other fields (such as neo-institutional theory, actor-network theories, economics, political sciences) could help deliver different viewpoints.

The conceptual frameworks and methodological foundations applied to both past and current transitions require elaboration. Existing conceptual frameworks must be challenged in terms of where they are applicable and what their limitations are. The MLP has generated considerable debate on its advantages and weaknesses (Andersen & Markard, 2020a; Geels, 2011; Markard & Truffer, 2008). This debate has worked to develop the MLP further, and it is hoped this will allow for increased use in empirical studies. This process of extending and expanding research on MLP has also brought in other frameworks and how they could complement the MLP (Markard & Truffer, 2008); with complex modelling (Faber & Frenken, 2009; Zeppini & van den Bergh, 2011), and of governance and power theories (Voß et al., 2009).

As theoretical frameworks advance, there will be consequences for methodological approaches in future transition work. How will the persistent requirement to improve how policy is developed in support of a transition be undertaken? Working from a theoretical viewpoint, it seems that there was initially little research completed on these areas (Meadowcroft, 2009; Shove & Walker, 2010). This has begun to be addressed as now the issues of politics and policies are regarded as an important area of research in transition studies (Avelino & Rotmans, 2011). Avelino, in particular, raises important topics on power, its location and which actors exercise their power, and therefore how that affects transitions in progress.

The way in which an energy transition originates and progresses in separate states and the interaction with different actors is an important area of focus for this research. In this gap, this work will both add to the analysis of transitions and develop the theoretical framework of MLP to apply it to other transitions. How outcomes are assessed, and the different aspects of that evaluation form an important bridge, not only to the major task of this research, but also to the measures of that success, and who it benefited. This review highlights the work that has been done on effectiveness, efficiency, and equity as measures and provides a framework to which this empirical work can contribute. One of the most important is how to incorporate empirical data and its analysis into MLP to determine better both the context within which renewable energy policies are developed and the outcomes of that policy.

In addition, the following areas require exploration as they are not addressed in the present literature:

- Do transitions occur due to practices from landscape, regime or through niche developments; or some combination of these?
- How particular policy mechanisms change over time during a transition
- The development and implementation of new policy frameworks to improve transition projects' efficacy at local, regional, national and international levels.

Thus, there are several lines of potential future research directly applicable to this study. These have been distilled from the literature review and build on the broad themes above.

This research's contribution to the conceptual understanding of energy transitions gains significant importance from the bridging of traditional policy analysis, and transition approaches, which includes socio-political dimensions. This connection has not been completed by scholars to date. This literature review furthermore shows that this research will aid future policy design by presenting and discussing the pathways of EU renewable energy policy implementations in the UK and Ireland; by surveying the evolution of renewable energy policies from 1995 to 2015 by the EU; and by giving a comprehensive examination of the case study countries' different renewable energy policies.

3. Methodology

3.1 Framing the Research

Kumar (2014) discusses the importance of designing a study to capture the complexity and diversity of social systems, including the energy system, stating that ‘social networks and their relationships are like spider webs which extend outward in intricate patterned structures; each of which is organized and perform a valuable function either singularly or collectively’ (pg. 1). While building renewable energy generation is a technical activity, the energy system is in totality a political and socio-technical system, with the potential effects involving humans, entities, and communities. By combining a focus on technology, growth, and institutional methodologies to understand the creation and implementation of renewable energy policies in Ireland and the UK, this thesis adopts an integrated approach to understanding how policy has functioned at the community, national and international levels.

This thematic approach's rationale is that a contentious issue should be examined within a full range of contexts, perspectives, and frames. This chapter describes how this research was planned and executed.

3.2 Methodological Design of the Study

The literature review from Chapter 2 shows that, though much valuable work has been undertaken by scholars from multiple disciplines, a detailed analysis of the trends and contextual variables relating to the evaluation of EU renewable energy policy has not been completed. Although the work to date offers significant learnings and enables this research, it does not fulfil the comprehensive requirements of linking political theory, transition studies and economic analysis to enable policymakers to determine best, and understand the context of, policy development. As highlighted in the Introduction, the main goal of this research is to examine renewable energy policy in the UK and Ireland employing the MLP and to thereby determine what were the policy results, as measured by who benefited and how those policies have performed over a range of metrics, including equality, effectiveness, institutional feasibility, and efficiency.

As outlined by Collis and Hussey (2014), research design views the research method holistically, working from the theoretical foundation to the process of collecting data and, finally, the analysis of the same. The research design allows the researcher to:

Figure 3.1: Illustration of research design method (derived from Collis and Hussey (2014))

Not only does this chapter describe the design of this research (case study) together with the justification of the approach taken (mixed methods), but it also presents how the researcher completed the data collection and the techniques that were employed to analyse the resulting quantitative and qualitative data.

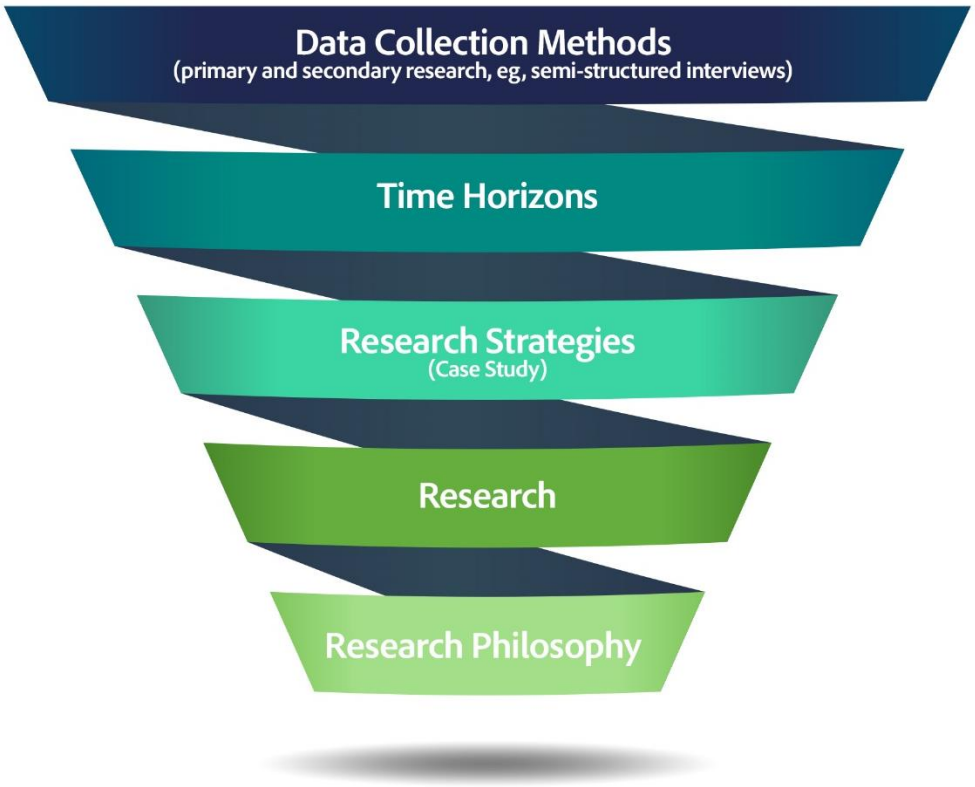


Figure 3.2: The research process (derived from Saunders et al. (2008))

Research Methodology

According to Saunders et al. (2008) systematic research incorporates specific methods to collect data, reflection on the importance of the results acquired and a description of any shortcomings. Without a research methodology in place, a systematic investigation becomes significantly harder. A graphic that Saunders et al. (2008) developed partly guided this work (see Figure 3.2). This approach is shown in the same figure: working from the bottom up, defining the philosophy, then the approach, the strategies, the horizons and, finally, the methods.

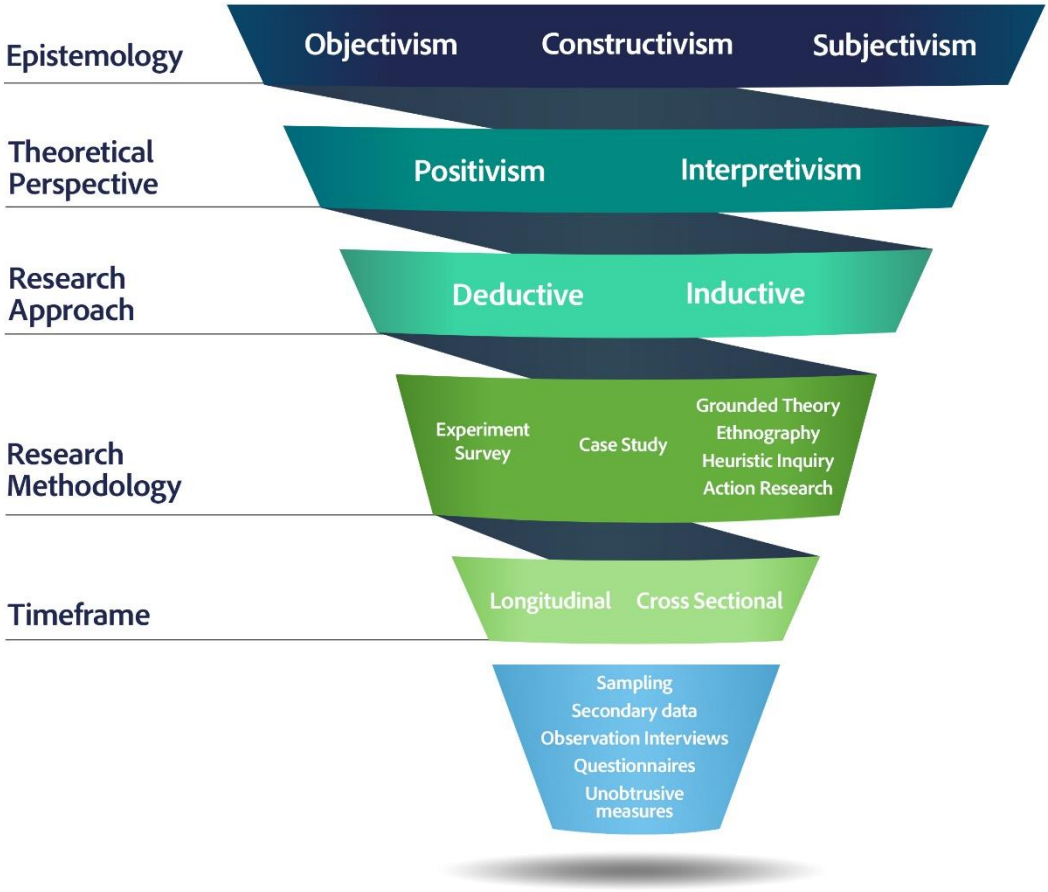


Figure 3.3: The elements of the research processes (derived from Saunders et al. (2008))

The above describes elements of the research method and how those elements are grouped into two different approaches. The first supports making a theory explicit in advance of carrying out the research, and therefore uses a deductive approach. The second school uses an inductive approach, which focuses on developing theory only once the research has been completed.

The five research questions addressed in this thesis are not posed as hypotheses. The researcher has attempted to gather data that shows both the rationales of the various actors and how policies were enacted, and some of the policy effects. This position is strongly aligned with the post-positivist epistemology (Denzin & Lincoln, 1994). These theoretical underpinnings, from the interpretivist approach, mean that the methodological foundation of this research has

involved the analysis of a range of renewable energy policy materials, completed and underpinned by a series of semi-structured, open-ended interviews with key figures involved in renewable energy policy development in the case study countries. This research, therefore, has taken an inductive interpretivist approach.

The basis for this methodological approach is built on two key areas. First, from a requirement to question the debates and assumptions made in the policy materials concerning the policy intentions and purposes. Second, policymakers need to find out how the assumptions made in these documentations were conceptualised and understood. The decision to employ this complementary data collection and analysis method thus rest on the need to clarify how the policy intentions were determined and interpreted and what this suggests about the implementation and institutionalisation processes.

Research Strategy

For any research to be successful, the means of data collection need to be defined (Sarantakos, 2013), and in that choice, the researcher has a large number of different methods available. In considering which method the researcher should choose, they must examine 1) the kind of research questions to be addressed, 2) what ability the researcher has to manage behavioural events, and 3) whether the questions are assessing present events. From that, the researcher has a wide range of options ranging from experiment to surveys to case studies (Yin, 1983). Here a mixed-methods approach was chosen. Johnson et al. (2007) suggest that this permits the researcher to avoid the dualism argument on qualitative or quantitative methods. Here, the researcher has implemented a mixed methods (triangulation) approach using case study and semi-structured interviews to achieve a deeper insight into design and outcome of renewable energy policies.

Case Study

Robson (2011) states that a case study method uses an ‘empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence’ (p.178). R. K. Yin (2017) describes ‘an empirical inquiry that investigates contemporary phenomena within its real-life context……and in which multiple sources of evidence are used’

(p.16) as a case study method. This, therefore, allows a researcher to access multiple data resources (Chetty, 1996). Johnson and Stake (2006) make a distinction between the three objectives of a case study:

Figure 3.4: Illustration of objectives of a case study (derived from Johnson and Stake (2006))

In this research a collective case study was adopted.

R. K. Yin (2017) in agreement with Robson (2011), puts forward that a case study approach is most suitable under the following circumstances:

- when it investigates a contemporary event through its real-life context
- when it manages a wide group of data sources

This then demonstrates how the case study approach is relevant to this thesis due to the substantial volume of different data sources necessary to be assessed to properly meet the objectives, combined with the study's contemporary nature.

All research faces similar questions of validity that must be addressed, whether utilising a case study approach or not. The validity of single case study results can be significantly improved with the addition of a comparable case to the study. By including in this group, two countries with multiple similarities and several very different characteristics, this thesis aims to provide that validity. According to Bartlett and Vavrus (2017), comparative case studies are 'particularly well suited to social research about practice and policy' (p.1). In the context of

this thesis, two cases (the UK and Ireland) are explicitly compared. All cases, however, draw context from the central case of global and EU efforts around reducing the causes of climate change through a transformation of the energy system. For that reason, a comparative case study methodology is implemented for the thesis to draw results from the UK and Ireland context.

Mixed Methods

The research questions posed in this thesis point to the use of mixed methods, for as Creswell and Plano Clark (2007) state, when the research 'employs strategies of inquiry that involved collecting data[…] and both quantitative and qualitative data and analysis' (pp. 18-19) it is the most suitable technique. This should allow for a closer examination of the information whilst contributing to the study's comprehensiveness. It has been suggested by Greene et al. (1989) that this approach brings about an 'enriched, elaborated understanding of that phenomenon' (p.258).

According to Mason (2006), a 'qualitatively driven'(p. 10) use of mixed methods presents novel ways of comprehending social experience complexities and contexts. The application to renewable energy policies of a flexible, qualitatively driven approach makes good sense, 'Given the multi-dimensionality of social experience….to be interested in and to draw upon different theoretically informed approaches to conceptualizing context' (Mason, 2006, p.19). The often-recognised value for mixed methods largely centres on the benefits of triangulation, an approach is taken in this thesis to deepen and corroborate data and analyses (Palinkas et al., 2015; Sarantakos, 2013),

Data Sources and Triangulation

There are several challenges to building a sufficient amount of data to meet the thesis's aim correctly. To enable triangulation, published data confirming the changes in renewable energy development in the UK and Ireland covering the period 1995–2015 has been drawn from three sources, with different techniques of data collection and analysis:

- literature discussing renewable energy policies
- policies, from white papers to published laws
- 42 semi-structured interviews with relevant (elite) participants

This research employs a problem-driven research methodology, an iterative process combining both deductive reasoning (with key themes and codes drawn from the literature review) and inductive reasoning (where the interviews and responses drove the research themes).

3.3 Method of Collecting Data

The events in the UK and Ireland are somewhat influenced by the separate goals and plans of a selection of actors. To examine this, semi-structured interviews have been carried out with key participants who were active during the study period. This research is not a technical study on renewable energy; instead, it is a discovery of the actors' experiences and opinions about policy, followed by an analysis of the development and outcomes of the policy. These cannot be found solely using quantitative methods.

Semi-Structured Interview

Forty-three semi-structured interviews were carried out in total, with the initial interviews conducted in 2017 and the remainder conducted across 2018, 2019 and 2020. Interview and survey subjects were identified first from an initial list of key actors from the researchers' networks, from the literature and from identifying people who held particular positions in policymaking and using snowball sampling, where future interviewees were identified by referral from previous subjects. Holding confidential one-on-one sessions delivers better prospects for generating relevant data and as such, this was the format for the interviews. Interviews were recorded, transcribed and coded to identify key themes and highlight categories related to support or opposition and key stakeholder concerns. The purpose here is to examine renewable energy policy development within a complex and multi-faceted lens. This ethnographic data is used along with other data sources to deepen and broaden understanding of how sustainability transitions occur. The research does not draw conclusions

based on the limited data collected in interviews and surveys. The process was iterative. Validation and reliability testing was conducted to ensure that questions were as open-ended and as unbiased as possible. The interview format was either face to face or by telephone and ranged in time from 25 to 90 minutes. Interview questions, which always contained the initial question set, were improved during the data collection stage in light of the data that had been collected to date. During the interviews themselves, further follow-on questions were added depending on the direction in which the interviewee took their responses. This addition and improvement were made in order to make sure that the interviews produced a significant number of useful materials.

The research aim was to interview influential actors in the formation, and execution of renewable energy policies in Ireland, the UK and the EU. The researcher did not set out to build a large number of participants but to make sure that the participants' group was diverse enough to build a wide-ranging set of viewpoints and influential enough to shed light on the research topic. Therefore, the researcher first determined the important societal groups engaged in the renewable energy sector in each case study country and then built up a list of possible participants within each group.

Five stakeholder groups were determined by the author:

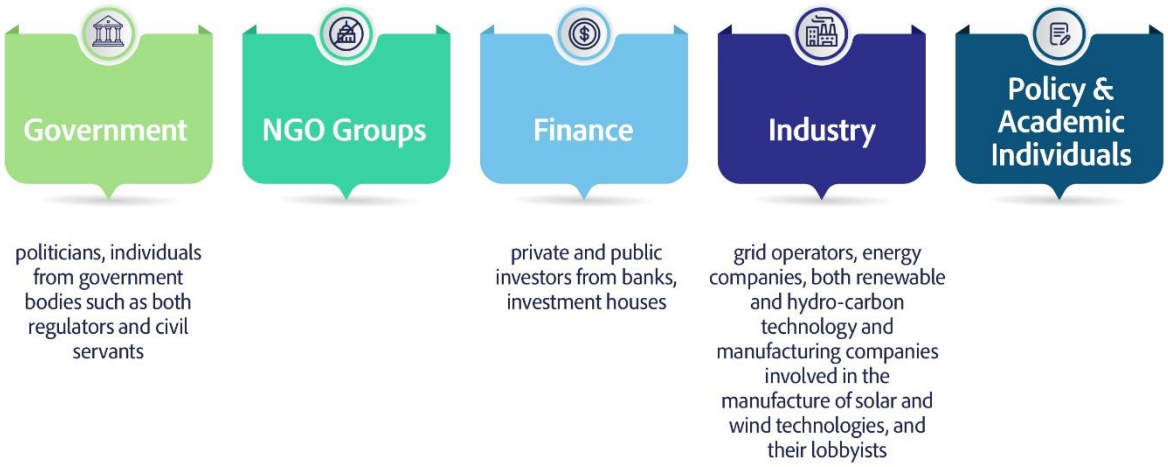


Figure 3.5: Stakeholder groups

Pinch and Bijker (1984) state that the group of interviewees 'share the same set of meanings, attached to a specific artefact' (p.414), and that requirement was tested in relation to the research questions of this thesis when identifying each participant and their relevant group. That test aside, it should be acknowledged that there can be significant overlap between members' activities in each group, and it is the case that people can move between categories over the duration of their career. Participants have been allocated to the group determined to be best, but individual allocations are a judgement decision and could easily be challenged.

Government as a grouping includes those who have a public mandate or who have a formal role in enabling policy processes. Therefore, it includes politicians, civil servants, both national and international, and members of regulatory agencies. Group two is comprised of individuals from lobby groups from the various Finance is overwhelmingly a group of actors who are concerned with deploying capital on behalf of their shareholders or investors to generate a return, though some might have other goals alongside profit. Group four includes utilities, developers and grid operators, as well as technology/manufacturing firms. non-governmental organisations group contains environmental NGOs and similar organisations. The last group contains individuals in academic research or those providing policy advice.

Creswell and Plano Clark (2011) discuss the idea of purposeful sampling as a useful method in qualitative research. Here its use is to support the researcher in selecting individuals to be participants in the research because they will be able to comprehensively broaden the analysis of the research questions and objectives of the overall study. Cozzens et al. (2006) also support the method whereby influential actors were deliberately chosen, in this case, from those five groups for this study. By bringing together a broad selection of actors with different roles and responsibilities relative to the research questions, this research avoided as much as possible interviews being composed of similar actors from comparable entities and biased with comparable stances. These individuals include numerous ex-ministers, CEOs, heads of important pools of capital, and leading policy experts from important think tanks, i.e., not just observers but also many key decision-makers. This is an important distinguishing aspect of this analysis. As discussed below, following best practice with no new themes being raised, in combination with the scope of individuals participating in this study, allowed for this study to investigate important themes and generate strong outputs (Guest & Johnson, 2006). Whilst carrying out the interviews the concept of theoretical saturation was referenced: if more interviews did not produce new themes and data, adding more interviewees was stopped.

The interviewees, their positions in the organisations they work in, and the codes which are used to identify them are listed in Table 3.1. These codes are then utilised in Chapters 3, 4 and 5 to identify from where quotes were derived. Seniority was determined through a review of the individual's title against their organisation's own published materials of seniority levels and a judgement of those levels against relevant positions in other organisations.

Sector	Code	Position	Country
FINANCE	FE11	Head of Real Assets	EU
	FE12	Global Head of Renewables	International
	FI11	Managing Partner	International
	FI12	CEO	International
	FR11	Head of Infastrure	IRL
	FR12	Head of Renewables	IRL
	FU11	Board Director and IC Member	UK
	FU12	CEO	UK
GOVERNMENT	GE13	Energy Committee	EU
	GE14	President	EU
	GR11	CEO	International
	GR12	Minister of Environment	IRL
	GR13	Minister of Energy	IRL
	GR14	CEO	IRL
	GR15	Minister of Energy & Environment	IRL
	GR16	CEO	IRL
	GR21	1st Secertary Depart of Energy	IRL
	GR22	Chief Scientist	IRL
	GR23	Assistant Principal	IRL
	GR24	Principal Officer Climate Change	IRL
	GU12	Minister of Energy	UK
	GU13	Minister of Energy	UK
	GU14	Executive Director	UK
	GU15	Secretary of State for Energy and Climate Change	UK
	GU16	Director General, Dept of Energy	UK
	GU17	Chair of the Office of Renewable Energy	UK
INDUSTRY	II123	CEO	International
	II22	CEO MEA	International
	IR12	CEO	IRL
	IR13	CEO	IRL
	IR14	CEO	IRL
	IR21	Head of Commerical	IRL
	IU13	CEO UK	UK
	IU21	CIO	UK
LOBBY	LR11	CEO	IRL
	LR13	CEO	IRL
	LR21	Head of Policy	IRL
	LR22	CEO	IRL
	LU12	Chairman	UK
POLICY	PI12	COO	International
	PR21	Researcher	International
	PU21	Head of Energy Policy	UK

Table 3.1: The interviews coded by country, sector and title

Sector	Geography	Seniority
F : Finance	I : International	1
G : Government	R : Ireland	2
I : Industry	U : United Kingdom	3
L : Lobby	E : European Union	
P : Policy		

Table 3.2: The interview codes

Although the first choice for this work was to interview participants in person, telephone interviews were also used where interviewees were unavailable. The aim of holding the interviews whilst also reviewing the written materials was to highlight and clarify the important topics in the two case study countries' energy transition.

Interviews, carried out correctly, are a well-established method of discovering critical pieces of information (J. Bell, 2005; Kvale & Brinkmann, 2009; Robert K. Yin, 2017), and semi-structured interviews with key stakeholders should give insight into how policy was developed in a given individual's organisation and context. There are four key stages in carrying out semi-structured interviews. First, developing a subject guide; second, selecting interviewees; third, carrying out the series of interviews; and fourth, developing an explanatory framework to understand interviews and to create key themes (Bauer & Gaskell, 2000). Conceptual and descriptive coding of interview transcripts has drawn on research software package NVivo to clarify unstructured data. Critical areas covered are illustrated in Figure 3.5

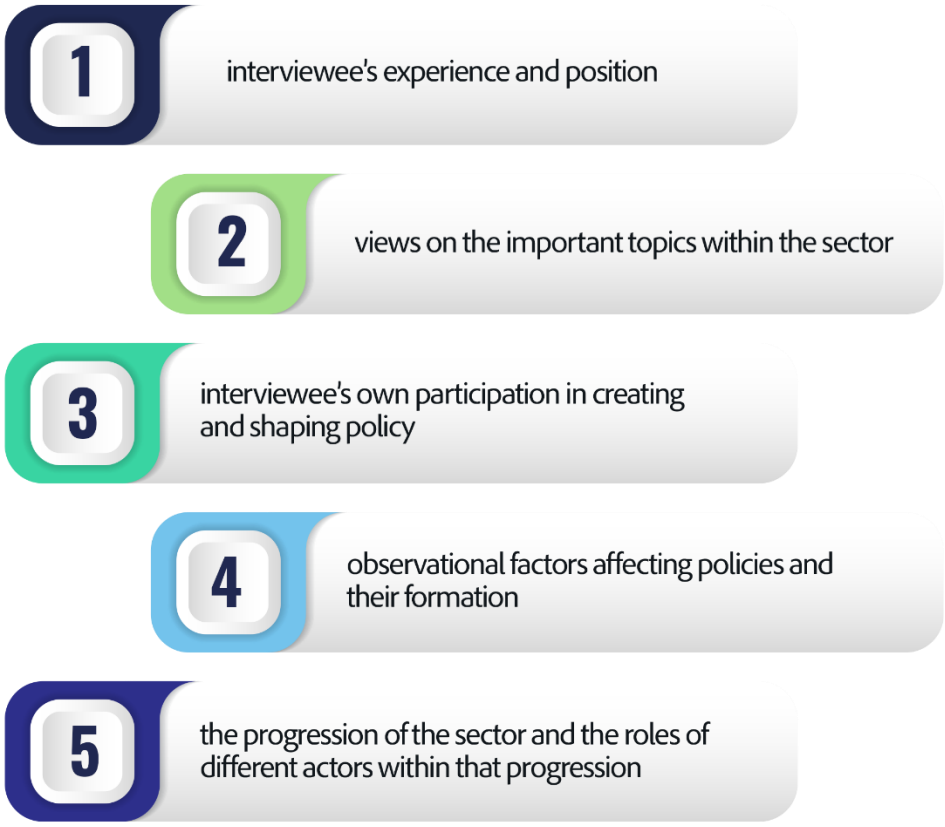


Figure 3.5: Areas of focus in interviews

Based on the above areas, the researcher created a set of questions that followed a semi-structured, in-depth elite interviewing model. Marshall and Rossman (1999) define elites as those *'considered to be the influential, the prominent, and the well-informed'* (p.83). These types of individuals could have information around non-transparent strategic, long-term policies of their organisations and give colour to the development of those strategies and policies. They should also be able to talk to how their organisations are organised and structured. Members of this group can put themselves in a position of a defender of an organisation's goals and strategies and the implementation of the same, as they might well be among the creators of those activities. As a result, it can be difficult to gather knowledge about organisational shortcomings and structural inadequacies because they either refuse to recognise or are unable to place themselves in a position to see these problems. The interview subjects participating in this research were drawn from a group of what would be considered elites. The

researcher focused on this group as it was believed that they would be able to provide knowledge and thoughts that other groups might not be able to provide.

Given that the interviewer wishes to gain significant and relevant answers to individual topics and wishes to avoid putting a limitation on those answers, the use of open-ended or semi open-ended questions is appropriate. These questions should enable an interviewer to follow up, clarify, investigate and probe responses further to gain knowledge-rich data (J. Bell, 2005). While semi-structured interviews with elite individuals deliver significant benefit to the research, the issue of interviewee availability was a problem this researcher faced.

Semi Structured Interview Topic Guide

Q1	Introduction; organizations; affiliation and position
Q2	Key goals of the policy
Q3	What were the major factors being assessed in the policy formation phase?
Q4	Which organizations were influencing policy development?
Q5	What individuals were important in the development?
Q6	What different forms of policy were considered?
Q7	What were metrics of success?
Q8	How long was the policy designed to function for?
Q9	What other countries were viewed as model?
Q10	Did policy formation change during the development stage?
Q11	Were you happy with the final output?
Q12	How was ongoing success monitored?
Q13	What would you have done differently?
Q14	Was the policy successful, and if so, for who was it successful?
Q15	Concluding thoughts and remarks

Figure 3.6: Interview topic guide

Participant Engagement and Trust

The questions for the interview were emailed to the participants beforehand. This was helpful for two reasons: a participant's engagement was increased by having prior visibility of the questions and their ability to give more productive answers. Easterby-Smith et al. (2015) speak to 'trust' (p.136), and showing the interviewee the questions, which were to be covered, went some way in building that trust. Overall, this allowed the interviewees to be able to assess better the goals and the purpose of both the researcher and the research itself. Also, further requests were made of the interviewees in terms of introductions to additional possible interviewees and relevant entities, which was made easier through their understanding of the research. Given that the interviewees were asked to communicate information that might not have been shared in an academic setting before, developing good interaction and trust was crucial to this study's success.

Obtaining Access

Given the original list of interviewees, many of whom were known personally to the researcher, access was efficient at first, though it became problematic as the individuals approached fell increasingly outside of the original network. Using the snowball method, the first interviewees were asked to help identify and access other key stakeholders in this area.

A wide range of renewable energy-related events and conferences was attended, which, alongside the value of gathering information from that event's programme, also allowed for networking. Therefore, the researcher expanded the list of possible interviewees through attendance at the events, and then snowballing was used with new contacts to maximise potential reach. Being present at these series of events allowed the researcher to build on his position in the sector, which helped build trust and relationships with participants, thereby supporting the interviews themselves.

Location

The interviews were carried out between the subject and author only, with no others being present. That confidentiality was critical to the validity of the data set. With the interviews that

were carried out remotely, the researcher rang the interviewees as arranged, clarified the ethics and asked for consent, including the use of an audio recorder.

Attending Meetings

Attending workshop and conferences achieved two goals. These events were sources of new information about the development of renewable energy policy, whilst also providing, in some instances, direct knowledge of interactions between different social groups. Though this researcher is fortunate enough to have had some significant interactions with key stakeholders, these events allowed him to reinforce such relationships and gain access to other possible interviewees. Notes were taken on various aspects of the workshop or conferences, on presentations, and on important discussions.

Recording and Transcribing

Each of the interviews was recorded, and this was done by either the recorder on the mobile phone or less frequently with a programme on the researcher's computer. The data, including the mp3 audio files and the word transcript documents, were stored (concerning the participants' and organisations' information) on the researcher's computers and backed up on Dropbox in the cloud. Based on their group, position, and country, the interviewee is assigned a code, as shown in Table 3.1. These audio files were used in the initial transcribing, but when analysing that transcription were listened to again to aid with validating.

NVivo 12 is a software package that is designed to help in data classification and, crucially here, in the organisation of that data. It is designed for qualitative researchers who are analysing large word data sets (Bazeley & Jackson, 2013), and it is viewed as a helpful tool for deconstructing that data into various categories and examining it for connections. This researcher found it extremely helpful, though several of its more advanced features failed to prove their value and so were ignored.

Ethics and Positionality

The researcher has considered the ethical issues involved and applied for ethical approval by the School of Natural Science ethics committee. This research has been planned and carried out using Trinity College Dublin ethical principles for research: respect for the individual subject or population, beneficence and absence of maleficence, and justice. All subjects

received an explanation of the form and goals of the interview, the topic of the research and, as explained, received the questions prior to the interview. All were asked to consent to the interview and for it to be recorded (King & Horrocks, 2010). Anonymity for the interviewees was confirmed to the participants at the start of the interview and was maintained through the research. Every participant is identified by a code used as the reference to their quotes in the research chapters, and none of the participants can be identified from that code. The researcher confirmed the transcripts by replaying with the audio file, and finally, all interviewees were offered a copy of their interview transcript.

Positionality, a researcher outlining their status and background, is a factor with all research, here being no exception. The set of experiences that a researcher brings to the work, or their position, may impact the research either in the interpretation of the data or by the means by which it was gathered. The researcher has held various roles in the private sector, and public bodies involved with renewable energy policy and had a relationship with some of the interviewees beforehand. Therefore, it cannot be discounted that the researcher brought to the study already formed opinions about policy and its development within the case study countries, nor that previous interactions swayed the selection of interviewees. Given that this cannot wholly be resolved in this research, it is hoped that the benefits to the research of access to elite interviewees and significant background in the practical aspects of the effect of renewable energy policy outweigh unintended design flaws. Given that the collaboration between the researcher and interviewees is regarded as crucial in generating high-quality and useful material, in this study, other positive effects are hopefully generated.

Documents

To place into context how renewable energy policies in the case study countries have developed and to build the required awareness of the socio-technical structure, the researcher has consulted a range of literature on these topics. Government departments and the energy regulators retain significant document repositories containing white papers, consultations, and regulatory documents. A systematic study of available data sets, periodicals, websites, books and other publications on the energy regimes in each case study country from 1995 to 2015 was carried out, and a database developed that documented specific ‘events’ in policy design, development and implementation. Reviewing those materials was critical in describing the landscape and how that affects policies, following some of the important debates within each of the case study countries, and describing the important changes over the period of this study.

Due to the quantity of materials available, the literature review enabled a selective approach as to which documents to review.

Each event related to the implementation of the specific renewable energy policy has been recorded in a database with associated information, from secondary sources, of background and drivers at the time the policy was introduced. Examples are GDP/GNP, renewable energy resource, EU and national legislative and the population's interest in environmental issues (as measured by opinion polls such as Eurobarometer), manufacturing base, new policy decisions, actions by private-sector participants, macro-economic changes, and strength of the oil and gas lobby.

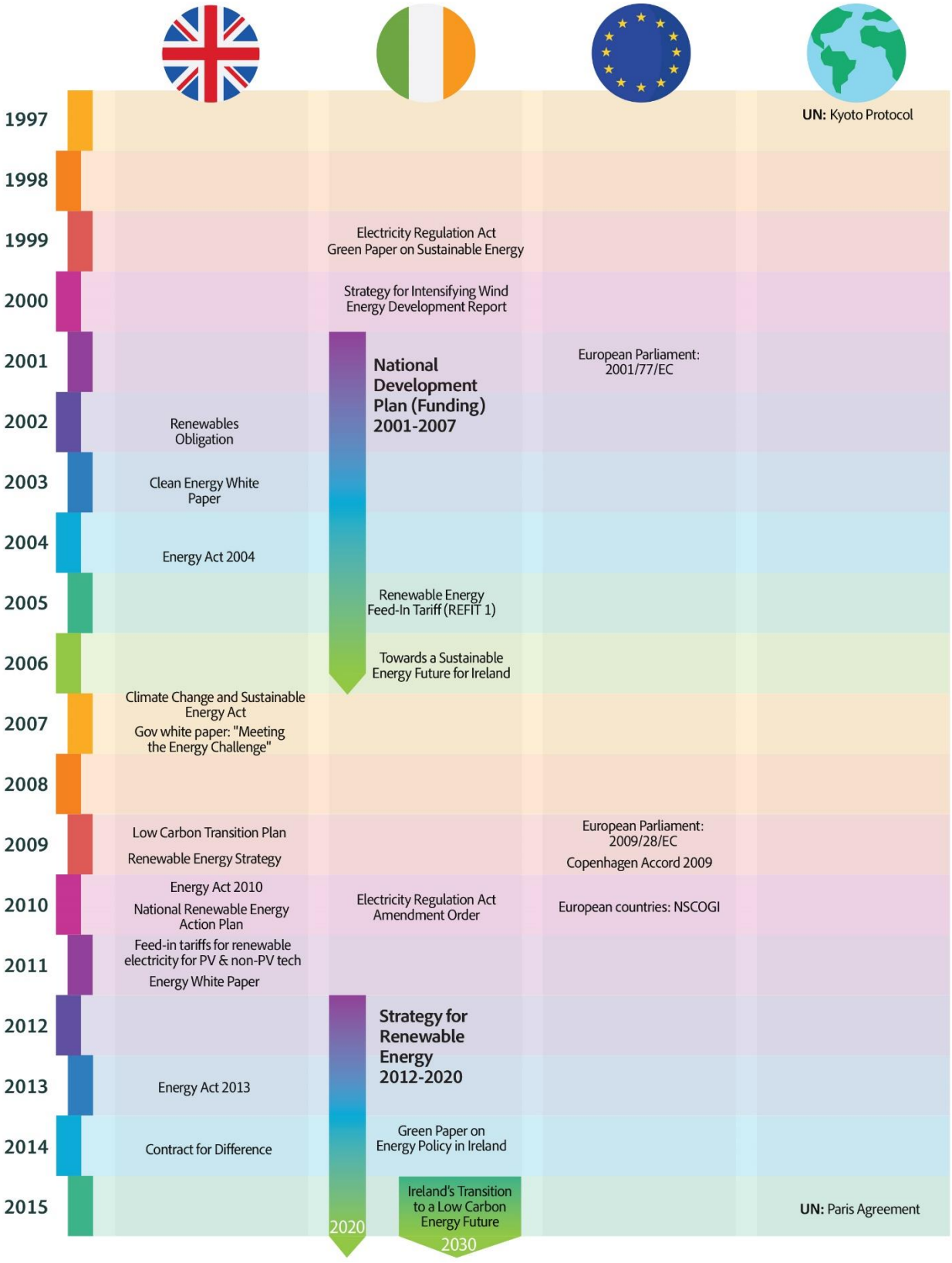


Figure 3.7: Snapshot of a portion of the data set

3.4 Data Analysis

This section explains the methods used to analyse both the interviews and document review. The initial analysis began as the data was being gathered, which allowed the researcher to determine the correct groupings of interviewees through an understanding of their various backgrounds and experiences. This process also allowed the researcher to create and then improve the questions for the interviewees as emerging themes became clear. This strategy confirmed that the focus remained on the topic of study as the data was gathered and ensured that a large amount of useful material was being generated. The data-gathering phase also offered the researcher an opportunity to improve his knowledge of the hypothesis separate from the literature.

All of the research questions required themes to have been inductively discovered from within the data, following the idea that ‘a theme captures something important about the data in relation to the research question’ (Braun & Clarke, 2006, p.82).

The first and second research questions require large amounts of material to be considered to determine how the interaction between institutions and actors operating within the UK and Irish transitions took place. From work undertaken through the Literature Review, it is shown that researchers have determined different approaches for the analysis of transition processes; the MLP analytical framework proposed by Geels (2004) was chosen for this research because of its usefulness as an analytical instrument for classifying and engaging with varied stakeholders, including ones in the regime and in a niche. This MLP framework describes three levels: niche, socio-technical regime and landscape. Within those three layers, there are processes and how their interaction works needs to be known to be able to understand the transition being studied. The final questions use overall findings to build a rational case, and once again, the researcher relied on the inductive themes that were generated from the analysis.

Thematic Analysis

Qualitative researchers use thematic analysis to manage a broad assortment of data in a systematic method, allowing those researchers to explain those data sets which they are in a fruitful way. It is one of the techniques used in the analysis of interviews, and it is highly regarded as a valuable process in the identification, analysis and commentary on themes (Aronson, 1995; Braun & Clarke, 2006); and so it was utilised for this study.

From Braun and Clarke's (2006) position, there are two key types of thematic analysis, those being inductive (data-driven) and theoretical (deductive). They further describe how using an inductive method allows the themes to be clearly connected to the data, whilst explaining 'a theoretical thematic analysis would tend to be driven by the researcher's theoretical or analytical interest in the area and is thus more explicitly analyst driven' (Braun & Clarke, 2006, p.84).

Using NVivo, and post-cleaning the data, validation of the transcripts took place to allow for analysis. The researcher listened to each interview's recording while reviewing the transcript, as this allowed changes in tone of voice to be observed, which allows for colour to be added to the evaluation of the transcript. As soon as the interview output was viewed as understandable, a process of recognising the initial codes from that data was completed, for example, auctions, policy and investment, again using NVivo to organise the data by code. This coding developed and was enhanced as the analysis progressed.

The fieldwork amounted to 42 interviews, which in total generated over 1600 minutes, and a significant amount of documents were read and evaluated. Alongside the interviews and document review, the researcher participated in multiple conferences. The data produced by these activities needed to be ordered and accessible, and to do so, it needed to be reviewed and managed. Identifying initial codes early in the process was required to allow that process to function and took place after the researcher was comfortable with the data.

The process for identifying global codes determined from the themes was started by reviewing the initial interviews. As more interviews were reviewed, and the participants' positions were understood, further codes were created. This approach allowed the researcher to build an understanding of the data and to organise the data appropriately.

Every interview was individually reviewed for three purposes:

1. create initial codes
2. create themes
3. determine which quotes to include

From this review, the researcher was able to arrange the classified codes into themes relevant to this study. Since the work was undertaken was in the main inductive, coding, and the discovery of themes (Braun & Clarke, 2006) were required for inclusion when determining the results. The themes were then themselves further deconstructed into sub-themes that further supported answers to the research questions.

The author categorised patterns that were developed from the data in the interviews into sub-themes. Themes and sub-themes were recognised as collective parts of ideas, perceptions and methods that appeared from the interviews. These were then brought together and categorised to chart the interviewees' viewpoints (Adams, 2015). These were then validated to assess the reliability between those themes and the codes. The same framework was used to code and theme the remainder of the transcripts, with the remaining data incorporated into the already determined themes. New themes continued to emerge from the data, which were, in turn, examined and assessed.

Figure 3.8: Word cluster, policy data

This study has analysed the data considering the identified and developing themes from the analytical framework, and the data clearly show both the emergent and theoretically developed themes. These were pooled and categorised into a comprehensible map of the interviewees' experience during the interviews. From this, the author was able to decide the themes that best included the data. Sub-themes continued to emerge from the data, as major themes were deconstructed into more specific subjects. Further data was connected to sub-themes, which were in relation to each theme.

Figure 3.9: Word cluster, offshore wind

Finally, whilst building a thorough understanding of the data from evolving and developing themes, individual themes established from the data and relevant for the thesis aims to develop arguments were identified. To develop and produce a coherent argument founded on logic and connected to the research questions, several developing themes obtained from the data were examined. The conclusions indicated, unsurprisingly, interactions between renewable energy expansion, institutions and the social actors.

Document Analysis

The section above described the method and practice of conducting the interviews and analysis of that data. This section describes the second source of data that the author examined in this study: In the main the documents were those published by entities including the UK and Irish Governments, the EC, and various entities related to renewable energy and policy. They range from policy-related materials to reports that were important in achieving the aims of the thesis and development of the energy and renewable energy systems. These data, held by organisations including IRENA, IEA, the EU and individual country government departments, and NGOs and non-elite entities, were used to understand profiles of the policy transition within each country, revealing any distinct phases of change. In addition, a description of how

events unfolded was developed. Given this research hopes to examine renewable energy policy in the energy transition, an analysis of companies and projects was not undertaken.

This analysis of those organisations' output offered additional information regarding the key discussions around energy and renewable energy policy. Each document was given a code, similar to the interviewee's category as illustrated in Table 3.2. Approached deductively this data was analysed utilising the inductive themes from interviews to obtain additional information. In this thesis the viewpoints of interviewees are regarded and categorised as human actors' viewpoints. This combined, overall analysis of document and interviews data was deemed necessary to analyse policy decisions for this study.

3.5 Summary

This chapter has described how the methodology supports the research objective. The overarching research approach is designed for the context in which the research took place and which method should be utilised to support the objective. That context of the research is one which involves the analysis of a range of policy materials, and interviews with major figures engaged in creating and interacting with renewable energy policies in the case study countries. This research takes an inductive interpretivist approach.

Through evaluating the work of other researchers, different methods of data gathering were considered for appropriateness. A decision that took account of how different approaches would support the data gathering and the analysis of that data was made. A mixed-method approach was chosen with the belief that it would allow fully for the benefits of using a case study approach. A framework was designed to explore and compare the effectiveness of the two case study countries' renewable energy policies, categorised corresponding to a system of policy mechanisms. Within this framework, previous research hypotheses, comprising theoretical discussions on the efficiency of different types of policy instruments and, as available, the previous empirical appraisals of individual renewable energy policy, were specified. This framework contains a conceptual analysis of the correlation between renewable energy policy and local characteristics, such as energy resource, energy demand, GDP growth,

and various other factors. A starting point and an underlying assumption being that a factor in the variation of renewable energy development in the different case study countries is due to the specific set of policies undertaken by different EU states.

This consideration of the existing research alternatives, given the objectives, aim and research questions, allowed for the design of a theoretically appropriate strategy. In completing the chapter, the method used in this research has been discussed and the variety of data sources used has been described. The semi-structured interview and case study approach have been used as they were determined to be best suited to meet the research objective. The following chapters outline the results generated by the methods described in this chapter and discusses their meaning in relation to these research goals.

4. Policy Context

4.1 Introduction

This chapter discusses and reviews the context in which renewable energy policy was developed in the EU and in our two case study countries, the UK and Ireland, employing the MLP and utilising its concepts of landscape, regime and niches. Overall, the research aims to establish the impacts of socio-technical transformation on the creation and implementation of renewable energy policy in the transition to a sustainable society. Therefore, this chapter presents the analytical dimensions of renewable energy policy as described by the MLP and summarised in Table 4.1. This chapter presents the crucial characteristics of the UK and Ireland policy context.

This research's key objective is to identify the part played by renewable energy policy in a transition to a low-carbon society. During this period under examination, wind and solar energy technologies have progressively become a crucial component of the Irish and UK generation grid; therefore, they now have a crucial part in these countries' energy system transformation. A systematic analysis is required, as the transition to a low-carbon society reveals 'systematic

interaction' (Robertson Munro & Cairney, 2019) amongst important actors, institutions and technology within the processes to develop valid results. Interactions that take place in the present socio-technical regime, how factors from the landscape level and niche events are also required to be understood for this analysis.

The trends and contextual variables (Table 4.1) are extensive, and this analysis highlights several of them as vital in how energy policy decisions have been completed.

Political & Policy Issues	• Stability of national RE policy • Policy culture and administrative procedures • Control and distribution of power between national and local-level actors and entities
Socio-Economic & Infrastructural Factors	• Availability of natural resources • Importance associated to employment opportunities and regional • economic development driven by the growth of RE as an economic sector • Importance of energy independence as a national and local policy goal • Energy prices; technology and other input prices • Competing technologies and industries
Cultural factors	• Public trust in institutions • Tradition of top-down vs bottom-up policy initiatives (not only RE ones) • Environmental awareness of the public • Historical experiences of transitions • Attitudes of the public and private sectors to new technology
Geographic factors	• RE resource availability in nation-state territory • Availability of suitable locations which are cost-efficient for RE deployment

Table 4.1: Possible variables affecting the deployment and form of renewable energy (RE) policy

This and subsequent chapters reveal the results of the semi-structured interviews that were completed with 42important actors in influencing and decision-making positions from important areas of the renewable energy sector. Given this study's research aim of understanding how sustainable transitions take place, a requirement is to include interviews from many of the most 'influential actors', as those actors are shown to be of critical importance in this transition (Lindberg et al., 2019). Those actors and their responses, which were generated through policy-related questions in their interviews, are, for the purposes of this study, individuals participating in the strategy and execution of renewable energy policies

in Ireland, the UK and the EU. The research goal of discovering the key actors' 'perspectives' on the development of renewable energy policy and, therefore, comprehend how they changed the transition pathway is key to this research. The participants have been chosen who have held or do hold relevant roles in important financial institutions, government bodies, regional energy organisations, energy businesses, lobby groups, and the renewable energy supply chain in the EU, the UK and Ireland. Also to prevent a biased group from emerging with a range of entities and individuals all having comparable viewpoints, individuals were invited from a wider universe: industrial companies, energy market analysts, regulatory bodies and academia. In addition, data collected from multiple conferences and different policy papers are discussed in this chapter. This chapter addresses the first research question by analysing the different factors placed into the context of the three levels of the MLP: landscape, regime and, finally, niches.

Research Question 1:

How did renewable energy policies develop, what are the categories of national RE policies and what policies were implemented in the UK and Ireland?

4.2 Landscape-Level Factors

This section examines the histories and context of renewable energy policies across the EU, Ireland and the UK. The research framework is derived from the MLP (Figure 2.5) and is used to illustrate the renewable energy system's socio-technical nature. Various factors within this system, whether technical (solar or wind equipment) and non-technical (institutions), or co-dependent and context-embedded, therefore interact during this change process. The aim then must include exploring what factors of renewable energy policy development affect socio-technical transitions to be further able to understand the interactions between social actors as they exist in a certain context.

This first section aims to determine and explain the various landscape-level factors that have affected and enabled renewable energy policy development in the case study countries. Overall, three landscape-level themes have been identified from the research as being the most important for the development of renewable energy policy: climate change, energy security and industrial growth / green economy.

Climate Change

Since the latter half of the twentieth century, the overwhelming majority of the international scientific community agrees that evidence-based research shows the planet is being changed in a significant and far-reaching way by global heating; and that humanity's actions are the most important cause of this global heating process (Jorgenson et al., 2019). Anthropogenic (human-induced) climate change has been driven by the increase in greenhouse gases in our atmosphere that keeps heat that would have previously dissipated into space from doing so, which then increases the Earth's temperature (Rosenzweig et al., 2008). Modern society, based on the production and use of energy from hydrocarbon sources, has materially increased the amount of GHGs in our atmosphere and has therefore caused a significant change in the temperature of the planet. Extensive research carried out by the scientific community has connected the anthropogenic increase to the change in climate change rate (Cook et al., 2016).

This scientific knowledge has come to be accepted by policymakers in the main as true and therefore requiring policy actions. This is articulated by an EU senior policy officer who is, unsurprisingly, in support of his administration's stated driver, *'I think in fairness to the European Commission, they saw an increased obligation on them, and this was articulated by President Juncker, and especially […] the commissioners 'committee in Katowice, that we not only had an obligation to do something about it in Europe'* (*Interview GE13*). The extreme dangers that global heating poses to us as a species due to changes in Earth's environment are explained in the various papers produced by the IPCC and in a host of both scientific and popular literature (Matthews et al., 2017). Which makes the facts that the EU is simultaneously the biggest emitter of GHGs globally (Schreurs, 2016) and, according to statements by the EU, the world's second-largest energy market (Valdés Lucas et al., 2016), important to the EU policymakers. These reports validated and informed the two positions taken by the EU on the subject: first, climate change is a critical threat to all of our futures and, second, that we cannot

wait to act on this threat. This point is illustrated by a senior elected EU parliamentarian '*No, I think the fact that there was a package, a Clean Energy package and it was to kick in [in] 2020 it was important to send a clear signal right across every member state that there was no time for fooling anymore. And I see now, in my own committee in particular, there has been basically a sea change in attitude especially at government level since the package came through and especially the Renewable Energy file'* (*Interview GE13*). The EU's climate and energy policies have by design enabled environmental and climate policy innovation throughout the member states (Helm, 2014). Key legal aspects supporting this were several environment sections, which importantly included the ideal of a significant standard of environmental protection (European Union, 2012).

The complexity of the crisis of climate change, as stated earlier, is a 'wicked problem' (Head, 2008; Incropera, 2016; Rittel & Webber, 1973) in terms of governance, size and longevity, and made it clear that a multi-level solution was required, with the EU and its member states understanding that both political cycles and the multiple layers of government were barriers to a successful outcome. The UK and Ireland, as member states, were subordinate to the EU's authority across the entire length of this study since becoming part of the EU's multi-level framework when they joined the EEC in 1973 (Commission of the European Communities, 1973). The complexity of the problem combined with the complexity of the EU was highlighted as a concern, as we see expressed by a senior executive from a global manufacturer, pointing out the long-term nature of the plans that need to be in place, *'It is just, how do you transfer that down from the highest levels into the actual Department in a meaningful basis that goes beyond just a five year… or a potential two and a half – five years term for an elected official' (Interview IR21).* Actions taken by the EU in response to the threat of climate change had a direct impact across all member states, including both Ireland and the UK, and need to be taken into account with the concerns raised by the interviewee and others across industry who shared their view. These actions are seen in the EU's commitment to lower emissions by 8 per cent from 1990 by 2012 (Nature Editorial, 2008).

The EU undertook a series of internal political actions (Parker & Karlsson, 2017) through both political statements and policy actions. An increasing number of public positions were taken by senior EU officials, such as this interviewee, in support of far-reaching policy '*Number*

One, I, like many more, I was concerned about the increased global warming, which was evident all around us. Even in my own country with storms taking place of a velocity we never saw before, flooding which we never saw before and then when I studied it and was with likeminded people in the European Parliament, became more and more aware that this was man-made, and we needed to do something about it'(Interview GE13). The EU acknowledged that its role as a major carbon producer gave it an ethical obligation to take meaningful measures to offset the crisis that it has added to, and that obligation was regarded as being set by the highest level of the EU. The EU was effective in pushing that message out to a wider group of stakeholders, for instance, here from a leading industry executive, *'the positive thing you could say is that there is an acknowledgment at the highest level of government that we do need to have a very strong climate change action policy' (Interview IR21).* The EU also pointed to an interest in taking a leadership position in renewables and green technologies, as it believed that it would then deliver to its member states a competitive advantage versus other major economies. Those various actions would need to take place at multiple levels and the interview data points to key policy figures, such as this interviewee, an elected official at the EU level, cognisant of those multiple dimensions. '*So […] I had the Irish cap on, a European cap on and I suppose a global cap on. And I saw an opportunity to formulate policy that could actually make a difference as opposed to talking about something, which you could do forever' (Interview GE13).* Therefore, the policy actions taken had to be applicable and deliver results across the EU, the member states and internationally.

Energy Security and Affordability

A related landscape-level theme which this research shows to be critical is the issue of energy security. The EU is the largest economy globally and has a highly developed, sophisticated integrated industrial and services consumer society that is dependent on a significant energy system for its existence. As such, it has considerable energy requirements, which have been satisfied in the main by fossil fuel resources. Fossil fuels continue to be the largest single component in the overall mix of generation (D. Jones et al., 2018); with resources such as oil and natural gas together forming a significant portion of the EU's energy generation capacity. The overwhelming majority of these resources are not under the EU's sole control, a fact clear to multiple actors, such as this interview subject, whose background spans senior roles in both the UN and industry, stating *'You want to make sure […] that you have control over the energy system, which is, specifically in Europe, a concern, no doubt, dependent on Russian gas and*

[…] electricity of course plays a part of that equation […]' (*Interview PI12*). As such those fossil fuels have been regarded, and are viewed as remaining, essential to the EU's ability to preserve the wellbeing of its society and economy. Those hydrocarbon-based resources though are not only major polluters (not only in carbon, but in a range of different emissions), but commodities whose pricing can vary considerably over short periods of time. It has long been regarded that the non-renewable nature of fossil fuels implies that there will come the point in the future when those resources are no longer available for societies to use. It is now much more likely that the resources are available but at a higher and higher cost of extraction. The utilisation of new expensive technologies, such as deep-sea oil extraction and the revolution in shale production of oil and gas, is required to continue expanding the reserves. These ongoing changes to the global market for the purchase of fossil fuels drive uncertainty in the security of supply whilst also giving rise to cost fluctuations; a point reinforced from this interviewee whose background in industry and the UN also included working at a leadership level in a Middle East SWF. '*Obviously, people always don't want to spend too much money so whatever solution you are driving with policy measure, you are trying to optimise your cost structure - you don't want to overpay and secure the supply' (Interview PI12)*. This situation creates significant challenges for EU energy security and affordability.

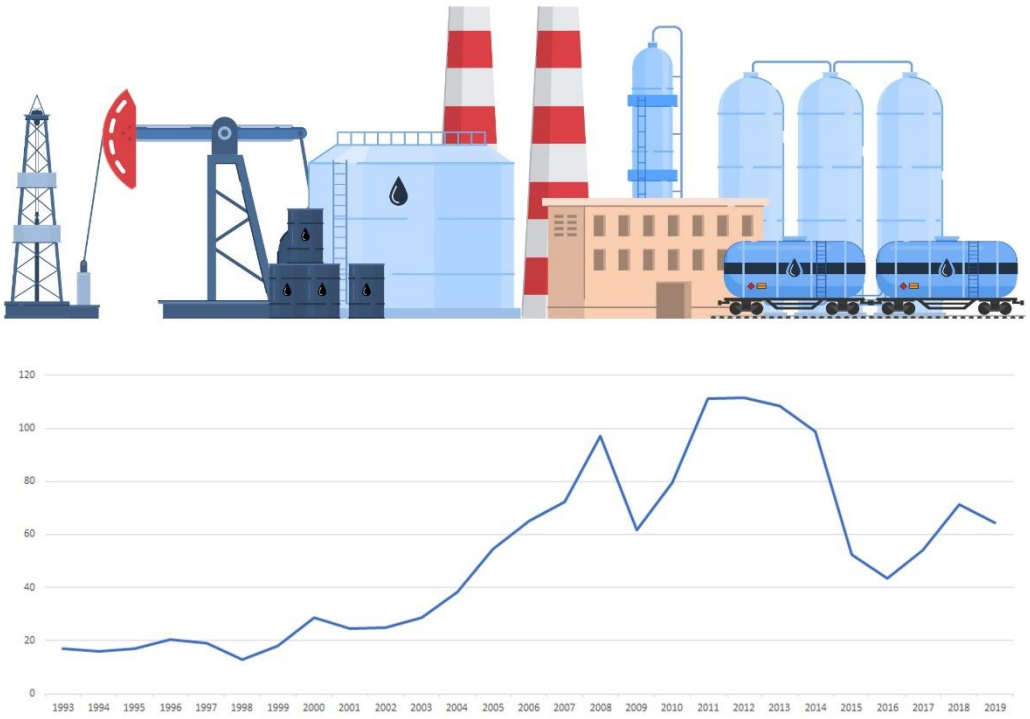


Figure 4.1 The price of oil over time –1993 till 2020 (data source: EIA (2020))

The EU's comfort in having a strong position of energy security is considerably compromised by its reliance on a collection of fossil fuels, as one senior executive of an oil major lays out, '*But at the heart of it is diversification of the energy supply system against the Russian threat' (Interview IU21),* that accounts for over half of its energy production (Chalvatzis & Ioannidis, 2017). Ireland has some of the worst energy security of all the EU member states (Radovanović et al., 2017), with limited gas and coal, no nuclear and poor interconnections to continental Europe and to Great Britain. Members of the Irish finance community, such as this interviewee, describe the situation, *'We'd be reliant on peat and so I think as an economy that does import […] the overwhelming majority of our energy assets […], the policies have been very good in improving our energy independence and [we] need to continue to do that' (Interview FR12).* The UK, in turn, has a declining resource in North Sea oil and, though it has an abundance of coal, this resource has become politically unacceptable in use.

It was therefore understood by the EU and EU member states that a solution to this problem of energy security as part of a broader energy transition to an energy system not based on hydrocarbon resources. That transition, relying on different forms of renewable technologies, needed to be supported by the incumbent energy firms, an idea they well understood, as a senior executive in one of those firms' states.

> *Yeah, I think if you go back, again, I don't think it has to do with climate change, […] clearly, there was a zero-carbon aspect to it. But I think the aspect that these were looked at was European Union security of supply. I mean there were issues around Russian gas and around domestic balance trade […]. Of course, […] the pricing of wind turbines were such that they were now coming into single digits in terms of cost (Interview IR12).*

This solution also addressed related concerns on importing hydrocarbon resources; how and from where are these resources obtained and transferred? Therefore, the reliance of the EU on imported hydrocarbon resources such as gas and oil are a significant area of concern for policymakers.

The EC has proudly proclaimed that the EU economy occupies the position as the 'world's largest regional market', which, given its lack of hydrocarbon resources and considerable energy requirements, also leads it to be the largest energy importer (Zajączkowska, 2018).

Given that the EU has 50 per cent of all of its oil and gas requirements being imported (Bluszcz, 2017), there is a significant ongoing risk in both the transportation of and the origin of those hydrocarbon resources until the transition materially changes the energy system. Here one of the senior executives of an Irish energy incumbent reinforces that viewpoint '*[…] I suppose it was a conflation of a number of things, but I would have said that primarily, renewables in the first instance were actually there for energy security. And it was after that, that the climate change piece came in' (Interview IR12).* The EU exists, therefore, in an unfavourable situation of reliance. It relies upon outside states to be available and willing to execute commercial agreements for hydrocarbon resources, whilst also being at risk of changes to the price of those resources, which are traded in a global commodity market with a material amount of volatility. Another of those leaders of a state-owned entity, here the CEO, clearly articulates the reasons for Irish policy actions.

> *[…] it was extensively spoken about and I suppose you had security as the drive, being one of the predominant themes. We had great concerns about the fact that we were dependent on imported fossil fuels. […] the second [theme] is the whole environment and carbon - so the notion of decarbonising electricity and creating a better environment. And this was when climate change was starting to get currency and European Directives were starting to drive out very explicit targets. And the third factor was the discussion around being able to produce energy costs effectively and getting control over the production in both jurisdictions and not subject it just to wild swings in energy prices on the back of oil prices, geopolitical shifts around the world etc (Interview IR13).*

Furthermore, the EU depends upon those outside states to be in a long-term situation of socio-political stability and be aligned geopolitically with the EU so that the necessary commercial relationships can exist over an extended period. Alongside that stability in those states extracting and then selling fossil fuels, there needs to be wider permanence in relationships for the transit of those fuels to the EU. Throughout the period examined here, the EU received most of its imported fuels through the Middle East and ex-Soviet states; areas of the world regarded as unstable and prone to various global interferences. This global situation and the volatility of the outlook moved the EC to prioritise the need for diversification of energy sources (EC, 2008). This diversification of resources aimed to reduce event risk, where one country or countries' production or transportation of resources may become restricted or even completely close.

Energy security, then, features highly in decisions made by the EU and our two case study countries. The search for that security continues to be an important component of the EU's and its member states' policies and is focused on the lowering of member states' exposure to either the increasing cost of hydrocarbon resources or the unavailability of supply. Proponents, such as the various trade groups and environmental NGOs, of low-carbon technologies suggest that through expanding renewable energy generation, a state will then decrease hydrocarbon imports, as the fuel for renewable energy generation is free and available locally (Gan et al., 2007). This argument does not factor in the need for many states to import that technology itself.

Climate policy in the EU, and in Ireland and the UK as member states, is driven then by several principal factors: the EU's interest in combatting the causes of climate change and a strategic need to attain greater energy security and affordability. This is clearly presented by the CEO of an Irish government-owned energy incumbent, *'So, security of supply, the environment and costs. They were the factors which dominated the whole discourse around energy policy back then, and they still do, to a large extent' (Interview IR13).* These factors of sustainability, security and equity are referred to as the 'energy trilemma'.

Figure 4.2 The energy trilemma

Renewable Energy for Industrial Growth

Since its first establishment, and unsurprisingly given its original mandate as an economic trading bloc, the EU has focused on the development of industrial policy as a critical area of importance for its economic growth. This took the form of a neo-classical laissez-faire approach as articulated by the Lisbon Strategy of 2000 (European Parliament, 2010), developing further with the ideas of the green economy (Albekov et al., 2017), causing low-carbon development to become one of the most important aspects. This focus on an industrial policy to develop the sustainable sector received further support and encouragement through the Europe 2020 strategy (EC, 2010). The goal was to *'[s]timulate the development and commercialisation of low-carbon and energy/resource-efficient technologies, products and services, for example by developing lead markets and creating incentives for frontrunners'* (EC, 2010). The published strategy identified two main areas for the low-carbon economy that were highlighted as growth initiatives: the more efficient and effective management of resources and the support for an industrial policy focused on market-driven solutions, that would help deliver on climate change goals and benefit members states' economies.

Ireland was aware and gave some consideration to the idea of building supporting industries for renewables, but the interview data suggests that it was not pursued, as the head of one of the largest funds in Europe based in Ireland illustrates below.

> *And I think the other thing that people thought about Denmark was they saw someone who was developing out in manufacturing capability, off the back of renewable energy growth. There was, in the early stages, a thought process in Ireland "Well why couldn't Ireland do something similar?" But I don't think, again, it was very well thought through in terms of geographically where we're located on just the physical logistics of trying to create a sector (Interview FR11).*

The EU then connected its climate and energy packages of 2009 to the goals of fostering economic development (EC, 2010). These goals were then articulated through a series of different policies, the most relevant for this study being the Renewable Energy Directive (European Parliament, 2009), and the Roadmap for Moving to a Low-Carbon Economy in 2050

(EC, 2011). The latter described investing near €270 billion, which would help generate new employment for 1.5 million people (EC, 2011). These policies allow for and deliver a strong framework, which articulated the theme, i.e. the framework translated landscape-level themes (climate and energy) into regime-level action (industrial strategy)s of the landscape down into the regime, for individual member states to work to develop their own industrial strategies. The success of that, though, is questionable in both the UK and Ireland, especially as it relates to the creation of a domestic manufacturing base in either solar or wind technologies, much to the frustration of this interviewee whose role encompassed the deployment of capital into renewables on behalf of the Irish government, '*I do think, however, that desire to create a manufacturing base that benefits from renewable energy growth persists in Irish policy, ..., there is a persistence in policy that says* "*Oh, let's try and do something that could encourage an indigenous base" without too much thought given to how that's actually achieved' (FR11).* In Ireland, even the idea of attempting to do so was questioned by leading government actors such as this interviewee, '*[b]ut the day-to-day is focused on meeting the targets and within that then, there's ups and downs. But the primary focus is meeting the targets, not the jobs that come out of it, because it's acknowledged that wind doesn't create that much ongoing employment' (Interview IR12).*

Alongside the industrial strategies of both the EU and the member states, the European Strategic Energy Technology Plan (SET-Plan) (Directorate-General for Research and Innovation (EC), 2018) was set up. Its goals were to promote the advancement and implementation of new technologies (protected niches) which supported a low-carbon energy system through aligning research taking place across the EU, and to be active in the deployment of different types of investment into those technologies. In the early days in the UK this was met with little success, as pointed out by a previous UK minister for energy,

> *We did have work forces going on to try and maximise UK content. […] But we didn't have a huge amount of capability of doing more than that. In some areas we lost the sale of facility in Wrexham. We lost the turbine facility in the Isle of Wight. Investors closed those down there initially before reopening. And so, the industrial side was seen to be desirable, but we were sort [of] swimming against the tide […]. But also, because we had come late to onshore wind and to solar, we had to be price takers, we had to be seen to work to be bringing down the cost being done in China and elsewhere. And that*

people were under pressure to deliver at a cheaper price. Well, they would say we can't use UK steel. We can't use UK manufacturing. You can't have it both ways (Interview GU12).

The cost of the replacement of hydro-carbon generation with renewables was an area of concern throughout the media, from policymakers as well as community groups; and the argument that the transition would help offset those costs through economic growth and technology innovation was a strong counterpoint, as put forward by a different minister for energy, again from the UK. '*Well […] the concern we had, given that this money was going to consumer bills, you wanted to try to see whether or not we could ensure that at least some of that went into UK-based jobs, given a lot of the manufacturing was overseas. So, probably the symbol of this was what we did in Hull, attracting Siemens and ABP ports*' *(Interview GU13).*

In both the UK and Ireland, this voice of concern around the cost of renewables remained constant. In the UK, though, the success of the offshore wind sector (both in terms of cost and in giving the UK a leadership position) combined with its existence largely out of sight of local communities allowed policymakers to push back against that message.

The changing point for that was offshore wind. Then, when we had a very clear strategy, we would say to people "You need to explain to us before we give you the contact for a different agreement. What is your strategy for UK content?" We had no power to make them do it but, they all assumed we did. So, they all went away to see how they could up the UK content. And so, we are now probably 50 per cent UK content. […] huge invest[ment] has come into Humberside. […]That is now filtering down through the supply chain, so we are not just leading the world in terms of how much offshore wind we have got installed, I think we lead the world in the manufacturing side of it (Interview GU12).

All of these policy activities around research and the mobilisation of investment were both supported and initiated by the large industrial groups who understood the potential benefit to their own activities, as explained by the CEO of the UK government's main financing arm of renewables.

> *Siemens lobbied hard and the government pushed them very hard to establish the factory up in the North East, which got put in on the back of a CFD regime, to support offshore wind, with Siemens having 70 per cent of the UK market for offshore wind. The UK being the market leader in the world. So, they lobbied for a regime, I don't think they lobbied particularly for one or the other, in fact most of their focus was on getting cheap capital debt to support the establishment of the factory up in the North East, near Newcastle (Interview FU12).*

These policy support mechanisms, nationwide as in the case above and EU-wide as with SET, therefore, ran the gamut from research support to direct financing assistance. At an EU level the SET-Plan, the European Energy Research Alliance (Maziere, 2011) were set up to bring together different research entities and help them work on the priorities of SET and the broader European Industrial Initiatives. On the financing side, the EU has pushed the European Investment Bank (EIB) to provide various example projects utilising new clean technologies with investment. The first programme invested over €2 billion into low-carbon energy projects (EIB, 2020), which, though a significant absolute number, is a tiny amount of the required investment. Alongside those activities, the EIB promised to allocate a minimum of 25% of its financing to climate change activities (EIB, 2015). Taken together, this action reflects a belief that policy needed to be comprehensive, large and to set the EU apart as the world leader; this was not always met as the head of an energy regulator states, *'The argument was always early on that if you do this, you're going to be a first mover and you're going to take advantage of the industries that get created globally, because you're in there first. My reflection, […] is, although that was in our thinking, in our plans, I don't think we ever really addressed the opportunities as strongly as we could'* (*Interview GU14*).

4.3 Regime-Level Factors: Policy Regime

As discussed in Chapter 2, upon introducing the MLP perspective, the regime is perhaps the major level within the MLP. Within this level, leading actors work to agree on structures and governance and form connections with other key societal regimes. They also choose which forms of innovations will be protected in a specialised niche and allowed to grow into a regime

standard. This section will discuss this level as it relates to the renewable energy system across the EU, Ireland, and the UK.

International Treaties and Interactions

The development of renewable energy policy, though based upon the experiences and interest of a series of actors, is tied to the environment of both national and international political structures, as these policies are influenced and created in the main by wider landscape-level themes. The United Nations Framework Convention on Climate Change (UNFCCC) (UN, 1992) is one of the earliest key international policies intended to focus on climate change problems. The Convention formed into a single framework the goal of countries working together to combat climate change. This was joined by Article 12 of the UNFCCC, which put substantial requirements on the EU member states to measure and account for their developments on GHG reduction. In aligning global plans, the UNFCCC facilitated the move towards international law-making collaboration; nevertheless, it is generally acknowledged that the Convention also contained numerous important flaws. Researchers draw attention to the absence of set plans, item-by-item commitments and, most importantly, of any realistic targets, as a massive failure in the agreement (Ciplet & Roberts, 2017). However, it should still be viewed as an instigator of action by individual countries, as each country then formulated specific ideas and plans on how they would address the problem. Industrial players such as this CEO in a multi-national developer pinpoints the problem, '*Each country did it on its own way. They all had their ideas, their own hobbies, and also even misperceptions […]. But in any case, it was the early start. […] Yeah, you simply start doing something and it may not be the most effective and most ideal and maybe even very expensive. But in any case, you start doing something' (Interview II22).*

In 1997, the Kyoto Protocol was agreed upon by the UN, and it came into force in February 2005 (UN, 1998). This major international treaty obligated the signatories to mandatory GHG reduction levels of at least 5 per cent below 1990 levels from 2008 to 2012 (UN, 1998). Here, unlike in the UNFCCC, there were set targets for individual states to meet and, as such, it is, therefore, a material move forward, as explained by the same executive, *'So, all these policies now will turn in the direction of facilitating the market mechanisms for renewables, guided a little bit with the renewables themselves. They will be pulled into the market by the market*

because it's competitive' (Interview II22). This step, though, was hampered by the fact that certain nations refused to ratify the Protocol. The EU was a driving force in getting as many states to agree as possible, but their efforts did not bring about the agreement from three key nations: the U.S., China and India. If one excludes the EU itself, these nations then and at the present time constituted the key global GHG emitters. Without agreement by those nations, the Kyoto Protocol was significantly weakened and even though China and India signed up in 2002, though without binding reduction targets, the absence of the U.S. from the protocol has dented its effect (Vogler & Bretherton, 2006).

This protocol gave rise to the EU, committing to lower emissions by 8 per cent from 1990 by 2012 (Nature Editorial, 2008). In determining how its commitment was to be shared across individual member states, a complex series of calculations and negotiations was required. These calculations and negotiations also had to account for how individual member states designed policy to achieve their obligations, with a mix of different policies highlighted, '*So, you need quite different approaches from a policy point of view. It could be more relaxed like setting targets with the Paris Agreement. The CO2 level. You could set targets on renewables in the country or you could facilitate the customers buying green products, green electrons or green molecules*'*(Interview II22)*. The increase in the number of member states during this period and the differences in individual member states' characteristics necessitated multiple changes to both its climate and energy policies (Helm & Hepburn, 2009). The UK and Ireland were bound to a 12.5% reduction and 13% cap on increases respectively in the period from the 2008 Kyoto treaty (European Commission, 2010a), with these targets required to be achieved through both demand- and supply-side mechanisms. These caps and reductions for Ireland and the UK were determined through a 'burden sharing' methodology (Lindberg et al., 2019) in which each member state's targets are formulated using their historical emissions levels and an assessment of what their capacity might be to lower their emissions. The way in which those reductions were to be achieved was left to individual member states to determine.

The Kyoto Protocol, though viewed as a major international success, had set the targets at a level that would not change the worsening trend on climate change (Burck et al., 2017). In addition, several key states, most importantly, the U.S., had not joined or had joined late with no set targets. In what is now viewed as a serious fault of the Protocol, it did not address how

individual states were to continue with emissions reduction at the end of the period covered by the Protocol, only addressing the 2008–2012 period (Prins & Rayner, 2007).

In 2007, at the UN Climate Change Conference in Bali, an attempt was made through The Bali Road Map (Macey, 2007) to elicit binding targets from individual states, targets which those states would then agree during the UN's Copenhagen Conference 2009. Copenhagen is, however, universally thought of as a failure (Dimitrov, 2010). An accord was signed, which though clearly acknowledging a collective wish on maintaining the temperature rise below 2°C (Ott et al., 2008), neither set legally binding reduction targets nor put in place *any* strong action plans. The follow-up conferences held at Cancun, and then Durban did not solve this failure (Bond, 2012). The EU-level representatives were regarded as having been forceful in attempting to drive climate change agreement forward, and when the failure to reach an agreement became clear, there was considerable exasperation on the part of the EU policy negotiating team (Parker & Karlsson, 2010).

At the conference in Qatar in 2012, a new amendment was approved by the existing Kyoto treaty participants (UNFCCC, 2012). This agreement delivered a new commitment period of 2013 to 2020. This specified that industrialised countries had agreed to a target of 18% lower than in 1990 (UNFCCC, 2012). The EU undertook to achieve a 20% decrease in emissions by 2020 as compared to 1990, which, as the EU had already made a series of emission reductions through their ‘20-20-20’ programme, was not regarded as adding much to the existing EU-wide efforts.

France was the scene in 2015 for the international community to meet on the basis that they would work to agree on a set of legal obligations, which critically were to include individual country reduction levels (Krugman, 2015). In a tense and difficult process, with decisions on collective action being the most fraught, the EU was clearly seen (and wished to be perceived as) the critical actor in pushing for an agreement (Davenport, 2015). While the final output did not meet all the various states' expectations, it did create a binding commitment to stay below a 2°C temperature increase from pre-industrial levels, with the Agreement coming into force in 2020 just as the 2013–2020 Doha Amendment concluded. The success of the Paris

Agreement has been significantly lessened by the planned withdrawal of the U.S. under the administration of President Trump. Though this withdrawal was not due to take place until the end of the first term of his presidency, and President Biden re-joined the Paris Agreement in his first week in office.

EU Policies and Regulation

As we have seen, EU policy goals have been subject to several broad landscape-level themes, which have affected the multilevel governance framework across the UK, Ireland and all EU countries. Although much analysis of the EU at an international level views the EU as a single entity interacting with other large blocs, such as China or the U.S., member states profoundly influenced actions from the EU to the international stage. Furthermore, the interplay between policy and regulation has had a significant effect on the development of the EU energy system, clearly explained by a senior Irish policymaker, '*Policy informs regulation, but regulation also informs policy' (Interview GR21)*. These feedback loops point to the dynamic development of policy and action throughout the EU.

Looking at both the targets set and what has been achieved to date, the EU continues to be a leader in climate policies. The goal of a 40 per cent reduction by 2030 in climate change emission sets it apart among the OECD states (Amanatidis, 2019*)*. It is important to make clear that this 2030 target is focused on climate change, whereas the 2020 targets included a CO2 target, but the renewable's directive primarily drove action. The 2030 renewables directive was established at the EU level and not made binding at the member state level. As a former chief scientist of one of the case study countries articulates, the various interactions of actors at the EU level were able to deliver on an ambitious policy whilst balancing different interests,

> *There's what comes through the diversity of thinking within EU member states and the trade-offs that happen between them. And then, there is the lobby groups who would be very effective at a European level in terms of putting out the imbalances that will happen for European trade, for European industry if there are too much costs. So, that's part of the dynamic there (Interview GR22).*

Likewise, the already realised emissions reduction surpasses the performance of its peers in this period. The recent successes of the U.S. (Felix et al.,) come closest to the EU achievements, though the change in their energy mix from coal to shale is the driver and the long-term effect of that change in the energy mix is as yet unclear. The Kyoto goals were exceeded, with 2020 on track (No, 2010). The EU achieved a 23% decrease in emissions from 1990 to 2014 (European Environment Agency [EEA], 2017). This was achieved while a material change took place in the energy system, the percentage of renewable energy on the grid growing substantially, and wind energy by 2014 increasing to 120 GW and solar energy to 90 GW (EEA, 2017). Meanwhile, hydrocarbon fuels such as coal continued to decline. By 2014 coal had 25 GW of generation on the grid (EWEA, 2016). Overall renewable energy made up 80% of all newly installed generation, up from 60% in 2008 and 70% in 2011 (Diaz Alonso, 2019).

Successful energy transition plans are thought to be driven by a particular series of assumptions around cost of energy, GDP growth, energy demand and community acceptance, and the EU must account for those in policy frameworks. Without such an account, it is unlikely that those transition plans would be successful. The plans also depend on the decarbonisation of the energy system through a change in the grid's make-up. Renewable energy achieves two different goals; they decrease emissions levels for the same power and remove climate change-enabling fuel sources. Creating a multi-level energy transition to a low-carbon society will require successful energy decarbonisation, which must require a material change in the energy make up (Helm, 2014).

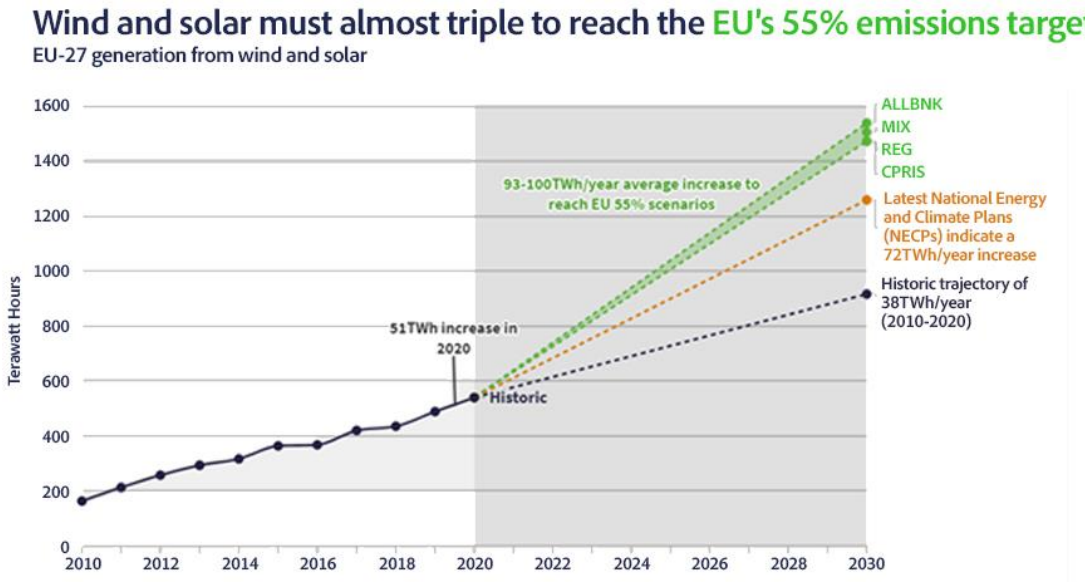


Figure 4.3 EU growth of solar and wind to meet the European Climate Law, emissions target of 55% (data source: Ember, 2020)

The '20-20-20' programme was the EU's main climate and energy initiative. It was designed in light of climate change's critical issues and intended to cover the decade to 2030 and beyond. Its development was not the result of one strong, centralised policy but rather reflects a set of interlinking rules and agreements across many different entities and groups (Rayner & Jordan, 2016). The programme was sustained by a growing set of low carbon policies in the EU, which was very clear to actors such as this interviewee, a senior executive from an Irish government-owned energy incumbent, '*So, in it, you have to set out how you intend to meet your targets and then within that, there's various different ways, so if you look at all the reporting through the EU, it sets out how we're going to achieve our targets and the measures that we're going to use to get there' (Interview IR12).* The EU's climate and energy policies have by design enabled environmental and climate policy innovation throughout the member states (Helm, 2014). Key legal aspects supporting this were several environment sections, which importantly included the ideal of a significant standard of environmental protection (European Union, 2012).

The EU and the EU energy system have combined aspects of a liberal market with comparatively strong environment and climate change frameworks, here commented upon by a senior Irish policymaker, *'And at the time […] when this was designed, if you go back to the original design of these type of things, they probably came out of the Chicago school of economics, and places like New Zealand and that, and if you look at the liberalisation that happened in New Zealand where they went absolutely […]' (Interview GR21).* Through the EU's governance system, balancing coordination of climate change targets whilst supporting the single market, this progression shows the effect of landscape pressures upon the regime and how protected niches become accepted by the same regime.

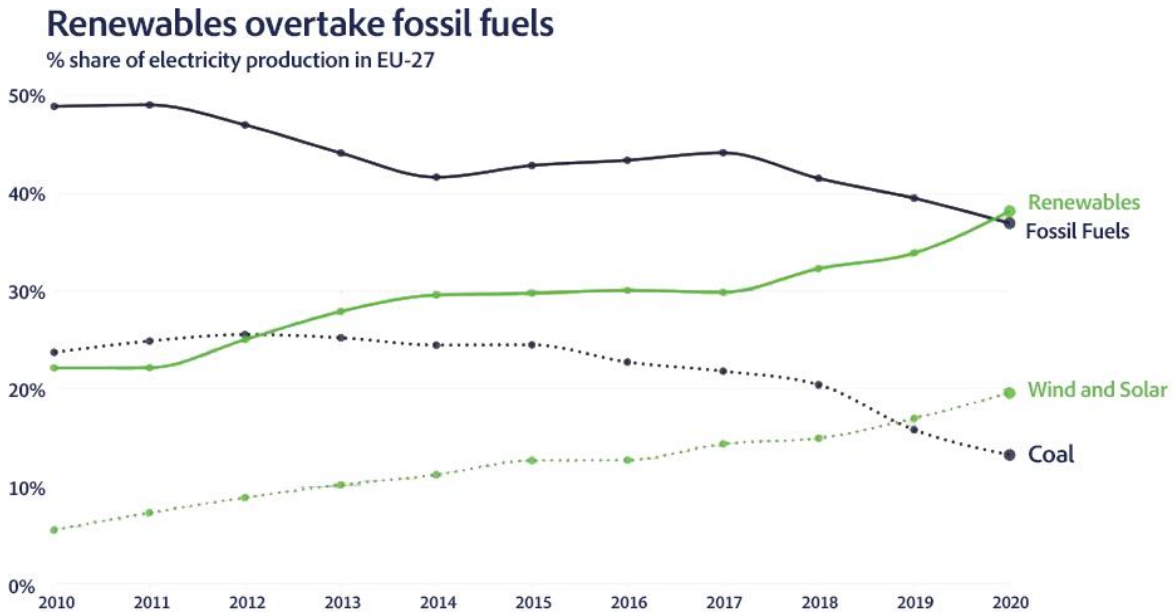


Figure 4.4 Renewables versus hydrocarbons as share of production in the EU-27 (data source: Ember, 2020)

Innovative climate change policies adopted by individual member states have gradually become sets of EU regulation, with the EU allowing those countries to build or propose new and different policy models (Kortelainen & Rytteri, 2017). Furthermore,'the Commission shall immediately examine whether to propose an adaptation to that measure' (European Union, 2012, Article 114.7), showing a critical feedback loop from member states to the EU.

The possible adoption of an individual member state policy at the EU level can also encourage regulatory competition as individual countries compete to be the leader (Grubb & Newbery, 2018), of which the UK in energy reform gives us a clear example (Grubb & Newbery, 2018). The EC's stated position is that it determines actions based on empirical best practice, and within that, the individual states have a key role in providing policy and technology learnings. The German Renewable Energy Law (2000), the UK emission trading scheme (2002) and UK Energy Efficiency Commitment (2002) are all examples of this, from which the EU then brought the EU Regulations (2001 and 2012) Acts. Ireland was a laggard in this area, with policy being determined in reaction to various cycles at the European level and after other member states had contributed to the iterative process. Financiers such as this interviewee, head of energy at one of the major Irish banks, point out the issue, *'That was a short-term view and it failed to think about the long-term trajectory of decarbonising the energy market, and try to develop out different sub-sectors at a much earlier stage […] other European policy makers took that long-term view, and Ireland took somewhat of a reactionary view' (Interview FR12).* Supplementing its formal law-making procedures, the EU regularly serves as a forum in which individual member states share and discuss different aspects of a policy; this process, the OMC (Prpic, 2014), has been particularly useful as it relates to climate change. The 2030 framework for climate and energy policies, the goals of which were discussed earlier in this chapter, was designed to allow the energy system of the EU, based on the energy trilemma, to be competitive whilst also being reliable and sustainable. This contains a new governance structure centred on individual member states, with key metrics to track progress (EC, 2014).

The EU internal electricity market

The Second Energy Package of June 2003, EU Directive 2003/54/EC, was designed as the mechanism to bring about a European internal electricity market (European Parliament, 2003). The goal was to create a level playing field for all actors by guaranteeing equal admission to the energy system with full clarity on the costs *(*European Parliament, 2003). After addressing the liberalisation of the market, the EU focused on regional division, a midway point to complete enactment of the internal market, which included gathering individual markets into categories based on multiple criteria in addition to their location.

The EC put forward the concept with the goal of reducing complexity by combining regional markets rather than having a series of individual markets. Electricity market integration began when Sweden and Norway established the Nord Pool, an electricity exchange, in 1990. Finland and parts of Denmark joined this four years later (Bredesen, 2016). The European Energy Exchange of 2000 included Germany, France, and Austria. These efforts by the EU to bring together separate markets to an internal one became important components of the present EU-wide market integration policy. The data points to this integration as being well understood and welcomed by various actors such as this subject, CEO of a major Irish government-controlled utility, '*So, in it, you have to set out how you intend to meet your targets and then within that, there*'*s various different ways, so if you look at all the reporting through the EU, it sets out how we*'*re going to achieve our targets and the measures that we*'*re going to use to get there*'*(Interview IR12).* The goal was the creation of an EU-wide electricity exchange, which was enabled through a Third Energy Package, codified in regulation by two directives for Electricity and Gas, with an extensive set of supporting regulations. The delivery of the EU Energy Union relies on the above to provide for a system that allows for the secure, sustainable, and cost-effective transfer of energy throughout the EU. This model for the energy system was explained through the Florence Forum during 2009 and was designed with top-down and bottom-up paths in mind (Vasileiadou & Tuinstra, 2013). This was deemed to be crucial to allow for the smooth functioning of the Energy Union (Pellerin-Carlin et al., 2017). These various actions, supporting the Energy Union, created a newly defined approach to a full EU market integration with a roadmap for implementation and allowing market-coupling initiatives for market participants; taken as a whole, they have been viewed as a major step forward by the EU in its energy policy (Szulecki et al., 2015).

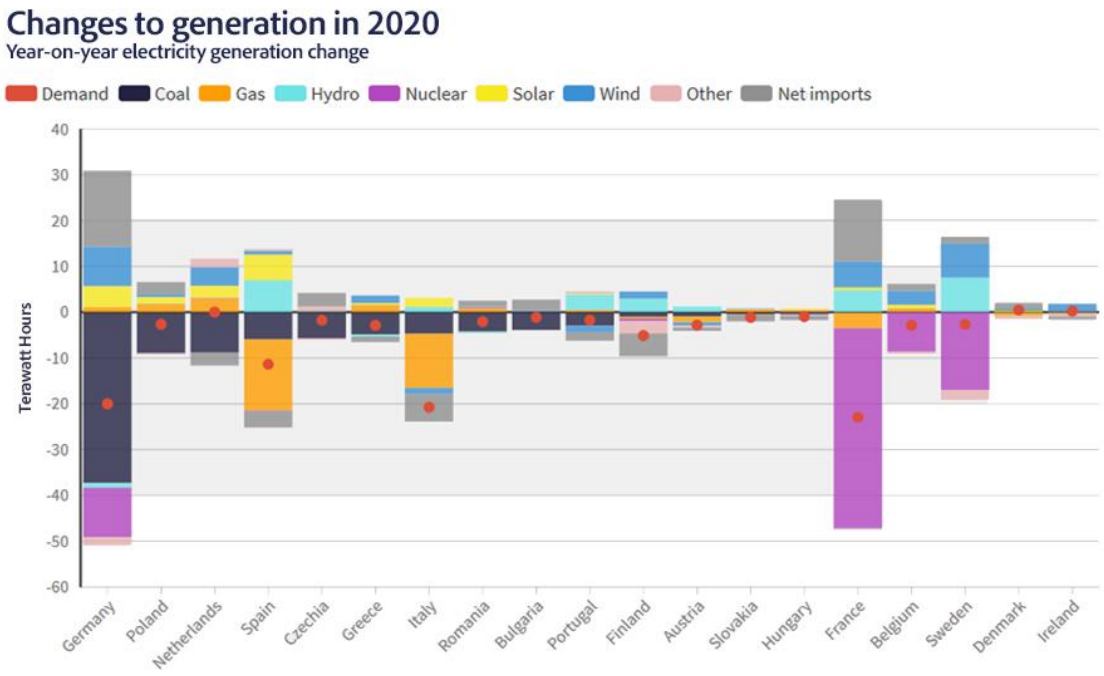


Figure 4.5 EU member states' changes in generation (data source: Ember, 2020)

Ireland: An Island On Its Own

Ireland, taken as one island, has particular characteristics, several of which are caused by its geographical situation. The island did not have interconnectors of size and operated an isolated and risk-averse system until 2002, which could not rely on support from the larger GB or rest-of-EU grids. This isolation manifested itself in a risk-averse culture, which continues to the present day. This culture is highlighted by one of Ireland's leading climate scientists, *'The system has inertia. … From my perspective, the system will stay with the status quo until it has no alternative but to move. And that's true of systems more generally, and I would say energy policy would be one of the more conservative areas in society, because energy is key. You don't want to take risks'(Interview GR22)*. In terms of energy cost, Ireland does benefit (and will benefit in the future) from the production of onshore and offshore wind, which is driven not only by cheap and abundant areas available for the plants but also by the overall size of the wind resource in Ireland (Cleary et al., 2016). The energy requirements for the island as a whole have increased materially throughout this period and, in particular, in the Republic, Ireland has achieved significant economic growth over a prolonged period, causing a large increase of energy needs (Glynn et al., 2019).

Prior to reform, the Energy Supply Board (ESB), the state utility, operated the electricity market with limited involvement from other stakeholders, much to the frustration of the private sector, here voiced by a senior executive from a global investment house with large exposure to renewable energy assets in Ireland, *'In Ireland you had a civil service that effectively were involved in the ESB. And were only doing the minimum they needed to do to keep the Brussels off their back' (Interview FE11).* Ireland's electricity sector was fundamentally changed by the Electricity Regulation Act, 1999, which undertook to achieve several material goals, again very much led by the EU guidance. With this act, the marketplace in Ireland became open to new participants across the value chain, but as this senior Irish civil servant illustrates, the government plotted a half-way house between state ownership and market liberalisation,

> *And the EU wanted you to literally set up an independent regulator, get out of ownership. But the regulation was independent, and we set up the energy regulator, we set up the telecom regulator, and then subsequently there was all changes on those […]. But the point being that there was a political choice to be made at the time, the State could have decided we're going to maintain the regulation role and get out of ownership' (Interview GR21).*

The composition of the wholesale marketplace was radically transformed with this Act. ESB Networks maintained possession of the transmission and distribution networks, but the transmission network's management was given to a new Transmission System Operator (TSO) through the implementation of the Act. In summary, the Act was to:

- Create EirGrid as an independent system operator overseeing and managing the transmission network
- Set up a national regulatory authority with overall responsibility for the market and market participants Commission for Energy Regulation (CER)
- Allow competition to come into the market on multiple levels (OECD, 2001).

These significant changes to the interactions and makeup of actors within the energy system were mirrored in changes in the governance set-up, as government, *'[s]et up regulators, brought in independent heads of government departments, and separate from the ministers, but then they actually ended up realising that it's not as easy to split things like that at all'*

(Interview GR21). The process was viewed as challenging, and the data points to this process allowing strong actors such as the ESB to maintain their positions of power successfully.

National climate mitigation policies

Since the first moves to create a policy environment for renewable electricity in Ireland, the different policy initiatives have undergone multiple changes (Gallachóir et al., 2017). An increasing number of different stakeholders have also become involved, as described by a senior energy executive in the Irish Sovereign Fund,

> *[…] the expertise that they can draw upon, from the likes of everything from the EFRI, SEI, even the IDA now, particularly with some of the corporate procurement needs in the country, they have been more influential. […] the regulator, EirGrid, all of these guys are contributing to policy on a much broader base than they would have done a decade ago, and that in theory should mean that the policy is better developed, better thought out, but it also means that the policy takes longer to actually come to fruition, and therefore new policy initiatives like the RESS scheme, which is succeeding REFIT, is taking a lot longer than anyone would have thought (Interview FR11).*

By 1994 the Alternative Energy Requirement (AER) had been put in place, allowing renewable energy generators to bid for a long-term Power Purchase Agreement (PPA) that gave (given the size of the renewable energy assets at that time) up to 15 years of revenue certainty to the asset owners. Though participation was disappointing in its early years, this policy became remarkably successful in terms of take-up. Government actions though, as per this leading civil servant interviewee, demonstrating Ireland's reluctance to be a leader and to react to changing environments. '*You have to take it in the broader context of what was happening both in the country and internationally, so there was a general move to renewables. We were slow off the mark, because a small country like Ireland will never be the first out there, it's too dangerous to be first out on some of these things, you just don't' (Interview GR21).*

Wind has been the overwhelming focus of both policymakers and the investment community in Ireland, given the resource available and the cost of production. Therefore, ambitious wind energy targets were set in 1996 to run to 2010 (Renewable Energy Strategy Group, 2012) and a range of climate change initiatives was rolled out to help the growth of this sector. The 1999 Green Paper on Sustainable Energy gave an impressive goal (given the size of the renewable energy assets at that time) of 500 MW installed of renewable energy generation from 2000 and 2005. This position is described as critical to Ireland's application to meet the EU member state targets, as stated here by an ex-minister for energy for Ireland, *'There was about ten or 15 different strands of work already happening in different areas of energy policy, like bio-energy and affordable energy and all these different things […] the overarching point was that our entire energy policy had to be directed towards decarbonisation, that that should be the great motivating force for the development of our energy policy […]' (Interview GR13).* This comment summarised the proposals for changes to the AER programme very clearly, which they hoped would increase renewable energy generation growth, placing it as the key mechanism for Ireland's emissions reduction (Renewable Energy Strategy Group, 2012). Moreover, it offered tangible suggestions for market liberalisation, welcomed by this senior executive of one of the world's largest investors, '*…and as the AER programmes 3 and 4 basically failed and we looked to […] get government support and shape, and effectively failed to do so […], certainly for direct support, on the basis that we were unable […] our only way to build out renewable power purchase in Ireland through the 2000s' (Interview FE11).*

Between 2002 and 2004, the marketplace continued a path to full liberalisation by 2005. During a period of high demand for energy due to the expanding economy, the overall portfolio was made up of generation assets nearing the end of life, with several due to be decommissioned by 2015. When a significant investment programme was necessary, liberalising the marketplace pushed policymakers to implement a policy programme that gave the finance community confidence in those policies long-term nature. Here the head of energy for one of the Irish leading banks' comments,

> *I think that linking the support structure with a levy on people's electricity bills, however, was thought through, and people realised that's how we're going to fund this long term. So REFIT being only 15 years, I think it was […] we weren't relying on the Irish Department of Finance or Treasury to ensure that that was going to be*

consistently funded. That was quite a unique attribute that I think policy makers did think about, and as a result, when we went through the recession, we still had project finance funding, albeit very few project finance banks funding renewable energy projects here, because they could see once people kept paying their electricity bills, there was going to be money there for a support scheme and therefore the support scheme was going to stay whole (Interview FR11).

By the end of 2004, the top three generators in the Republic of Ireland had over 90 per cent market share, with the ESB, the state-owned incumbent, the dominant player (CER, 2006). By 2015 the ESB's share of the market had decreased by nearly 50 per cent. This transformation of the market was supported by the 1995 Act, which enabled investors and asset owners to enter the market. These actors were focused on investing in renewable assets and traditional generator assets through a CER and ESB agreement to dispose of generation assets.

With the creation of the Renewable Energy Feed-in Tariff (REFiT) in 2006, brought in to supplant the existing AER scheme, increased investment came into the sector and continue*d* to grow the percentage of wind power as a portion of the overall energy mix. Policymakers recognised this success, *'So part of the reason why you introduced competition at the time was to bring competition into the market to drive down prices […] also to diversify the supply of the range of products available to people. And that had to be done, and the EU as well, […] were driving liberalisation generally, so there was other directives there as well' (Interview GR21).* The speed of growth of wind power generation as a percentage of the overall mix led policymakers, supported through the advice that they received from their various advisors, to believe that growth was fully correlated to the level of returns available to investors and asset owners. With that in mind and led by the wind industry's lobby group, comprised of individuals such as the interviewee below, actors supported a narrative that many projects were not developed because the AER competitive bidding process resulted in too low prices. '*I think what Ireland did in the late 2000s, early 2010s, in setting up renewable electricity policy, to deliver for 2020, was a very big success. I think that there was a lot of policies coordinating with one another and all facilitating one another, to deliver on a very clear target for 2020. So, I think that would be an example of what's very good'* (*Interview LR13*).

This early auction-type policy was deemed not to have delivered the desired level of deployment, as the ex-CEO of a key government renewable energy agency comments, '*Ultimately, the goal was cheap deployment and I think that there were policy evolutions in terms of if you look back at the earlier experiments in […] wind support and the so-called AER-type mechanisms, which were a kind of a version of an auction,[…] in their own way' (Interview GR14)*. Interview data also shows that multiple actors felt that the government, faced with overwhelming problems in the public finances post the economic collapse of 2009, were happy to see a slowdown in renewable power in Ireland. Here one of the largest investors in wind power in Ireland comments,

> *And so therefore my take on the Irish government was incredibly happy to see […] from 2008-9 when the […] collapse happened that actually they weren't really pushing […] hard to hit the target and that's why they're not going to hit any targets now. Because the consequences of trying hard to hit the target would mean an increase in prices. They thought in two ways around distribution investment required, but also the subsidies required from the refit […], payment and under that. And that's the […] political decision, so Ireland has then been incredibly slow to adopt (Interview FI11).*

Both of these two policies, AER and REFiT, have been financed by a Public Service Obligation (PSO) levy created in 2002 to be in operation from 2003 ((Farrell & Lyons, 2015)), a direct cost to the public. '*I am acknowledging that just under half of the PSO levy that's raised every year goes to supporting renewables for that relatively small amount of payment and I think there was a twofold return in the last five years. […] The evidence is there to support having a[…] in claiming a level of certainty in the market with regards to some electricity pricing does benefit the consumers.*' *(Interview IR21)*. Manufacturers, represented by senior executives such as the interviewee above, were confident that it was public money well spent. Energy policy in the Republic of Ireland was further described through a White Paper from 2007 (Department of Communications, Marine and Natural Resources, 2007), which, alongside discussions on guaranteeing a secure supply and points on how to reduce the cost to the taxpayer, put in place a new goal of having 33% of all electricity coming through renewable energy sources by 2020. This was highlighted by interviewees as a critical piece of policy in the development of the frameworks in Ireland,

> *A couple of crucial ones. There was the 2007 White Paper which really set the tone for Ireland's ambition to 2020. That was crucial because that prevented the overarching policy contexts for Ireland to drive an ambition in renewables. Really for two reasons. One is an acute dependency in imports of fossil fuels and secondly, the emerging European Directive around setting explicit targets for decarbonisation of the energy business (Interview IR13).*

With a change of government later in 2007, this target was increased to 40 per cent by 2020; Ireland was viewed as struggling, though, in its ability to manage the significant requirements coming from the EU across multiple areas in the energy system. '*Yeah, well I suppose starting from the back, 2007, we had the single energy market and I know that was a big project, and I know the lead into that was a very political one in a sense of, it was more political and economic and technical, all of these together. So that was very challenging*' *(Interview GR21).* Northern Ireland, meanwhile, shared the same policy on renewables in electricity as the rest of the UK. Therefore, the Renewables Obligation (RO) was the main policy lever and provided a considerable economic incentive for the private sector to make investments into renewable energy, with a corresponding cost for taxpayers.

The Republic then moved between AER and REFiT, the main difference between the two is the change from an auction to a guaranteed price for renewable electricity. The move was widely welcomed by investors, including government-owned ones such as this interviewee, '*So I think in Ireland it would have been REFiT 1, which would've come into place really in '07/'08, and that was the […]government support scheme that was very much taking over from the former scheme, which was the AER scheme' (Interview FR11).* Ireland would reverse this in later years as auctions became viewed as the method of delivering best-priced outcomes, '*You're only getting to the point now, where you'd have auction type and lowest bidding and the Irish policies have to be seen in the context of other European countries and the benefit from meeting the targets, in a lot of government areas de-risking things leads to lower cost*' *(Interview IR12).* Responsibilities for policies and marketplace regulation was combined with the Department of Enterprise, the Competition Authority and the CER. The Department summarised and communicated how a particular policy was to be applied, derived from the EU targets, '*Leading on then to the REFiT which really was a period where you had a lot of growth in uptake. The focus […] Ireland as in many things, would very much take the level of*

ambition and the timelines from Brussels. So, certainly the overarching policy context would be we must meet our European goals' (Interview GR14). The Competition Authority scrutinised the marketplace for examples of market power, and the CER administered the day-to-day functioning of the energy system.

Through the Climate Change Response Bill of 2010, an 80% decrease in emissions by 2050 compared to 1990 (Irish Goverment, 2010) was agreed. From 1990 and 2005, unlike the performance of the entire EU in the same period with emissions figures that reduced by roughly 8%, emissions in Ireland grew by 24% (see Figure 4.5) (EPA, 2011a). This disappointing outcome can be explained by the high growth that the Irish economy experienced from 1995 to 2005. The reverse effect can be seen in the significant reduction caused by the collapse in Ireland's economy, with emissions-reducing 11% by 2009 in CO2 equivalents from the level of 2005 (Martin Howley and Emer Dennehy, 2011). The energy sector's output increased by 4% per year through 1990 and 2005, but that sector emissions in 2005 were 49% more than in 1990. A substantial percentage of the decrease in emissions in 2009 (by 12% relative to 2005) was determined to be because of the economic downturn.

The growth in onshore wind nearly entirely delivered this decrease, '*So, I think it was clear to everybody that wind was likely to be the most economic* [sic] *way to reach our targets, rather than solar or anything else '(Interview IR12).* Ireland had not succeeded in building other types of generation assets, '*I think on the solar side, I think there was just no-one […] I'd say policy just ignored it*' *(Interview FR11)* or delivering more efficiency, '*So, I think we've been successful in onshore wind, with AER and REFiT 1 and REFiT 2; we've failed pretty much every other renewable technology, from a policy perspective '(Interview FR11).* This reliance on onshore wind came at the cost of relations with multiple communities across Ireland, who objected to wind generation assets being built in their localities, '*But the government didn't really think past, "the country will only absorb so much onshore wind, and so much industrialisation of the rural landscape." No-one really thought past that.'(Interview FR11).* A unique aspect in the case of Ireland is the major role of the agriculture sector in GHG emissions, creating challenging issues as the sector faces difficult choices to bring about decreases of emissions. EU wide, by 2005, the energy sector accounted for 79% of CO2 whilst farming accounting for circa 11%. Comparing that to ROI, energy accounted for 66% with farming bring circa 28% of overall GHG emissions (EEA, 2010).

Ireland had undertaken to decrease emissions to 20 per cent from the 2005 levels by 2020 – examining recent figures indicate that there will be an increase. This 2020 target has therefore been missed, and Ireland has challenges to meet its more ambitious 2030 levels and the 'net zero' objective by 2050. Policymakers in the republic were focused on how the policies for renewable energy had been a success whilst ignoring the fact that the overall target would be missed, as this industry executive points out,

> *I think what Ireland did in the late 2000s, early 2010s, in setting up renewable electricity policy, to deliver for 2020, was a very big success. I think that there was a lot of policies coordinating with one another and all facilitating one another, to deliver on a very clear target for 2020. […] I think in general, in more recent years, […] the policy hasn't been as aligned and coordinated, because I think the energy landscape has become a bit more clear (Interview LR13).*

This viewpoint that Ireland had achieved some level of success was not shared by the environmental groups. They pointed at the policy being in place, but that actions since the policy being passed had not been delivered. A key policy advisor from an NGO states, '*In Ireland we had a lot of consultation and discussion around the launching of the White Paper in 2015 on energy, I can't think of the name of it. But the 2015 Irish White Paper and that was really positive and set a really positive direction. But then the implementation of that policy has lagged '(Interview LR21).* The EU had decided on an objective of reducing emissions by 40 per cent by 2030, and these handed down targets were the driving force behind Ireland's state-level targets, '*There was a burgeoning realisation that, with all these international agreements that Ireland had signed up for, we had to translate those international agreements into the various sub-sectors in the energy space in some way' (Interview FR11).* Further new objectives to decrease emissions by at least 80 per cent by 2050, compared with 1990 levels, were agreed. Overall, though, as stated here by a senior Irish civil servant, Ireland was not a leader across the board on EU initiatives

> *But in the main, Ireland has a record of responding to EU legislation rather than leading it, that's in all the areas, like where you look at the environmental side at the moment, we're still way behind on stuff, and you look at the renewable energy targets for 2020, we're going to be fined or pay, and going to have to get biocarbon credits to*

the tune of 500 or 600 million plus in 2020, because we're just not going to meet the targets.(Interview GR21)

The Directive 2009/29/EC identified that 50 per cent of all emission were caused by large emitters (industrial and power), and those producers of emission were then placed under the European Emissions Trading Scheme (ETS). This brought an overall target, for all those entities within the ETS, to achieve a 21% decrease compared to 2005 before 2020. For Ireland, then the target was to reach a 20% decrease compared to 2005 levels. Current forecasts indicate that agriculture emissions achieved a 4.4% decrease in the period 2005–2020 (EPA, 2011*)*. This failure by Ireland to meet its targets was commented on widely in the interview data and remarked upon as symptomatic of a policy failure, *'We consistently fail in meeting our own policy objectives and we fail in meeting EU policy objectives, so it's very difficult to say that I'm happy with Ireland's performance' (Interview LR21).* This places a high cost on the polluters, with a decrease of 127% relative to 1990 levels, to meet an 80% decrease in emission by 2050.

I think beyond 2020 we still don't have an ambition, or a target, and I think that the lack of that means policy is a lot more fragmented and not fully clear on what it's trying to deliver. I think that has meant we've been in a much more dissatisfying state in the last few years […] than, let's say, in a post 2020 world, for renewable electricity, and that's just talking in a renewable energy context (Interview LR13).

UK – Effects of Political Change

The UK has made substantial decarbonisation of the energy system a state aim during the period under examination and has recently reconfirmed that (Climate Change Committee of the United Kingdom, 2019). It did so through the landscape effects discussed earlier with, once again, the EU is highlighted as a significant factor, here by a policy advisor from a leading think tank, '*[The] EU really […], in my view, dragged the UK into having a renewable energy target and the RO was a mechanism to meet that, was seen to be a mechanism to meet that*' *(Interview PU21).* The UK electricity industry underwent a large transformation, a combination of privatisation (1990) and liberalisation (1998), which eventually resulted in the market being controlled by the 'Big Six' energy suppliers (EDF Energy, E.ON UK, SSE, Centrica, Scottish Power, RWE npower). The UK is widely seen as a global leader in the privatisation of its

electricity sector (Newbery, 2017) and many other countries, including most of the EU, have largely emulated the UK approach. Unlike Ireland, which has a legacy ESB, there is no legacy CEGB, although there is a privatised National Grid and now a separated ESO. The UK government's overall principles in its interactions with the market was on cost, the longevity of infrastructure, and energy flexibility (Grubb & Newbery, 2018), without attention to renewables. The Department of Energy was closed in 1992, downgrading the centre for energy policies to the Department of Trade and Industry (DTI). DTI then became the author of the regulatory framework, with execution owned by the independent regulator, Ofgem. Ofgem's key responsibility is to make certain that the marketplaces were appropriately competitive and to safeguard consumer interest (UK Department of Energy and Climate Change, 2011).

The introduction of the RO in 2002 was a key point in the development of the renewable energy policy framework in the UK (Wood & Dow, 2011). It was, though, preceded by three acts, the Non-Fossil Fuel Obligation (NFFO), NI NFFO and the Scottish Renewables Obligation (SRO), which acted as the states' principal policy mechanisms. Support for renewable energy assets emerged as a side-effect of the NFFO (Pollitt, 2011), when pro-renewable energy lobby groups contended successfully that those assets ought to be eligible for non-fossil fuel subsidies. The NFFO policy on renewable energy, originally set to be in law and operational in the years 1990 to 1998, put in place an auction procedure with multiple separate bids; and it is interesting to note here that both the UK and Ireland had auctions early in the period, moved away from them and then reinstated them. Participants would propose to generate a set quantity of renewable energy at an acceptable value. Through the five bids, the state gave contracts to the best-priced participants. The NFFO auctions were complex, demanding advanced financial skills and enough funding to manage the risks and the policy worries. It generated only a gradual expansion of renewable energy (from 1.9% in 1990 to 3.0% in 2002). These assets, controlled and managed by the incumbent firms, be they a utility or a developer, had a cost of generation that was near to the value achievable in the market for power. It was that market value that policy supporting renewable energy had as a target to meet.

With Labour's victory in the 1997 general election, the government put forward that climate change should be a driver of energy policy. Together with the activity of the NGOs, this gave a strong impetus to the climate change agenda, '*The British decision to sort of end coal was*

[a] very strong NGO type-driven decision' (Interview FI11), remarked on here by a leading renewable energy investor. This coal phase-out, though not legislated to start until a decade later, had its roots in the acts by the Blair administration. Emissions trading was put forward as the centre of the policy framework addressing climate change, but the Labour administration, also in 2002, enacted the RO. The introduction of the RO was a major moment in the advancement of the UK energy transition. This policy placed a generation requirement for the utilities on the amount of renewable energy per year, increasing to 10% in 2010.

Suppliers had several means of achieving the targets:

- Produce renewable energy
- Go into the secondary market to purchase the Renewable Obligation Certificates (ROCs)
- Choose to accept the fine for failure to have the required level of ROCs.

The 2003 White Paper, Our Energy Future: Creating a Low-Carbon Economy (Department of Trade and Industry, 2003), discussed the necessity for the UK of achieving a 60% decrease of emissions by 2050 and set a goal of 10% renewable energy generated by 2010. Once again, the EU was seen as the guiding factor clearly by 2008, recognised at the highest level of government, such as by this ex-minister,

> *But the key thing for the UK was that we had signed up to the EU renewables targets. And of overall 15 per cent of UK energy coming from renewables which translated into targets for heat, transport and electricity. And, everything was driven by, could we have a plan that could meet those targets? Without those EU targets I don't think the UK would have moved very aggressively on any of it (Interview GU12).*

Climate change became a growing issue for the public throughout the first decade of the century, and as such, it, in turn, began to be a bigger area of interest for politicians to focus on, as well as compete with others on (Capstick et al., 2015). This attention delivered a cross-party consensus around the significance of the issues of climate change. Energy security concerns, driven by escalating hydrocarbon fuel costs (Figure 4.1) and volatility in the geopolitical sphere, were soon ranking alongside climate change in the government's mind, and this was reflected through the 2007 *White Paper, Meeting The Energy Challenge* (Department of Trade and Industry, 2007). Rising gas prices encouraged utilities to use an increased level of coal

during the years of 2000 and 2006 (Department for Business, Energy & Industrial Strategy [BEIS], 2019). Overall, there was a reconsideration of coal, legitimated with the promise of 'clean coal'*;* this flirtation was short-lived, and by 2020, coal was a small part of the energy mix. Hydrocarbon-based generators, especially coal, were the subject of increased public concerns, which, combined with the challenging emission targets, projected that most existing plants should close by 2015.

In 2007, the UK government agreed to the EU '20-20-20' target (Department of Trade and Industry, 2007), which contained a goal of achieving 20% renewables measured by energy use by 2020. The UK Parliament then enacted a series of important laws, the Climate Change Act 2008 (CCA) (UK Parliament, 2008) being material. The CCA 2008 aimed at building a framework for the transition to a low-carbon economy, as this ex-minister for energy reinforces, '*So it was really, really clear that we needed to focus all our attention on electricity as a pathway to decarbonise to meet the climate change targets'* (*Interview GU13*). The CCA 2008 committed the UK to a 34% decrease in GHG emissions, taking the 1990 levels as the starting point by 2020. It also created an 80% decline in emissions target for 2050, established a Committee on Climate Change (CCC) to monitor and recommend the progression against the targets, and facilitated GGE trading programs. (Carter & Jacobs, 2014) . In 2008, the government additionally established a new government department (Department of Energy and Climate Change (DECC)).

Putting in place targets, and the creation of a new department, created momentum around policy development. The UK Low Carbon Transition Plan (2009) put in place a target of 30 per cent renewable energy by 2020 and a near-full move to renewables by 2030. Other policies followed.

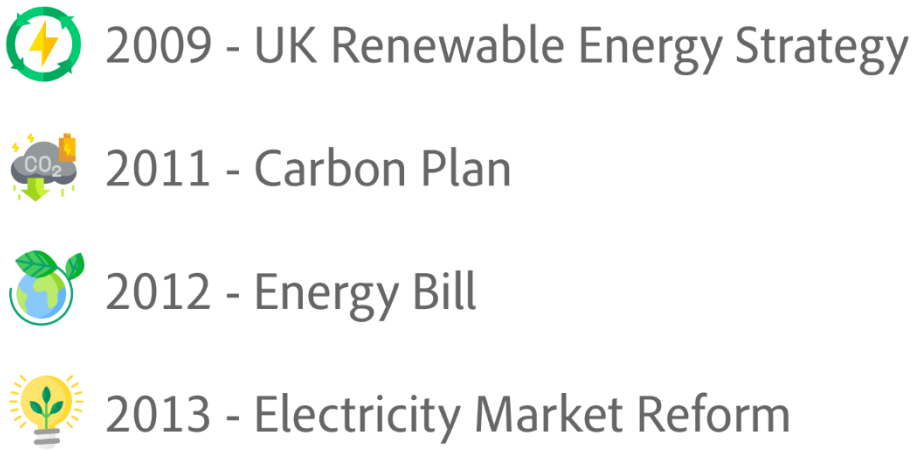


Table 4.2 Major UK energy policies

Taken together, these acts make a significant progression to direct intervention in stimulating the market, as an interviewee from a leading think tank remarks, '*I think […] in the first instance, the sort of RO era, […] the EU really essentially, in my view, dragged the UK into having a renewable energy target and the RO was a mechanism to meet that, was seen to be a mechanism to meet that and it fulfilled*' *(Interview PU21).* The RO was more market-oriented than the NFFO, '*Over this period of time the UK government's starting point has always been that competition and markets produce the right results* '*(Interview PU21),* given the secondary trading of ROCs. As all individual types of renewable energy assets were given the same value of ROCs, the RO was focused on large cost-efficient technologies, such as offshore and onshore wind.

Small-scale producers and independents raised concerns as those generators felt this was unfair to their activities and suggested 'bands' for distinct renewable energy assets. The government refused, contending that the state was not well-placed to pick winners but left it to market forces to decide the correct technologies. This market focus was dependent on private capital, enabling the growth in investment; private capital required larger assets, using more developed technologies. As clearly laid out below by one of the largest investors into renewables in the UK,

> *To increase the amount of investment, realising that there were different deliverers of capital. So, private equity taking development risk for higher returns at one level of risk*

> *tolerance, versus infrastructure capital on pension fund money, which was needed with lower risk and lower returns, which was needed to get that into cost curve and to deploy stuff at scale. So, it was very clear that even though we were trying to set up a Green Investment Bank that would help that, private capital is the answer and getting more private capital needed (Interview FU12).*

This focus on economies of scale, combined with the structure of the RO, allowed the market to be dominated by actors who had human and financial capital at scale. The utilities and large investment firms, therefore, had a significant advantage, which they also used in lobbying, as highlighted by the CEO of a government investment fund, *'And usually the SSEs or the Centricas, who usually lead on these things, put their prices up and then they would use the green subsidiary stuff to talk about "Well, we only had to put it up because of that"' (Interview FU12).* Interviewees, however, were split as to the effectiveness of the utilities in that activity, as shown here by the CEO of a large investment fund,

> *[…] I think that there's a huge sort of dark negative lobbying e-type group as well, ranging from the utilities in terms of wanting to lobby against and putting submissions in for things that could cause them problems, although they're pretty inept given what's happened to them. As in […], if they'd really been competent at it they, [would have] stopped the policies materially damaged them (Interview FI11).*

The political and public awareness of climate change focused attention on the existing RO (2002), which led to a reformed RO (2009) being put in place. This new RO was informed by the understanding that different technologies will produce different outcomes; therefore, ROCs were allocated differently to each separate technology, dependent on the level of development and amount of risk. In 2010, the government established a FiT (Ofgem, 2011), '*I guess my perspective is that the Conservative Liberal Government, after the election in 2010, just wanted to make a change for change's sake. It was simply that the RO was a Labour invention and they no longer wanted to continue a Labour policy '(Interview FU11)*. By 2011, the Treasury had created the Levy Control Framework (LCF) to manage expenditure by the government on renewable energy programmes. The objective of this was to bring about a re-ordering of the UK electricity mix with renewables becoming a significant portion of the system, and it was very successful, though at a greater cost than originally hoped. That overspend was due to a

greater than anticipated demand from RO and FIT schemes and a large fall in wholesale electricity price (BEIS, 2016).

After the international financial crisis of 2008, the formation of a new coalition between the Conservatives and Liberal Democrats in 2010 brought to power a government much less focused on climate change, and more concerned with market reform. While policy momentum has increased during the study period, the transition speed depends on political and economic factors

> *But then when the coalition government came in, in May of 2010, the policy became, for electricity, […] part of the overall electricity market reform discussion. So we were working together [...] on how we were going to set up the electricity markets in the UK. This was one big team effort, including the renewables people, or me anyway, and my Chief Executive and a few other people. And so it wasn't so much looking at alternatives, it was […] converging on this is what we want to do for electricity in the UK, electricity markets in the UK. And these are the goals we are committed to achieving and how do we evolve towards that (Interview GU12).*

Public attention to climate change, though it remained strong (BEIS, 2019), was less important than financial concerns in general, with the UK government realising that they didn't have full public support for large-scale buildout of renewable generation. At the same time, the economic situation increased worries about jobs, industrial competitiveness and energy costs. Whilst central government became concerned about control of cost with light-touch policies removing management from its hands,

> *…which officials didn't want, and which I had introduced in government in opposition into the Conservative manifesto, which was a policy piece that I'd brought back from California. Seemed to be very consistent with our light touch, using market regulation to drive policy outcomes. And being sensibly technology neutral, but in reality, driving greener, low-carbon outcomes. So that was my major contribution to the architecture of the CfD (Interview GU13).*

The build-out of solar generator capacity significantly grew after the 2010 implementation of the FiT policy. Though still comparatively small, the amount of capacity nearly doubled in 2014 to 4.1 TW h. The coalition government was clearly influenced by the junior partner, helping this expansion, as explained here by an ex-senior government civil servant,

'[*E]mphasis between them shifted, subtly over time and the key thing being what happened pre and post the financial crash and subsequent economic hardship. And you know, remember the political context at the time was that we had from 2010 to 2015 Liberal Democrats running the energy department, which added a green tinge to the government that might have otherwise been less supportive of the renewables agenda' (Interview GU16).*

There was widespread criticism of financial support for onshore wind, combined with community objections to the build-out of the power plants, but the coalition government did continue to push forward on policies in support of the transition.

> *We had inherited a structure from Ed Miliband and the then government, and the Conservative government bought into that agenda. Very strongly at first and then a lot of the rhetoric from David Cameron and from others was very strongly in favour of it. But we were in a Lib Dem-controlled department. I think often, it is assumed that the Lib Dems set the tempo for the Department. In fact, it was very much mutually shared across the ministerial team that we, as far as we had been aware, we had good support in Number 10 and Number 11. We knew we had push-back from some other government departments. We knew there were some difficult backbenchers, but we felt we were in charge of our own destiny in what we were trying to do. The renewables directive was just coming in. That was broadly seen as unattainable. That was 15% of all energy to come from renewable by 2020. That translated into about 30% of electricity from renewables. People said […] that can't be done. And that was the overwhelming view and the fact that we would comfortably get to 30% by 2020 would have been a surprise [to] a lot of people (Interview GU12).*

This required an increase in large-scale utility plants, which in turn, increased community fears about the local landscape, as well as more generally held concerns on cost given the renewable subsidies level.

> *[…] the government came in with […] a reasonably clear idea about what it wanted to do in general terms, but those proposals were refined, shaped, influenced by the feedback received from both the green groups and the energy sector definitely, and [from] wider business interests (Interview GU13).*

Onshore wind remained, from early 2000s to the end of that decade, with a strong level of growth, leading to the community conversation on renewable energy, and in particular, wind,

becoming increasingly negative. Concerns about subsidies drove this attitude, '*Consumer groups, I think, also had an input in that but […] the area where the real pushback came out was when the power prices went up' (Interview FU12)*, but also ideas of damage to the local countryside as well as the idea that rural communities were being taken over by corporate activities (C. R. Jones & Richard Eiser, 2010). The deployment of offshore wind increased with both the support from the amended RO and from the negative pressures on onshore wind as an investment option. Installed capacity expanded swiftly.

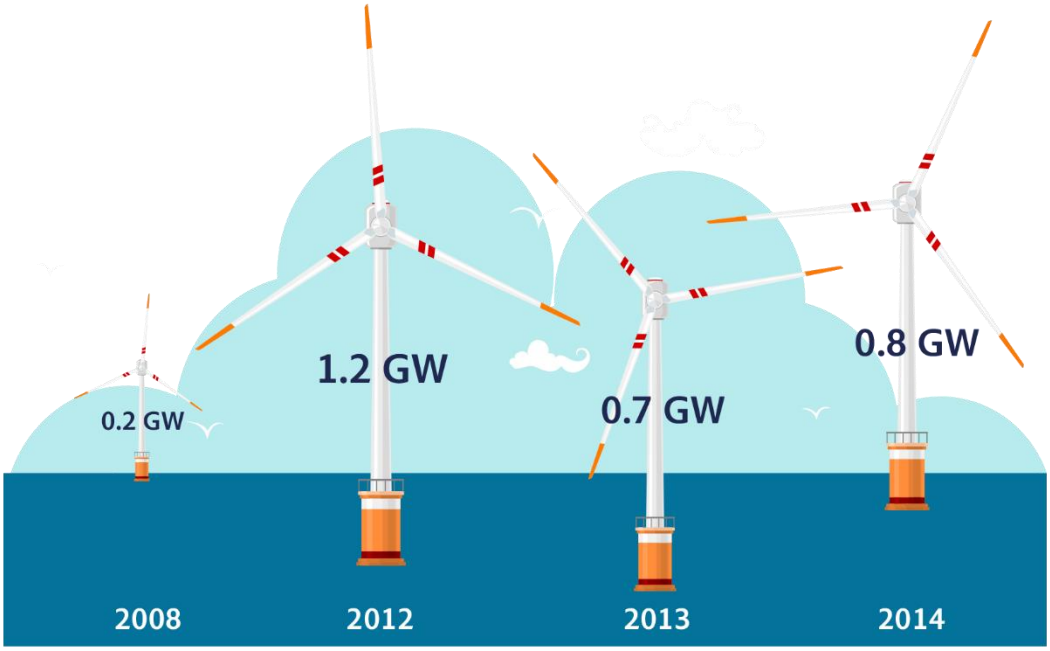


Figure 4.7 Annual installed offshore wind, UK 2008-2014 (data source: WindEurope, 2019)

This growth put the country as the global frontrunner in offshore wind. The Electricity Market Reform, from 2010 on, supplied appealing incentives for large-scale renewable generators through the CfDs.

> *Converging on this [policy attention] is what we want to do for electricity in the UK, electricity markets in the UK. And these are the goals we are committed to achieving and how do we evolve towards that. So, yes, we looked at some alternatives there, but I just want to stress, it was not in the context of alternatives for renewables policy. Because we had the idea of feed-in tariffs for small stuff, […] the rocks and so on for larger things, and we just […] kept evolving that. And I think gradually as we saw prices coming down, the thing that came to the fore was […] being very clear that we*

> *would continue to reduce subsidies, and people should be prepared for reductions happening regularly. So that […] we were always just fixed on the idea that investors […] should get a return, but it shouldn't be a disproportionate return* (*Interview GU12*).

Overall, large-scale renewable generation grew heavily at this time, championed by both large corporate actors and policymakers. Onshore wind, as discussed, confronted opposition from civil society actors, environmental NGOs and local communities. In 2013, cost worries turned into a conflict over the cost of energy for the consumers, which led the government to retreat from various policies. There was a marked decline in support for activity implementation against targets, and a focus on each type of technology's individual costs.

> *And so we did this plan […] how do we take all these technologies and make an estimate of how much each one can deliver and put it all together and chart it over the 10-year period? How much would be done and at what rate and so on. […] Charles Hendry when he became minister was very taken by this idea and so was Greg and we published this as The Renewable Energy Roadmap (Interview GU12).*

The government refused, until recently, to sign up to renewable energy ambitions post-2020, notwithstanding frequent urging from the CCC. The data points to a level of disappointment with the UK government's lack of interest in listening to the environmental groups. As an interviewee from the finance sector suggests, '*Very little that I saw in the environmental groups. The environmental input came from the Committee on Climate Change, which says we have a carbon budget and if we continue on the trajectory that we are, we're going to miss that carbon budget, therefore we need to stimulate more, therefore the current set of regime is not fit for purpose'* (*Interview FU12*), the NGOs were not invited to the discussions where decisions took place and policy was formed without their involvement. The headline conclusion of the CCC report, published in June 2020, was that there is a sizeable policy deficit 'between recent, current and planned short-term action, and what is required to put the UK on track to meet its long-term climate targets.' (CCC, 2020). This highlights the risk to the leadership position that the UK has built in the past as a leader in offshore wind.

4.4 Regime-Level Factors: Technology Change

Challenges for the Power Sector

Our transition to a low-carbon economy has presented several challenges for the power sector. Much attention has been given to the requirement to substantially change the energy mix, highlighting the extensive work required to ready all states' power grids for that change. The energy regime is obviously not just a group of interconnected technologies: it is therefore circumscribed by regulation and economic concerns, with the landscape and niche layers influencing choices on approach, development and investment. It also encompasses multiple types of actors involved in the work to create this transition. This work was viewed unfavourably by the utilities and grid operators as both a cost and a risk, and in both the UK and Ireland, they were, in the early part of this study period, a negative force, as explained by a senior executive in one of the largest wind developers in Ireland and the UK, '*In the early days, the utilities, the energy, were heavily fighting against it. It's not in their interest so they were not – yeah, there were some exceptions. But in general, they are not very helpful*' *(Interview II22).*

In today's power system, the dispatchable thermal-capacity balances any supply-demand mismatch and provides back-up capacity and ancillary services, such as frequency and voltage control, to maintain grid stability. In the transition to high penetration of intermittent renewables, balancing services are becoming increasingly important, and the decline in conventional generators, which provided such services 'for free', is forcing fundamental changes in grid operation and power electronics (Steinbach, 2013). '*But in Ireland the key issue has been the fact that they have actually been unable to do anything because the grid wasn't fit for purpose, to allow anything […] to happen and so there was no point in […] bringing more stuff through, or making more things happen just because you never get a on connector*' *(Interview FI11).* A generally agreed tactic for efficiently managing this challenge is building flexibility in the energy system, so the larger static demand-and-supply environment of prior periods is replaced by dynamic changes in the energy system to react to demand and supply changes. This will further add to the challenges facing the grid operators.

4.5 Regime-Level Factors: User and Market

Market Conditions

In the uptake of any new technology, there are several critical supporting activities, which include basic R&D, scale-up into applications, and the funding and building of scale demonstrations. At the same time, new technologies must be allowed to function in protected niche markets, which give those technologies support and space to flourish. Public or private financing is critical, as usually there exist strong incumbent actors who are well capitalised. Given this, an innovation needs to be protected in a niche to the point when it can function in the regime as a fully-fledged commercial activity, and then market demand will support and demand further innovations. That protection takes the form of a set of policies and incentives designed to enable the growth of that innovation over time. The result of the policy design requirements for renewable electricity is that if a price differential between renewable and conventional power exists, a policy needs to be put in place to bridge it. A country such as the UK or Ireland, which manage their economies on the basis of a market-based system, need to have an enabling mechanism, given that firms operating in this system will commit capital to an activity based on the direct commercial benefit. A wide variety of means, such as technology grants, tax incentives, beneficial business conditions, payments for power over and above the market price, and benefits to renewable power producers in the form of green certificates, are available and have been utilised. More than 40 governments worldwide have chosen a version of a FiT for their mechanism (IRENA et al., 2018), with UK-based industry lobbyists such as this interviewee taking on a global role.

> *During that time, most of our effort was to go around the world and to convince governments that you need to decarbonise your economy, and better sources of energy rather than fossil fuel, and solar is a very strong substitute. Some countries, they just took it, they accepted it. They took it and they really ran away with it. And some countries were hesitant, and they were saying that without subsidies, it cannot exist. If we fast forward that to 2018, what we have seen in this period, a lot of these countries are now, not only convinced, but also […] in the forefront of deployment of solar (Interview LU12).*

A different model is the RPS, which we have discussed earlier in the UK context. The UK use of ROCs required energy generators to produce a certain percentage of renewable energy versus their entire portfolio of generation. These ROCs are issued by the national regulator, Ofgem, and allocated to the energy generators, which are then free to trade them with other market counterparties. The number of ROCs would vary depending on the type of technology, given government the ability to prioritise different technologies and the size of the generator asset in MWh. Generators were obligated to buy ROCs to a percentage of their total energy generation. Penalty payments were enforced on the generators if their targets were not achieved. The key material difference between ROC and a FiT is that ROCs are subject to a buyers' and sellers' market, enforcing a changing price determined by normal demand-supply mechanism; FiT is a fixed value decided by policymakers. Increased market participation then brings about a lowering of the price of ROCs, which is a feedback loop over time that takes the price back to an equilibrium.

The discussion as to which market-based mechanisms, such as the ROC or FiT models, are more appropriate for a particular context is complex (Grubb & Newbery, 2018), but FiT models seem to have resulted in greater levels of deployment (Kilinc-Ata, 2016).

4.6 Niche Level Factors

As was introduced and discussed in Chapter 2, of the three layers of the MLP framework, the niche level is where innovations are hopefully protected and allowed to develop before, in a successful case, becoming part of the regime as fully-fledged standalone innovations. It is, therefore considered as the most important socio-technical layer for system innovations. Issues of R&D, new business models and the development of renewable energy technologies, in general, are therefore areas of investigation in how they are protected as niches.

From a social science basis, this research aims to contribute to our understanding of the development of renewable energy policies in the EU. Within this context, issues relating to technological development must be addressed, as these changes can become obstacles or drivers to achieving an increase of renewable electricity generation. For any niche-based innovation to have the space and support required to become a part of the regime, research and development policies are of critical importance. Technology innovation is, and policies that support it are, deeply connected with various private-sector industries. A significant number of scientific advances are championed by or are developed in, the structure of industry-based R&D, and this is true for innovations relating to renewable electricity generation. Both Ireland and the UK had research activities focused on renewables, both in universities and in industry R&D groups, but the UK clearly was devoting more resources in absolute levels as well as per capita.

Solar PV prices declined to less than one-tenth of their 1992 price by 2002; prices have since maintained that pace of reduction as continued installations took place. This gives an approximate learning rate of 17–22% (Candelise et al., 2013), i.e., as installed capacity increased by a factor of 2 this led to a decrease in PV costs by 17–22%. The learning rate for onshore wind has been approximately 7%, and for offshore wind, 9% . It is clear that cost reductions globally have been significant on an annual basis, and that has further increased renewables' installed capacity. Renewables make up half of all new global generation installed since 2012, with solar PV dominating. The levelised cost of electricity (LCOE), the cost of electricity per unit over the lifespan of the asset, from solar PV has reduced by 73% from 2010 to 2017, with onshore wind prices reducing by 23%. The energy transition is supported by this significant decrease in the cost. As the CEO of one of the UK 'bid 6' states, '*But the point is it was an amazing success and it developed an entire new industry for Europe, tremendous technological innovation and just as importantly it paved a way for the rest of the world to follow.' (Interview IU13).*

In 2017, offshore wind projects in the UK were tendered at market prices without subsidy for the first time (IRENA, 2018).

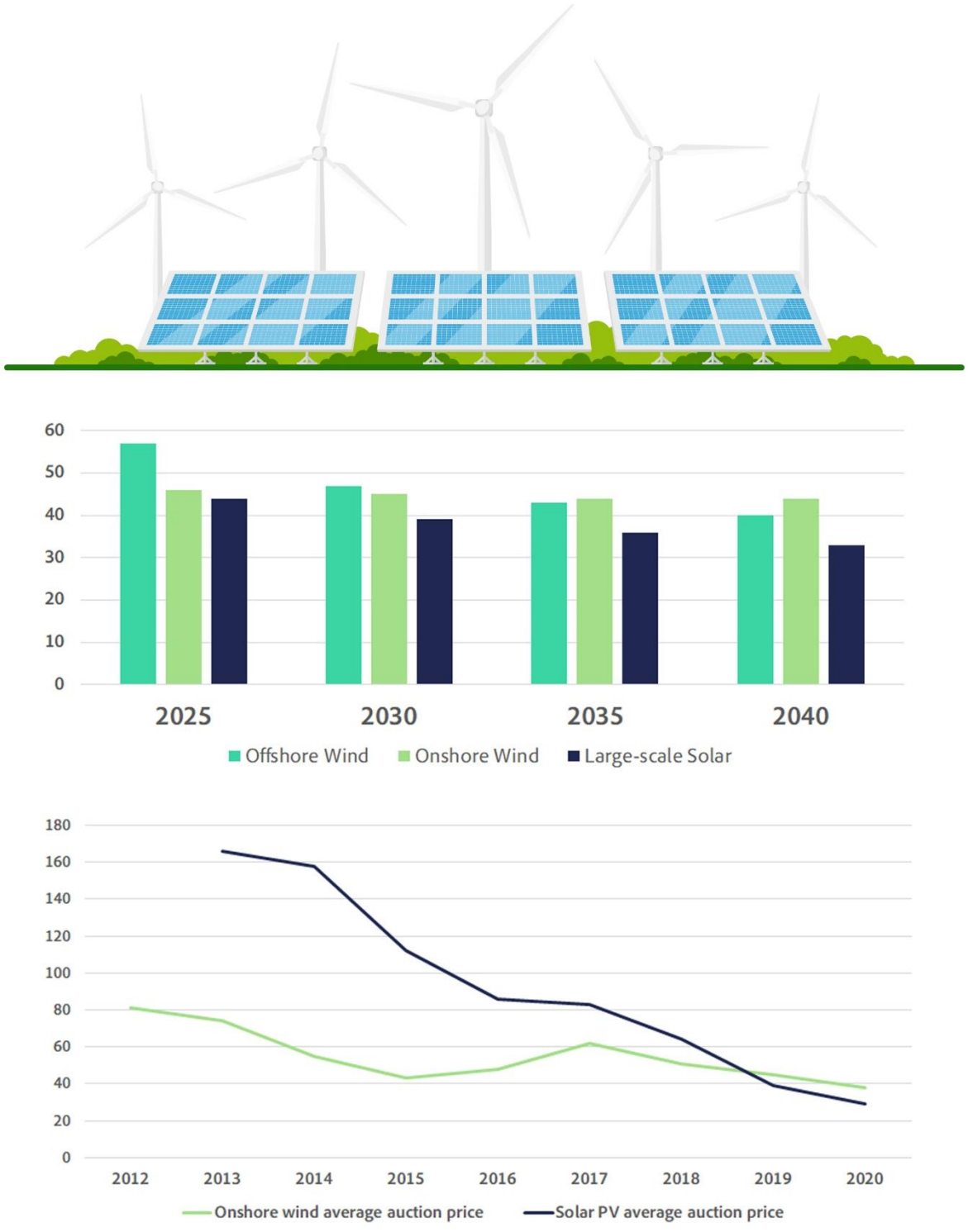


Figure 4.9 Auction prices for global onshore wind and solar PV in GBP per MWh (data source: IEA,, 2019)

Over the period of this study, solar PV, onshore and offshore wind projects have been contracted at US cents 2–3 per kWh. These are values lower than what hydro-carbon or nuclear

generators can compete. The significant declines in the cost of renewable energy technologies do, though, offer the hope of an energy system dominated by renewables.

Decentralised vs. centralised energy generation

Overall, energy generation can be categorised into centralised and decentralised types. Centralised types of energy generation are, in the main, the traditional baseload generation sources such as nuclear, coal or gas power plants. As niches, new technologies and innovations have operated as subscale, decentralised assets (e.g., small onshore wind or Kwh solar PV installations). As they have entered the regime, the two technologies that focus on this research have expanded greatly in size and are now comparable in importance and size to the traditional baseload energy generators and so are categorised as centralised power plants. This point is highlighted by a senior Irish climate scientist,

> *In a sense, we have an energy system in Ireland which is quite locked into the thinking that energy [is] centrally generated, distributed through the network. And that's fine. That model has worked very well for Ireland and has been central to Irish development. How it will evolve, what is the vision of that, and how it will bring in more distributed systems is still evolving (Interview GR22*).

Overall, larger power plants have better efficiency and better return-on-investment metrics than smaller ones. The drivers of economies of scale, financing costs, and more cost-effective secondary costs such as grid connections and civil works give larger plants a considerable advantage. This power of the large actors is remarked on in the data here by the head of policy in a leading environmental NGO,

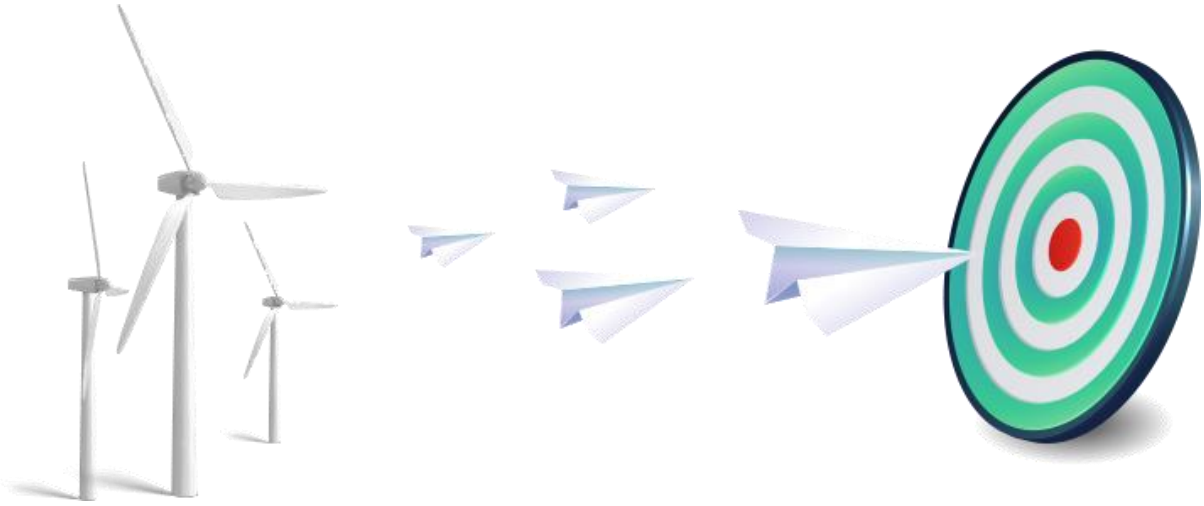
> *I think on electricity […] ESB Networks is a very powerful voice and whenever you talk about Microgen they say "no" and it doesn't happen, they don't like it. I think the major utilities don't like Microgen […] So there's a lot of scaremongering around, it if it's going to increase electricity prices for everybody and costs will rocket and poor people will get poorer and rich people will benefit, and that kind of language is always argued from the ESB side (LR21).*

Smaller, decentralised power plants do, though, have their own distinctive benefits, such as in energy security. Decentralised power is a key area of focus for community empowerment and energy justice (Heldeweg & Séverine Saintier, 2020). The distributed nature of small-scale renewable energy power plants provides greater security of supply compared to a limited number of large, centralised power plants of the same size, as there is less risk of many power plants failing versus one. To guard against interruption, reserve capacity for utility-scale generators has to be materially greater than for distributed assets.

4.7 Summary

This chapter addressed the following research question, **How did renewable energy policies develop, what are the categories of national renewable energy policies and what policies were implemented in the UK and Ireland?** The crucial characteristics of renewable energy policy considered in this research are remarkable in the range of landscape effects that affect the growth of renewable energy generation and how the policy was developed to enable that growth. In many of the debates around the development or the implementation of renewable energy policies, these characteristics can be seen only briefly; researchers have tended to concentrate on one or more sub-aspects of a policy. Therefore, given the wider theory case of this research, the analysis of the UK and Ireland shall be driven by the characteristics considered so far. Those characteristics are underpinned by a broad agreement internationally on the action, driven by the landscape-level energy trilemma of security, affordability and clean generation. EU policy has been created somewhat on the basis that the EU needs to be a leader internationally, driven by both a competitive position versus other international actors, as well as by significant concerns on security. Supporting climate action national responses, aided by EU targets, have varied between the two case study countries but have capitalised on natural advantages and consistent technological developments that have led to ongoing price reductions. These same national responses have been hindered by incumbents who have a privileged position in the regime, combined with a political culture that favours them. Case

study states also then encouraged, and have become reliant on, private investment to enable the transition to a low-carbon economy.



5. The Factors Influencing Design and Implementation

5.1 Introduction

This chapter uses inductive themes discovered through this research to evaluate the transition process, which takes place as prominent actors, institutions, and different entities inside the policy structure interact. The empirical conclusions answer Research Question 2; w**hat factors influenced the design and implementation of those policies, considering the relationships between institutions, actors, industry structure and decision-making processes?** This work shows the consequences of the transition's technical and social characteristics and how various factors influenced the construction and execution of renewable energy policies in the EU, UK and Ireland. How individual components of the policies interact with the levels of niche, regime and landscape are additionally analysed. Humans determine the creation and deployment of technology, and their actions can change that context, which then can create a new socio-technical structure. That change can be driven through new and increasing social demands, electricity usage being a relevant example.

The research framework illustrates the socio-technical nature of renewable energy systems, which acknowledges that various elements, both technical and non-technical factors, affect and are interlinked during the processes of change. As discussed in Chapter 4, the energy trilemma

of security, affordability, and the environment, *'You've got the trilemma […] of decarbonisation, energy security and price […]' (Interview GU13),* have been the guiding contexts affecting the development of renewable energy policy in the EU, Ireland and the UK; as recognised above by the UK ex-minister for energy, and below by the CEO of an Irish state-owned critical infrastructure incumbent,

> *We had great concerns about the fact that we were dependent on imported fossil fuels. […] [the second factor was] the whole environment and carbon — so the notion of decarbonising electricity and creating a better environment. And this was when climate change was starting to get currency and European directives were starting to drive out very explicit targets. And the third factor was the discussion around being able to produce energy costs effectively and getting control over the production in both jurisdictions and not subject it just to wild swings in energy prices on the back of oil prices, geopolitical shifts around the world, etc. So, security of supply, the environment, and costs. They were the factors which dominated the whole discourse around energy policy back then, and they still do, to a large extent (Interview IR13).*

On examining the data, several important themes become apparent, which, according to the interview subjects, were the main factors affecting renewable energy policy in the EU, UK and Ireland. These are illustrated in Figure 5.1.

Figure 5.1 Main factors affecting renewable energy policy in EU, UK and Ireland

These three themes, therefore, become important in the evaluation of negative and positive contributions to the advancement of renewable energy and provide answers to questions on how social actors view the renewable energy system. Such questions include what influence context has on the expansion of the renewable energy system and how do systematic interactions among numerous factors affect the development of the renewable energy system.

5.2 Socioeconomic, Institutional and Energy Market Factors

The signing of international climate change and environmental agreements signals a country's promise to lower their use of high-emission generation sources and increase their use of renewable energy (Popp et al., 2011). When examining a broader set of countries who have signed those international agreements (broader than Ireland and the UK), it is clear that multiple types of policies have been used to increase renewable energy's share of the electricity system. Researchers have found that those policies are positively associated with higher levels of renewable energy adoption (Aguirre & Ibikunle, 2014; Carley, 2009; Marques & Fuinhas, 2012). The data also shows the landscape and regime contain other socio-economic, institutional and energy system elements that are worth highlighting (Hughes & Urpelainen, 2015). It is widely assumed that democratic regimes, providing as they do a stable business environment with clearly understood rules and containing protected property rights, create a more supportive environment for investing (Busse & Hefeker, 2007; Jensen, 2003). More significantly, checks and balances in democratic countries boost governments in their ability to implement policies that balance the interests of different groups in society (Bayulgen & Ladewig, 2017), also recognised by leading climate scientists working in the Irish and EU sphere, '…*here's what comes through the diversity of thinking within EU member states and the trade-offs that happen between them. And then, there is the lobby groups who would be very effective at a European level in terms of putting out the imbalances that will happen for European trade, for European industry if there are too much costs'* (*Interview GR22*). Fredriksson et al. (2007) examine how the types of a country's institutions and their interactions determine the type of renewable energy policies. Farzin and Bond (2006) and Pfeiffer and Mulder (2013) discuss different types of governance and how that might affect the implication of policy.

Income Level and Macroeconomic Stability

Researchers have found that the underlying strength and economic stability of a country are factors in the development of a progressive renewable energy policy, which subsequently

affects the development of renewable energy assets in that country (Aguirre & Ibikunle, 2014; Sadorsky, 2012). The wealth of a state, measured through metrics such as GDP per capita, and how that is related to the MW of renewable energy generation as a percentage of the grid, has also been discussed by researchers (Simionescu et al., 2019), all of whom acknowledge the large amount of capital needed for the build-out of renewable energy assets as a point of concern for policymakers (Polzin & Sanders, 2020). This discussion on the availability of capital and the performance of the economy is fully supported, throughout the interview data, as an area of concern, here illustrated by an ex-Irish minister for energy, *'[W]e'd come out of this horrendous period of economic collapse, financial collapse […], so there was little or no money around for most of the time we were in government. An almost complete collapse in investment capacity on behalf of the state' (Interview GR13).* However, researchers such as Chang, Huang and Lee (2009) show that this positive relationship does not always hold, though this research points to it is clearly linked.

Market Size and Human Capital

The influence of the size of the market and its energy needs on how renewable energy development unfolds has been unconvincing in the literature. The increasing need for energy could be matched with an increase in hydrocarbon fuel generation given relatively plentiful resources, instead of building renewable energy generation; but as has been shown in Chapter 4, the EU believed that it was critically important, as a large market with significant energy needs, to invest in renewable energy. Some research has pointed to states which have an increasing population also having an increased energy requirement, while other research clearly demonstrates that the energy requirements of a society are not tied to population. Either way, the link between that increase and the growth of renewable energy as a percentage of the grid in a state is weak (Sorrell, 2015). The market size has been shown to affect a state's ability to make investments in new technologies, as we can see in this warning from a senior Irish civil servant, '*And the other thing, I suppose, to remember as well is that electricity and the energy market generally is a hugely capital-intensive industry' (Interview GR21).* This ability is also dependent on the level of human capital (levels of attainment in education), given the need to be able to correctly carry out such investments and how to use them effectively.

Carbon Dioxide Emissions

Several researchers have commented on how public perceptions of environmental issues and concerns about increased levels of CO2 emissions have created pressure for policies that work to limit emissions, as stated by this interviewee who, as a climate scientist, puts it in the terms we would expect from that background, *'The policy from the climate perspective, obviously, the objective is to reduce emissions of CO2' (Interview GR22).* These pressures consequently accelerate the adoption of renewable energy (Sadorsky, 2012). There has also been research showing the reverse, with higher-emission economies dependent on hydrocarbon fuels both in utilisation and as a resource to be sold not facing the same pressures from their public (Marques & Fuinhas, 2011; Romano et al., 2017).

Energy Sector Variables

The price of alternatives to renewable energy has traditionally been a factor in the attractiveness of renewable energy generation assets. Private-sector capital has based its investment in generating capacity by comparing the levelised cost of electricity to the equivalent hydro-carbon cost (and policy has therefore worked to reduce that cost to encourage investment) and what policy support is available to bridge the gap. This type of calculation is illustrated by the head of a solar industry lobbying organisation, *'I think it was a combination of policy development at the right time…. plus, the electricity market had fall and don't forget, the cost of fossil fuel was a lot higher those days' (Interview LU12).* Price volatility created by movements in the hydrocarbon commodity has worked to encourage investment in renewable energy assets, with the near-total cost of these assets known on day one of investment as they have a minimal cost through the lifespan of the asset. This feature certainly becomes attractive when hydrocarbon generations have a high level of volatility and negative effects on a country's economy (Awerbuch & Sauter, 2006). Researchers such as Chang et al. (2009) and Marques et al. (2010) found that reactions to an increase in hydrocarbon prices differ based on the wealth of the state, with wealthier states or resources-dependent economies not being swayed by that volatility; therefore, a switch to renewable energy does not necessarily take place. Given the considerable investment made by most modern economies in hydrocarbon generation up until recently, renewable energy was initially viewed with suspicion. This suspicion centred on the cost of renewables versus hydrocarbons and questioned their reliability as a provider of baseload generation (Aguirre & Ibikunle, 2014). In well-developed grids with a significant amount of available hydrocarbon generation, perceived risks of building renewable energy assets are lowered (Battaglini et al., 2012). In Pfeiffer and Mulder

(2013) work on developing countries, a large percentage of hydrocarbon generation combined with a low percentage of renewable energy generation per capita is seen as a negative correlation.

The Pressure of the Community

One of the most thought-provoking areas that stands out in the interview data, primary sources and a review of existing research is the pressure that came from certain elements within local communities and certain sections of the state to limit the deployment of renewable energy assets in both the UK and Ireland and how policy effectiveness was changed through that pressure. *'I think probably the majority of the Conservative Parliamentary Party were against onshore wind. They didn't believe the opinion polls which showed that it was very significantly popular with people in all parts of the country, not just in areas where you couldn't see the turbines' (Interview GU12)* states an ex-minister for energy.

The new build of renewable energy assets elicits a broad range of responses from a variety of actors, from industry, financiers, and local community groups, and the issue of 'public acceptance' is at the forefront of renewable energy debates, both in the media and in policy makers' interactions. One international investor interviewee stated that *'One hundred and one Conservative MPs wrote to him [David Cameron], which is a huge percentage of the non, people not in government [MPs rather than government roles], as in […] more than half, and that then leading to some very large policy pullbacks here. And that kind of very small, hugely focused lobby group was hugely successful in a negative way' (Interview FI11).* In some cases, the expressed views of the community have been able to change renewable energy policymaking. Examples include Germany's cutting of nuclear power from its generation mix following the 2011 Fukushima Daiichi accident (Kharecha & Sato, 2019) and, directly relevant to this research, the changing and elimination of policies that supported onshore wind in the UK. In the latter case, Amber Rudd, then Secretary of State for Energy & Climate Change, stated on 8 November 2015 that '*We are reaching the limits of what is affordable, and what the public is prepared to accept.'* During the later period of this study, both the UK and Ireland saw significant community pressure against the build-out of onshore wind and solar assets. As illustrated by the CEO of a UK industry lobby group, *'Agricultural land was obviously*

challenging, because we had a lot of opposition to putting solar and wind farms within the countryside. […] obviously, the size of the UK didn't give us the opportunity to go and build large solar parks in wherever there was a bit of land' (Interview LU12) and in Ireland by a senior government minister, *'There is no doubt that the opposition to turbines was very genuinely held by local communities. Insofar as people felt that it was going to destroy quite a sector of their lives. They were going to resist it. In some cases, that was coming from people who had lived in areas all their lives, farmed land and were just worried about what the impact of this was going to be on their own farming and on their own livelihood' (Interview GR12).*

There were three principal arguments against onshore wind and solar farms put forward in the UK and Ireland are illustrated in Figure 5.2:

Figure 5.2 Community arguments against locally built renewable assets

These arguments and the way in which they were put forward led to a complex, and in many ways hostile, environment for the granting of permissions for new onshore wind farms.

> *We have had major investment by large companies in wind power. The lack of community engagement with some of these, or a lot of these, I think has been problematic. We have had this backlash with wind generation, in particular, lots of various socio-economic issues, I would say, have become an important element of the whole discourse in Ireland (Interview GR22).*

Multiple applications were being subject to long delays or outright rejection. As was found in the data,

> *The government has been pretty straightforward in they're supposed to pursue evidence-based policy, [which many] took to [be] the kind of being the lowest possible cost. I guess the piece that I suppose I've missed which […] led to the Conservatives and the no onshore wind was that […] there's also a social aspect that the government has as our elected representative as much as I may dislike it, to say that even though […] it might be cheaper to have onshore wind, it's socially unacceptable for some reason and therefore we're happy to pay more to put it all offshore (Interview FI11).*

The Renewable UK statistics (Muthoora & Fischer, 2019) point to GWs of onshore wind generation awaiting planning permission in the UK, and it also talks to permission taking two years to get to a decision point and then having a success ratio of 40%. Nearly 50% of these applications receive objections from bodies as varied as airports to local communities. Climate change denial was also used to support a position of limiting growth in renewables as demonstrated here by this interviewee problem, *'Then, we were dealing with an awful lot of people who simply didn't believe in climate change; some in parliament, some in the media and who were pushing an anti-renewable agenda because it would help to advance their arguments against climate change. And so, there was constant pressure' (Interview GU12).* How the UK and Ireland governments reacted to this pressure from communities differs widely and will be discussed in a later section, but the comments from an Ex-CEO of an Irish state incumbent firm, and present leading renewables investor clearly set out the issue, "*I think with all of these things it's all very well having government policy and all the rest of it, if society doesn't want it, you can forget it" (Interview IU13)*

5.3 The Role of the EU

The EU has taken a leading role for energy system change, both before and since the Kyoto Protocol, as explained by this leading global investor, *'In Europe I would say […] that it had a very significant political agenda […] around renewables and I would say […] there was engagement and understanding of the requirements of the capital […], but the EU didn't*

necessarily feel it was its job to shape the programmes that would be implemented at national level' (*Interview FE11*). For its goals to be achieved required multiple areas of the energy system to be built and functioning, a stable political framework, and support systems around financial, technical and administrative capacity and alignment. All these frameworks had to exist for a series of individual energy markets to be reformed. The frameworks, combined with the targets from the EU, both pushed and enabled Ireland and the UK to make a set of policy actions in support of renewable energy assets. As one interviewee, demonstrating his background as the CEO of the government-owned incumbent, stated, *'Those goals changed, I think, once […] the Kyoto Protocol started to kick in. When […] a number of years back we started to see the European Union in particular putting in binding renewable targets. I think that's what really gave the whole industry real momentum '(Interview IR12).*

The EU is an archetypal instance of a powerful institution that exerts coercive power, and studies of transnational policy diffusion countries have found the EU institution to be a significant factor in the adoption of policies across member states (Wurzel et al., 2019). The EC observes and appraises member states' policy actions; non-observance with EU regulations is taken to the European Court of Justice (ECJ), with the prospect of financial fines. This approach came across clearly in the data, as spoke a policy expert from one of the world's leading think tanks, *'[The] EU really […], in my view, dragged the UK into having a renewable energy target and the RO was […] seen to be a mechanism to meet that' (Interview PU21).*

Throughout energy and climate change policies, the enforcement of goals by the EU has created a strong coercive floor. And, even though different member states have been the entities constructing the policies on renewable energy support, the data points to the EU as the dominant actor in the regime. These policies and frameworks, explored in a previous chapter, placed a significant burden of adherence upon member states, with hard targets put in place and penalties for not reaching them. The UK ministers were aware of and focused on the requirements,

> *But the key thing for the UK was that we had signed up to the EU renewables targets. And of overall 15% per cent of UK energy coming from renewables which translated into targets for heat, transport and electricity. And, everything was driven by, could we*

have a plan that could meet those targets? Without those EU targets I don't think the UK would have moved very aggressively on any of it (Interview GU12).

The Irish actors viewed the pressure in the same way, *'The focus […] Ireland as in many things, would very much take the level of ambition and the timelines from Brussels. So, certainly the overarching policy context would be we must meet our European goals' (Interview GR14).*

As has been discussed in Chapter 4, several EU-wide objectives have been set since 1990, requiring, for instance, there to be at least 20 per cent ultimate energy use generated through renewable generation by 2020 (Directive (2009/28/EC)). Rather than directly mandating targets, the EU focuses on incorporating guidance on renewable energy markets into the competition policy as an indirect way of influencing the policy instrument choices of national renewable energy support schemes. Therefore, it is a fair hypothesis that the EU's coercive power to harmonise and advocate renewable energy policy innovations adopted at the nation-state level has been an important driving force for renewable energy policy adaption in each member state. Though, certainly, the Irish outcomes were viewed as substandard, even with that driver, unsurprisingly by the environmental NGOs, *'We consistently fail in meeting our own policy objectives and we fail in meeting EU policy objectives, so it's very difficult to say that I'm happy with Ireland's performance' (Interview LR21).* That coercive power can most easily be seen in the financial penalties that the EU informed its member states that they would suffer if they did not meet targets. The realisation that those penalties would actually be imposed took a while to be fully acknowledged, especially in the Irish context, much to the private sector's frustration, as stated by this interviewee.

So, they recognise the need to take action to deal with, let's call it, the EU targets under wider climate change agenda, but they are very much concerned about the costs of strategy. The Department of Finance, to be fair, are taking a broader view and I would say the Department of Finance are very much thinking about the impact of missing EU targets and have now been convinced that EU have actually imposed penalties on them, and other Departments are generally supportive of the agenda (Interview FE12).

Policy makers in the UK and Ireland soon understood they had little choice but to determine ways to meet the EU targets, and actors in each country reacted differently to that challenge, with Ireland happy to be a follower,

> *We were just having a debate about when they [civil servants] were saying "largely decarbonised" and I was thinking, "and fully eliminated by" – "Oh Minister, do we really need to say eliminated? It may not be that it's entirely eliminated, Minister, it may be that we're on a course, we're all agreed that we're on a transition, we're on a movement down," they gave me all kinds of language, […] they tried to incorporate in the document, to avoid using words like "eliminated. " (Interview GR13).*

The EU Directive (2001/77/EC48) and the Climate and Energy Package (2020) were very detailed on those targets that were set for member states, with 13.2% share of the generator mix coming from renewable energy sources by 2010 and, as has been previously referenced, 20% of ultimate energy use generated through renewable generation by 2020. When these targets are combined with a decrease of GHG emissions by 20% compared to 1990 amounts for each of Ireland and the UK, this led to an estimated requirement to change to around 30% (UK) and 40% (ROI) renewable energy share of total electricity demand (Grubb & Newbery, 2018; Schulte & Lanigan, 2011). It was also clear to actors outside of governments, such as financiers, that the UK was focused on delivering to the energy transition,

> *[…] in the UK, I would say […]the civil service were […] in good faith trying to implement material programmes. And so were very slow and […] the political commitment behind it was more real and understanding was deeper about what was needed. In Europe I would say […] that it had a very significant political agenda […] around renewables and I would say […] there was engagement and understanding of the requirements of the capital and, but the EU didn't necessarily feel it was its job to shape the programmes that would be implemented at national level (Interview FE11).*

This, then, entailed a radical transformation to a different energy system and was understood to be a very challenging task by many within and outside of government; it gave rise to many competing interests and debates about how realistic the targets were. These discussions were observed by government ministers such as this interviewee,

We would have had arguments about – so if you look at Paris and all the other international agreements, you see phrases like "largely decarbonised by 2050", and then in other documentation you'll see, it's in a sort of language, and the word "eliminated" doesn't feature all that often (GR13).

The EU, as per its governing model, imposes obligations on individual member states through targets built upon those states per capita GDP. Directive 2009/28/EC (European Parliament, 2009) called on individual member states to create a National Renewable Energy Action Plan (NREAP) for 2010, which would outline how the targets were to be achieved by 2020. These plans required member states to have 21 per cent of the ultimate energy use generated through renewable generation by 2025. *'So it was really, really clear that we needed to focus all our attention on electricity as a pathway to decarbonise to meet the climate change targets. Over and above that, we have the 2020 European agreement which required us to go down the path of renewables as part of the mix to decarbonise'(Interview GU13).'* The implementation of the Directive was not handed down in a vacuum; rather, the EU put in place multiple mechanisms for the support of its goals. These ranged from EU-backed financial securities and market-based tools to different subsidies accessed through a range of programmes administered by key EU institutions. The Commission also identified the need to involve stakeholders from local and regional authorities, policymakers, regulators, industry, and citizens, in the transition (European Union, 2008) and to provide a platform for feedback. That said, many felt, such as this CEO of a governmental body focused on sustainability, that it was a top-down process with little regard for bottom-up information, *'But ultimately the metric is we have targets to deliver, imposed upon us by Europe, are we on track or not [?]' (Interview GR14).*

The targets that the EU required individual member states to achieve by 2020 point to the EU asking for a significant change in the state's energy system in a short period of time. The fast achievement of targets was the primary goal, which was clearly understood by the private sector, as this CEO of an international bank states,

I suspect the big picture was simply that the UK had signed up to certain targets […], like every other country in the EU and was looking for ways to get there. And I guess

> *when the government looked up the available resource […] offshore wind at that time was a vast resource. There's clearly onshore wind, but for an island with limited available land, like the UK, that was always going to be difficult to get to target (Interview FI12).*

Given that this transition required finance, technological development, physical building of infrastructure and a range of government policies created, individual member states were genuinely concerned about their ability to meet those targets. Whether these measures were solely responsible for what has been a massive growth in the share of renewable energy generation in both the UK and Ireland, as a percentage of the grid, it is clear that the overwhelming bulk of responses from the interview's points to them as a key factor. It is also clear that these measures elicited, in the UK and Ireland, fundamentally different responses.

The EU: Continued Driver of Policy

The EU continues to push forward with target-driven policies around renewable energy and emissions reduction, with strong attention placed on innovation and entrepreneurs from 2014 (Fitch-Roy et al., 2019). The Clean Energy for All Europeans package (2019), broadens the responsibilities and power of the Energy Union to allow the EU to meet its own obligations under the Paris Agreement. A new governance system containing 'national energy and climate plans' is brought into force, with national policymakers faced with multiple negative consequences for failing to meet the targets, a clarity that many member states had not found before.

> *Probably the big point we have been making, is that we said, "Listen, we are far short of our targets. We are not going to meet our targets." Amazingly, in the last two years I have seen government departments, including Climate Change, making the argument that we will meet our targets. Now, everybody accepts we are not going to. The Government has reacted (I am just going to dwell on this for a second) the Government has reacted to that in two ways: Number One, they said, there is nothing to worry about because the EU would never impose fines on us. [Well,] The EU are making it very clear that they are not going to yield, and they will impose fines if we miss our 2020 targets, Number One (Interview FE12).*

This act gave targets for the EU of a 40% reduction in GHG compared to 1990 amounts and a mandatory RE generation percentage of a minimum 32%; all of which, if not met by 2030, would trigger significant penalties for that member state.

The result is that after the member states have created and executed policies that support these targets, they are anticipated to deliver 45 per cent emission reductions by 2030 compared to 1990. A goal lauded by this interviewee, whose role in the Irish civil service oversaw many of the policies,

> *I suppose, first and foremost, it's how that scheme will contribute to Ireland achieving its renewable energy ambitions out to 2030. […] briefly, we are obviously, as part of our membership of the European Union, working towards our contribution towards the Clean Energy Package, specifically the recast Renewable Energy Directive of 2018 and, more specifically still, Ireland's contribution to an overall European-wide binding target of 32 per cent renewables by 2030 (Interview GR21).*

5.4 The Lure of the Market

The transition to a low-carbon economy requires an enormous upfront investment in replacing existing infrastructure,' *When you're talking about offshore wind, where development costs get into the tens, sometimes you know, hundreds of millions '(Interview FI12)*, which, given the manifold market failures in the energy economy, need to be induced by the policy. Access to capital has been regarded as critical to enable the creation of projects, such as renewable energy generation, that need a significant expenditure before returning profits (Brunnschweiler, 2010). The creation and management of policy-induced incentives involve putting in place a framework in which the state allows actors to generate profits above those available without that policy, *'And obviously […], the overall economics to ensure that the financial returns from a project are sufficient to cover the capital expended and a reasonable return on top of that ' (Interview FI12)*. Policy, therefore, needs careful management to the optimum point of bringing investment to bear without allowing excessive profits to be made. *'And industry, I*

think, was very greedy, both solar, particularly solar, and onshore wind and if they had been willing to be less greedy, then they would have had a smoother transition and a bigger role to potentially play' (GU12). Then, the task for policymakers has clearly been to balance the level of incentives to make sure that they do not overly reward those participating in the policy investment. *'The onshore wind sector; again, they were greedy '(Interview GU12).*

When designed at the optimum level, incentives are a strong instrument for pushing fundamental change (Wu et al., 2020). As that new technology moves from a protected niche to the regime, it allows those incentives to be withdrawn, *'So, it was a question of how you then used subsidy to wean people off subsidy and how you created, therefore, a more vibrant, competitive market '(Interview GU12).* Researchers have shown how many EU member states have used policy on the understanding that the state needed to mobilise capital, in turn, for hydrocarbon regimes in the 1950s and 1960s, for atomic power in the 1970s and 1980s, and then, from the 1990s, for renewable energy (Grabas & Nützenadel, 2013). The data also reflects this point, *'And the other thing, I suppose, to remember […] is that electricity and the energy market generally is a hugely capital-intensive industry '(Interview GR21)*. As has been discussed, the private sector can be pulled into investing in renewable energy assets by raising revenues available from renewable energy generation, thereby creating multiple protected niches, through different policy instruments. All of the following have been implemented by various states at one time or another: FiTs, green credits, long-term loans and the support of research into new technologies.

Governments in both the UK and Ireland understand that large sums of capital were and are required for the build-out of renewables infrastructure. They also believe in the need for private institutions to provide that capital. As non-governmental sources of capital are estimated to have USD 200 trillion in assets(Convergence, 2018), the private sector is considered to have a critical role to play.

> *I suppose the issue at the time was […] a sort of a common belief across the developed world, certainly, and even in the World Bank and the developing world, that liberalisation of markets was a good thing. That would have probably spun out of the Thatcher era […] in the UK and the Reagan era in the States, and that whole new sort of liberalisation philosophy, privatisation (Interview GR21).*

The way that institutional investors are organised with their types of capital and their business models has meant that they have become a willing source of capital for renewable energy assets, which fit their investment profile (Mazzucato & Semieniuk, 2018). As a critical stakeholder in society (given their ability to deploy capital into the buildout of critical infrastructure), these investors should also have a long-run interest in protecting society from the crisis of climate change, and it is undoubted that in recent years all financial institutions are pushing integration around their environmental, social and corporate governance (ESG) credentials (Kotsantonis et al., 2016).

The question of how to effectively mobilise 'the market', which is taken to mean developing policy that encourages actors such as private institutions and their financial resources to aid the deployment of renewable energy and complementary infrastructure, is the major focus of policymakers in Ireland and the UK. Here an ex-Irish minister for energy states the position clearly, *'So it's just a matter of creating market structure so that you get the best, lowest price' (Interview GR15).* This has been widely discussed in the academic and governmental spheres (Klessmann et al., 2013; Wüstenhagen & Menichetti, 2012), and states that policymakers have as an orthodoxy that the transition to a low-carbon society depends on the private sector to provide the capital needed to change the energy system (Müller et al., 2011; Popp et al., 2011).

> *And we were talking across the piece, we had a massive amount of discussions with the energy industry themselves, people from the Big Six, people from the independents, new entrants. We had major discussions with investors, because it was actually clear that unless we had serious investment we were going nowhere. And we had to get investors comfortable (Interview GU13).*

The interview data also makes clear that one of the crucial requirements for a successful renewable energy policy is an ongoing path of consistent decrease in costs (both technology cost and cost of capital). The aim is to bring about a position in which renewable energy assets are able to be competitive with hydrocarbon generators, which have benefited from large subsidies (Jäger-Waldau et al., 2011), in the energy market. *'Now, plainly the cost of technology is coming down, so that's independent of government policy or more independent of government policies and now increasingly, we're focusing less on government subsidy and*

more corporate uptake, but that is a separate conversation altogether '(Interview FI12). To lower the cost of capital, policymakers have had to take into account factors that impact institutional investors, as explained by an Irish civil servant in the Department of Energy,

> *So when those policies came in I think there was wind energy in particular […], which was the main […] recipient of […] the support, was a relatively new sector, it was still quite costly and it was felt that given the stage of development it was at, it needed quite significant support from the State or from the consumer. So I suppose the key enabler there was to give a fixed long-term contract to allow project developers to access low-cost financing (Interview GR23).*

Investments in renewable energy deployment by institutional investors are made more challenging by several factors: significant initial capital costs, risks common with the adoption of new technologies, long payback periods and a large regulatory overhead, combined with community reluctance to accept assets in their locality (Haley, 2017; Klessmann et al., 2013; Müller et al., 2011). Researchers have analysed the decision criteria for investors in light of those factors; for instance, Mignon and Bergek (2016) suggest evaluation criteria such as cost, market uncertainty and political risk inform the investment decision. Here illustrated by the CEO of a large investment fund, *'I think also recognising that policymakers in the department realise that, Ireland having coalition governments that come and go, if you're going to set up a scheme to support long-term capital investment or renewable energy, you need to have certain […] key pillars within that support structure, they gave that visibility, gave that certainty to financiers '(Interview FR11).* It is clear that these factors directly impact the attractiveness of a renewable energy opportunity, and that then becomes a key point for institutional investors. Changes in policy, which have been highlighted by Chassot et al. (2014) and the interview data, are a risk that has affected investment decisions. If, for instance, we look at the responses from project developers among the interviewees, one can see regulatory risks and the restructuring of the planning and other critical decision points as important principles when they evaluate their investments, '*So it was important for us to fully understand the nuances of what the department intended, and how much policy makers were behind the scheme' (Interview FR11).*

Szabó and Jäger-Waldau (2008) imply that an increase in the number of actors willing to invest in renewable energy assets will lead to a cheaper cost of capital for those assets, a restating of supply-demand theory. As investors value stable and clear policies combined with non-burdensome processes, the delivery of those policies will lead to a market in which investors are more confidenttherefore lead ing to a larger amount of capital and lower capital cost for renewable energy assets. The critical enabler, though, was policy supporting renewables rather than more general market reforms as acknowledged by this large investor, *'But that was […] renewable policy-driven than more broader market deregulation-driven […] '(Interview FE11)*. This market-friendly environment is clearly seen in the data as having critical importance. It appears that it would lower, in turn, the perceived regulatory risk and then the cost of capital for renewable energy projects while still allowing for a reasonable rate of return. *'Over this period of time the UK government's starting point has always been that competition and markets produce the right results '(Interview PU21).*

Therefore, the deregulation of the energy market was key and, as has been described in an earlier chapter, was an activity embarked upon by both the UK and Ireland.

> *A key part of that was the Electricity Regulation Act 2000, which allowed for the deregulation of the electricity sector and other rules as to how new entrants would behave and was a key piece of legislation at the time, that allowed suppliers to come in and supply as a green energy, [those early entrants] had a distinct advantage in terms of the timing of market opening (Interview IR12).*

Fiscal and financial incentives, alongside deregulation, are therefore viewed by policymakers as proven in accelerating the deployment of renewable energy generation in both the UK and Ireland. In terms of the type of incentives, a number of researchers (Couture & Gagnon, 2010; Del Río & Bleda, 2012; Pyrgou et al., 2016) have focused on the advantage of FiT versus other policy levers. It is clear that countries follow each other's models in determining different policy choices. As we will see later, in reference to the use of auctions, FiT quickly became the accepted policy choice across Europe, as explained by the CEO of a critical state infrastructure company.

> *I don't know how the Irish government landed on the feed-in tariff approach, the extent to which it did extensive due diligence or replication. As I watched government policy, unlike the private sector where one has a major challenge, one tends to look extensively at success or otherwise, in other jurisdictions and unashamedly, if I may say so, leverage the factors of success to other jurisdictions' (Interview IR13).*

Grants and subsidies have also been viewed as important, especially in the early stages of technology development (Olmos et al., 2012), to allow those technologies to become commercial and move from their niches to the regime. Given that investors do not bear the costs of those technologies' commercialisation, it also reduces the cost of the renewable energy assets (Bergek et al., 2015; Klessmann et al., 2013; Olmos et al., 2012). This latter point is also reflected in the data, *'Both in terms of being able to cover the higher, at that time, capital expenditures […] for renewable energy technology which were not so mature and also, […] investors expected a higher return, but also reducing the volatility of the cashflow' (Interview F112).* Whether there are short-term or long-term policies in place is critical to the investors' type and method (Masini & Menichetti, 2013). Del Río et al. (2012) contend that a range of different policies is required to improve renewable energy generation growth. This research shows a policy mix comprising different but interlinked instruments as being critical. However, no scholarly consensus exists, nor is one apparent in the data as to what the optimum policy mix that should be created might be (Foxon & Pearson, 2007) or even on what principles to use (Carley, 2009).

Linking Renewable Energy Investment and Energy Policy

Policymakers, therefore, are focused on creating a set of circumstances that enable a flow of private-sector capital,

> *So […] in Ireland it would have been REFIT 1, which would've come into place really in '07/'08, and that was the […] government support scheme that was very much taking over from the […] AER scheme. And what that involved at the time, […] I would have been in Bank of Ireland, we would have spent a lot of time sitting down with the Department, understanding (Interview FR11).*

It is broadly agreed that renewable electricity policies, such as the ones discussed above, are complex to get right and require significant education and dialogue with the investment community to shape trust and understanding of the likely outcomes of those policies. Many of the interviewees commented on how hard it was to become educated in government policy, their frustration with the education process, and the commitment of the government to the longevity of a particular policy once they had become familiar with it.

> *Understanding what REFiT actually meant, because the legislation wouldn't have been clear on all of the various parameters from a financing perspective, okay? So, all of the banks were trying to get, at that point in time, their heads around this new scheme, […] trying to get their heads around […] renewable energy investment in Ireland. This was over a decade ago, it would've been pretty new. And part of our understanding of those schemes and the robustness of those schemes, we would have then brought that to our credit committee to create a renewable energy credit policy, off the back of that scheme (Interview FR11).*

Different results in policy outcomes are strongly influenced by the different levels of risk which investors determine exist in individual policies (Deshmukh et al., 2012; Van Dijk et al., 2003; Wüstenhagen & Menichetti, 2012). For instance, different mechanisms, a FiT or TGC, could be anticipated to deliver comparable results if the risk is not accounted for in the investment.

The perception of lower risk in a FiT for an investor is viewed as the reason why researchers point to greater growth of increased capacity under that structure versus through TGC mechanisms (Abdmouleh et al., 2015; Bürer & Wüstenhagen, 2009). Reduced risk brings about a decreased finance cost for renewable energy assets and therefore lowers an investor's cost of capital. *'And, of course, it's very hard to predict, like the model, what response the investment community is going to give to a particular set of subsidies' (Interview GU12).* A renewable energy policy that effectively lowers risks for private-sector actors is consequently expected to deliver greater deployment of renewable energy. Financial economists generally agree that risk and return are the fundamental determinants for private investors (Merton, 1973). Therefore, policy instruments affect investors' behaviour by either reducing the risk of a renewable energy project, increasing the return, or both. While the decision metrics of investors are well-known, systemic knowledge about the particular effect of renewable energy policy on investors

remains scarce. What is clear is that higher returns spur greater investment. *'Both in terms of being able to cover the higher, at that time, capital expenditures were for renewable energy technology which were not so mature and also, you know, investors expected a higher return, but also reducing the volatility of the cashflow' (Interview FI12).*

There have been, by historical standards, low-interest rates and lacklustre economic projections across OECD states during the study period. Institutional investors were increasingly looking for 'real' asset classes, '*The private sector - all breed of private sectors' developers saw green as being both an opportunity to make money and as being part of a new paradigm. The private sector more than any others drove the transition in the energy sector to renewables helped enormously' (Interview IR13).* In many cases, these types of asset can provide stable, inflation-linked cash flows with minimal correlations to other asset classes. Both the UK and Ireland are viewed as attractive target areas for investment, offering stable and predictable cash flows and having long-term contract guarantees by the state, frequently with indexed tariffs. Both onshore wind and PV power plant are designed to last for 30 years or more, which suits the extended investment horizons of many investors, who rushed in to provide capital to the energy transition in Ireland and the UK. This interviewee clearly links the driver of the EU, enabling the private sector to push the energy transition.

> *The private sector, more than any others, drove the transition in the energy sector to renewables, helped enormously — and probably the most significant factor […] was the European Directive. The European Union, basically, […] in forcing markets to deregulate, taking the power away from utility monopolies, opened the door for the private sector to be part of the solution in terms of decarbonising the economy. They created a playing pitch in which these people could compete (Interview IR13).*

Financier and industry interviewees clearly believed that the significant cost declines in solar and wind technologies (leading to a significant decline in power prices) was not driven by government policy so much as by capital's ability to flow to projects, the declining cost of renewable energy technologies and improved efficiencies.

[…] So, we've been active in the renewable energy sector for probably 15 years now and clearly the thing that we focus on is mostly the stability of revenues coming off the project. So, feed-in tariffs, CFD and also rock […]. And obviously […], the overall economics to ensure that the financial returns from a project are sufficient to cover the capital expended and a reasonable return on top of that. So, what we've been mainly focused on is exactly that, the level of property and the cash flow is linked for that property, that the government has legislated through the EU and that's obviously gone through an evolution. Now, plainly the cost of technology is coming down, so that's independent of government policy or more independent of government policies and now increasingly, we're focusing less on government subsidy and more corporate uptake, but that is a separate conversation altogether (Interview FI12).

The preceding statement does not account for the fact that capital flows only through the direction of policy and, therefore, that policy had directly influenced the cost of technology which is referred to above. What is clear is that all policy levers were focused on the smooth flow of private-sector capital to the renewable energy sector, and the market was fully empowered by the government to determine the speed of adoption of renewable energy. This is well stated by the regional CEO of one of the world's largest utilities,

So, all these policies now will turn in the direction of facilitating the market mechanisms for renewables, guided a little bit with the renewables themselves. They will be pulled into the market by the market because it's competitive. So, you need quite different approaches from a policy point of view. It could be more relaxed, like setting targets with the Paris Agreement. The CO2 level. You could set targets on renewables in the country or you could facilitate the customers buying green products, green electrons or green molecules (Interview II22).

5.5 The Power of Incumbents

The literature on industrial policy offers particularly valuable insights and gives especially important lessons for analysing powerful incumbents' power in the state–industry interactions (Colli et al., 2014; Johnstone & Newell, 2018) . It discusses at length how powerful entities can influence policy, *'In Ireland you had a civil service that effectively were involved in the ESB. And were only doing the minimum they needed to do to keep […] Brussels off their back' (Interview FE11).* And not just major policy, but government departments, moving them towards outcomes which are to the benefit of those entities (Laffont & Tirole, 1991), *'[…] but people like the major energy users, be it energy-intensive industry representatives who were lobbying […] about the concerns, about the costs on all their members and the desires for exemptions from the subsidy costs for energy intensive players, which of course is passed in recent years' (Interview GU13).*

Government departments in the UK and Ireland have not been set up to challenge powerful interest groups or to make significant changes that challenge the status quo, *'[W]e would say that the Department of Climate Change is actually probably the most conservative department when it comes to policy around this area and that their considerations are as much to do with costs as anything else' (Interview FE12).* Researchers have put forward the strong political and economic influence of lobby groups (representing incumbent industry actors), combined with willing policymakers, as leading to a reduction in renewables deployment (Zhou et al., 2019).

The ability for policymakers to counter an incumbent is directly related to the power that incumbent holds, the context that they operate in vis a vis the state, *'Where, basically, the various levels of state were very biased towards the incumbent entity' (FE11).* For instance, ESB, the Irish state-owned utility, has had a critical position in the development of the Irish State itself and, as such, has been viewed at many times as having a more important voice than the government itself around energy policy. A leading policy researcher here reinforces this point,

> *So, in Ireland, the utilities have a massive overwhelming influence and when I say utilities, I mean as regards the ESB. […] they […] have got so much more intellectual and muscle and capacity and expertise than the Department itself. And this is a key issue for Ireland and a small department. It would be slightly different in the UK because things do have the institutional capacity and the resources even to secure good consultants. The ESB have huge influence in Ireland (Interview PR21).*

Tight collaboration amongst various stakeholders within the private sector and the government (and within government) and energy generators are required to overcome and challenge the power of incumbents such as the ESB (Geels et al., 2016; Heiskanen et al., 2018; Pollitt, 2012). This collaboration needs to account for those groups' vested interests and how those interests create complex political economy dynamics, *'The government came in with […] a reasonably clear idea about what it wanted to do in general terms, but those proposals were refined, shaped, influenced by the feedback received from both the green groups and the energy sector definitely, and wider business interests '(Interview GU13).* Where reforms around incumbents were successful, alliances were developed among different actors, compensation schemes were implemented, and extensive, widespread information campaigns carried out. The fact that the most important alliance was between politicians and civil servants was viewed as critical to the transition, '*I think in the UK there was a clear recognition from the outset and certainly, at more political civil service level. Whereas, if I was making a distinction in Ireland, I think the politicians had really little grasp and the civil service were playing a game' (Interview FE11).*

In both the UK and Ireland, independent agencies with differing responsibilities for energy reporting and some level of execution on renewable energy policies have been created, which influenced the reliability of transformations. Their role in pushing changes to the energy system with the incumbents was problematic, given the government's inability to cope with resistance from those incumbents, a shortage of public knowledge of the extent of financial assistance and failure to create agreement amongst differing stakeholders. Oil and gas companies have been some of the biggest beneficiaries of government support in multiple forms, and that support has often gone against reforms and the stated policy goals around climate change, *'So, there's been very good work but, you could still always feel the presence of the petroleum, the oil and gas people' (Interview GR13).* Policymakers have often justified the support for oil and gas companies on grounds such as equity and competitiveness, but a direct result of subsidies for oil and gas is that consumers are more likely to turn to these options over renewable energy,

further adding to their incumbent advantage. Those firms have worked hard to maintain that advantage has been one that those firms have worked hard to maintain, *'[Y]ou see the likes of Shell, etc., […] kind of making a large noise […] virtuously plying what it's doing, but pretty strong on all the lobbying meeting with ministers, etc. You know, […] causing delay, obfuscation, all those kinds of things' (Interview FI11).*

Challenges for the Utilities

One of the most visible types of incumbents in both the literature and in the interview data are the utilities, who have been operating in a more challenging environment recently that in the majority of their existence, *'In Ireland, it was the ESB as the substantive shared voice and so that would have dominated at that time. I think in the UK, I feel there was more equilibrium. I think that I would have said in Europe, it was more the NGOs had the share of voice' (Interview FE12).* The massive growth in renewables and wide-ranging and significant changes in business models driven by and for that growth has led to an influx of new actors competing in the slow-changing energy utility marketplace. These actors have been developing new value propositions as an alternative to the traditional energy utility approach, which is under pressure not just by the entry of those new actors but also by the fundamentals of renewable energy assets that provide flexible power. That flexible power has led to traditional fossil fuel power plants becoming more prone to loss-making periods as they are likely to be operated under partial load for long periods due to the priority given to renewable energy on the grid.

Overall, then, the rise of renewables presents multiple issues for the utilities. They foresaw these issues and had been acting to protect their positions in both the UK and Ireland, *'In the early days, the utilities, the energy were heavily fighting against it. It's not in their interest so they were not – yeah, there were some exceptions. But in general, they are not very helpful' (Interview II22).* The impact of the energy system's growth through the required expansion of renewable generation energy assets by the incumbent energy utilities across Europe dramatically change existing business models. Wholesale electricity prices across Europe have fallen dramatically in price, which is affecting the revenue streams of leading utilities (European Commission, 2020), with those whose asset base is still majority-conventional suffering the greatest declines (Vannier et al., 2020).

Renewable energy has already achieved a significant share of energy generation in many countries, effectively disrupting the fossil fuel-based market and business models that have long been operating globally. *'I suppose the industrial dynamics and the economic dynamics have changed immeasurably, and of course technologies have changed. […] we now actually have a situation whereby in Southern Europe solar dominates, North Western Europe wind dominates' (Interview IR12).* The implications of this change to the UK and Ireland's energy system are far-reaching, as not only have the fuel sources changed, but ownership models and regulatory structures have also been disrupted to accommodate new actors in the regime.

State energy planning for the encouragement of the growth of RE do not usually deal with the possibly extreme changes necessary of the incumbent utilities if they are to maintain relevance. Nor do they examine the new ownership models and regulatory structures required to allow renewable energy state goals to be meet or what this might mean for the utilities' business model. This strategy gap has further reinforced the utilities' interest in slowing the transition, *'[R]eally, I think that there's a huge sort of dark negative lobbying e-type group as well, ranging from the utilities in terms of wanting to lobby against, in putting submissions in for things that could cause them problems, although they're pretty inept given what's happened to them' (Interview FE11).* Correspondingly, though several utilities have created considered visions around growing renewable energy production, only some offer specific measures for making the revisions to their business model that would allow them to survive, in this new regime. *'The ESB guys, and I've great time for a lot of the individuals, but I do think that there's no sense of urgency there about the transition that's needed, and they're more interested in protecting their own position post the transition than they are […] in doing what's right for the country' (Interview GR21).*

This absence of comprehensive business models from utilities has overlapped with a period of low profits from their traditional activities of sale of units of electricity, gas and heat. Lobbying then becomes focused on protecting the position that utilities formerly occupied, clearly articulated by this ex-Irish minister for energy. *'And here, I mean, […] the ESB are world champions at lobbying in terms of… I mean they're a government in their own right, but they know that they need a good relationship with ministers' (Interview GR15).*

Utilities: Renewable Energy's Biggest Foe

Renewable energy, then, has been a threat to the business model and dominance of the utilities in both the UK and Ireland. Although each state continues to operate a centralised model of energy generation, with major incumbent utilities dominating the energy market in both states, these incumbents are much reduced in terms of power and market share. The UK and Ireland represent an energy transition that causes multilayer disruption, driven by contested areas between incumbents and new market entrants, with a trend of greater decentralisation of generation assets and evolving business models. However, in Ireland policymakers were clearly happy to slow that process down if it meant protecting the ESB, '*The ESB in my view, is an extremely, well it says evidently important body in Ireland. In fact, the ESB, I always feel is a repository of far more, well certainly as much and arguably far more expertise and knowledge about the transition and what's happening and what needs to happen, than every district in the department. And that's a big problem' (Interview GR13)*. The energy sector is somewhat unique in that the transition that the UK and Ireland, and many other states, causes significant wider disturbance. This reinforces the crucial position that the state has to play, given the scope of socially and environmentally sustainable change driven by those changes to the energy system. The state has to work to enable these changes, as described by the regional CEO of one of the largest international utilities,

> *I think the UK, my view is that it was purely about decomplication and […] hitting those targets on renewables and at that time in the UK, whether it was Conservative or New Labour, but what they knew was that you didn't need an industrial policy, you didn't need a renewable policy, you were just left to get on with it and it would solve the problem and it was all about the driving investment with a market that would drive the costs down (Interview IU13).*

While the UK and Ireland are increasingly adopting renewable energy as a percentage of the mix, multiple data points show that this occurs within a context in which utilities remain among the most dominant actors in policy development (Kattirtzi et al., 2021). This dominance aims to continue a system in which utilities manage significant centralised generation,

> *The big one was the utilities and in particular we know the utility I'm talking about, you know. They're owned by the State and they would have had the technical knowhow, the financial knowhow, they've been around for a long time, they know how to go in and*

inform and influence in a positive way towards what they need to do. So, I think that's ESB obviously and then you know, some of the other semi-States would be in the same sort of community. But from my perspective and a private person, that's not private, but my perspective is ESB are the most well organised in terms of that informal influencing. (Interview GR11).

In Ireland and the UK, contrasting characteristics of an energy system in transition are visible, implying that how transitions occur in specific locations vary depending on those contexts and no standard model exists (Bridge & Gailing, 2020). In socio-technical systems, transitions can be thought of as being created through interaction amongst new technologies and changing / different institutions. The changes and development of new clean technologies in IT, energy storage and new forms of generation have led to and required actors to transform business and operating models whilst also resisting changes to their traditional operating models. This can be seen clearly in the change of centralised energy to decentralised generation, with utilities constantly pushing against its growth, *"And by the way, it creates really challenging questions about how energy markets work in the future, how power markets work in the future, if you've got zero marginal costs and trying to get investment in." (*Interview *GU13).* These changes include activities such as agreeing to new grid connections at a cost more applicable to distributed energy and enabling different ownership models, and they have all been viewed with hostility by the incumbent utilities.

Renewable energy technologies are regarded as causing significant changes to the regime because they can spur substantial modifications concurrently to the grid, to operating models and to the role of the regulators. A major structural change is underway, from an energy system based upon a grid with large generation assets and a demand-side containing passive consumers to a system in which generation is increasingly being distributed across the grid, and to new models connecting communities and individuals as intelligent consumers. As the CEO of an Irish governmental renewable's initiative states *'From an ESB perspective, wow they've managed to hold this off, the tsunami. And if you look at some of the European equivalents in the private space they've been literally wiped out. ESB have managed to hold this off for as long as they can and hopefully get their act in order. But that's not positive for Ireland full stop, right. '(Interview GR11).* Incumbent energy system actors are fighting back, as we have seen, by lobbying for policy changes and acquiring companies operating in the energy system,

such as wind power developers, to remove competition. There is also evidence of their engagement in influencing emerging technology developments by constructing and justifying centralised models, '*[…] most development profit was made in offshore wind, arriving out of UK renewable energy policy. Then you look at the participants in offshore wind development and I think all of them, bar a small […] percentage of activity, relating to Centrica and Scottish and Southern'(Interview FI12).* This then shows that though incumbent actor utility companies position themselves as advocates of renewable energy (and are happy to profit from it, as above), they have been working to protect the classic centrally managed business model of energy systems, *'In the early days of policy setting, across Europe, I think the main monopoly suppliers, the large distribution companies would have had an enormous amount of say with respect to […] where each Department of Energy was going to go' (Interview IR12).*

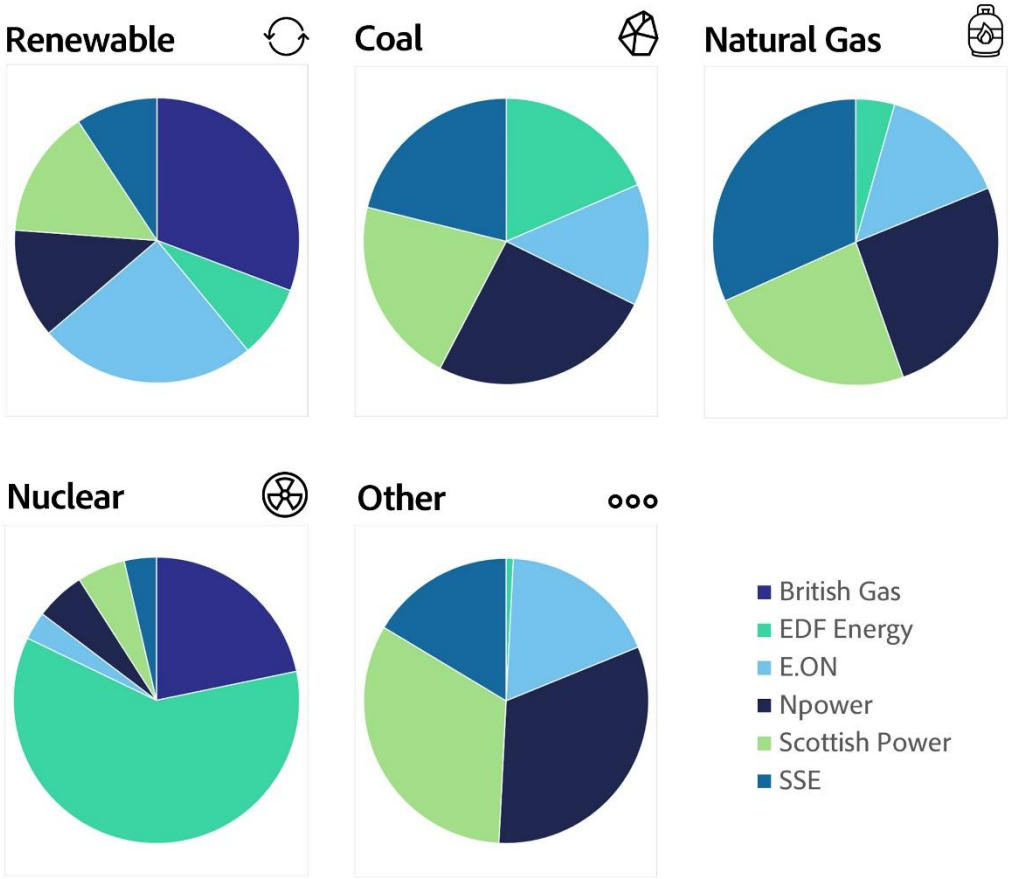


Figure 5.3 Big Six ownership in renewables and non-renewables (data source: ELEXON, 2020)

5.6 Summary

This chapter addressed the research question **What factors influenced the design and implementation of those policies, considering the relationships between institutions, actors, industry structure and decision-making processes?** It is clear from the data that the EU policies mobilised actors in both the UK and Ireland around creating policy that would enable the state to meet targets set by the EU. Attention to those targets from Brussels became the primary focus of policymakers in those countries throughout this period, *'[…] the overarching point was that our entire energy policy had to be directed towards decarbonisation, that that should be a great motivating force for the development of* our *energy policy […]' (Interview GR13).*

What is also clear is that, without those targets, the other factors at play would not have been sufficient to motivate policymakers around new material initiatives in support of renewable energy,

> *I mean, it's absolutely the case, whether this would be an alliance of the energy officials when they go to Merrion Street to try to get the money or permission or whatever else, it's absolutely the case that the only real driver would have been the European goals as set out in the directives. If they didn't exist, nothing would have happened. And that's why, for instance, you see much more progress on things that have definitive targets, such as there was a renewable electricity target back in the day (GR14).*

Once those targets were understood, the UK policymakers approached their achievement as a way to push what they regarded as their leadership in energy policy,' *[…] so the complexity is that the UK really […] it definitely had a superiority complex when it came to European energy policy '(PU21).* On the other hand, the Irish position was to see the targets as a burden, with no goal apart from adherence, *'We really are missing that [overall objectives] at an Irish level, it's like what is our objective? What I see our objective is, is what does Europe tell us to do and how are we going to do it, how are we going to do what they tell us and we don't really do what they tell us '(Interview LR21).* Meanwhile, industry actors had different viewpoints from

government participants on the ambition and organisation required to achieve the new targets. However, it is clear that the EU and, furthermore, the member states looked to the market and the private sector as the enabling function that brought about this transition. '*The European Union, […] in forcing markets to deregulate, taking the power away from utility monopolies, opened the door for the private sector to be part of the solution in terms of decarbonising the economy' (Interview IR13).*

Across Europe, incumbent utilities have been negatively affected by the shifts in the energy system over the period of this research and have had to work to change their business model drastically.

> *So there's who was involved in trying to influence and who was actually influential and I think the Big Six utilities clearly ,[…] probably if you counted up who has the paid employees ,whose job it is to do government relations and policy ,you would see that those companies had the wherewithal to give effect to their lobbying to corporate interests, but also they were joining trade bodies and had their own trade bodies. So they were clearly influential. Then they were also an easy place for government to go to when they were saying, "We've got to get the energy industry on board" (Interview PU21).*

Any disruption in the relative position of an actor (such as a diminished status of the incumbent utilities) is a material change in the socio-technical system and in many cases entails niche developments in technology, business models and types of new actors rising to become embedded in the regime. Therefore, that regime has already undergone a material change in the UK and Ireland, but the data points to a slowing of the rate of change due to the actions of the utilities. The ability of the utilities to slow that change needs to be seen in the context of weak institutional capabilities. In this context, the skill sets, and government experience need to be improved to allow a more level playing field to be reinforced. *'It's probably worth emphasising (because it's […] general relevance to how politics and government works) that when I came into that job, I had no background at all in this field' (Interview GR13).* Market developments, though, have aided the move away from incumbents, with a visible shift in consumer preferences to new market actors. *'It needs to encompass not just the transition for the energy system, the dependencies as well, the infrastructures, the transport system, which*

obviously will need to be decarbonised as well. It will need to enable all of those community engagements …' (Interview GR22). Lastly, incumbent actors who have been operating in the existing dominant socio-technical system have been disturbed by, for instance, the elimination of different subsidy programmes which were in place to support old technologies and the introduction of regulatory frameworks that allow new, potentially disruptive inventions to develop into widespread innovations.

6. The Effects and Costs of Policy

6.1 Introduction

In assessing the effectiveness of how a different renewable energy policy has performed, the majority of the literature, as discussed in an earlier chapter, have employed installed capacity, total investment and the percentage of the grid occupied by renewables as key metrics. A significant number of country-level case studies exist that examine renewable energy technologies in light of different policy instruments and their success, both as per the policy goals (in the main, tracking increased capacity) and in terms of other metrics (such as equity, etc.), as well as the speed of deployment. Metrics, such as those above, are useful in understanding what has happened, but this chapter will discuss two key drivers focused on the why of the low-carbon transformation, which this research highlights, and how the two case study countries differed in approach. How individual countries have addressed the necessary transformation has been materially different; the chair of a solar lobby firm here notes the different speeds at which countries approached the transition,

> *Some countries, they just took it, they accepted it. They took it and they really ran away with it. And some countries were hesitant, and they were saying that without subsidies, it cannot exist. If we fast forward that to 2018, what we have seen in this period, a lot*

of these countries are now, not only convinced, but also there are in the forefront of deployment of solar (Interview LU12).

A review of the literature has shown us a complicated picture of what has worked and what has not. It also shows that the measures adopted vary widely from country to country, as reinforced by this international utilities' executive,

Each country did it on its own way. They all had their ideas, their own hobbies, and also even misperceptions, misconceptions, whatever. But in any case, it was the early start. And it's normal with the early phase. Yeah, you simply start doing something and it may not be the most effective and most ideal and may be even very expensive. But in any case, you start doing something (Interview II22).

This chapter addresses the third research question.

Research Question 3:

What are the main determinations which have defined policy effectiveness?

In this study, one can see two important themes around policy effectiveness from the interview data that are mirrored in the literature. These are shown in Figure 6.1.

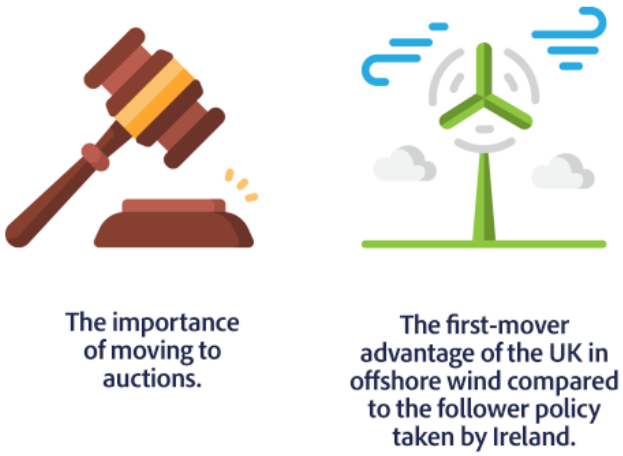


Figure 6.1 Policy effectiveness themes

The following sections discuss these two themes.

6.2 The Coming Dominance of Auctions

Renewable energy auctions are increasingly becoming the standard that renewable energy policy adopts, owing to their ability to reveal competitive prices and a perceived ability to bring about a lower cost of installed capacity if adequately designed (Del Río & Linares, 2014; Winkler et al., 2018). The concept of auctions has been widespread across multiple public policies, from the distribution of rights to hydrocarbon reserves to frequency bands. Policy advisors from think tanks, such as this interviewee, identified their value, *'I think that [flexibility] was a primary motivation and the introduction of auction schemes was fitted sufficiently with a market approach' (Interview PU21).* Auctions as a key mechanism for renewable energy framework is a very different construct than support mechanisms, such as FiT or tradable quotas. There is also a considerable variation in how these auctions for renewable energy assets have been implemented in different countries. This flexibility in design has allowed the assessment of pricing in the winning bids and the inclusion of other important factors. Flexibility has been cited in the data as a reason for the growth in auction use, as the can be held in response to particular policy drivers or events. Here an ex-UK minister for energy talks about how macro events affected the security of supply and cost, driving the use of auctions as a means of achieving cheaper power through renewables. *'Then when the Russia–Ukraine dispute happened and it all became about security of supply. That was the first Russia–Ukraine dispute, 2007. And then Ed Miliband promised a price freeze and then it suddenly […] all moved on to how do you keep it affordable? So, it is always adapting to what are the political pressures at the time' (Interview GU12).*

In 2005, six countries employed types of auctions to generate and grow their renewable energy capacity; by 2018, this number had risen to 55 (IRENA, 2019). It is clear from this research and from the literature that more and more countries have been following this lead, influenced by others' positive experiences of using auctions. Large pools of capital, such as that which this interviewee was head of in the UK, also recognised the value of auctions, *'Fifteen years' support mechanisms, but over the next ten or 15 years and, of course, because it's moved to an auction process. So the UK saw lots of good progress in other countries from Brazil to […] you name it, [with] the auction process' (Interview FU12).*

There exist significant research and data on how auctions have performed and should be designed (Gephart et al., 2017; Winkler et al., 2018), and this gives policymakers working today a strong background of materials with which to steer their choices (IRENA, 2017b). The 1990s saw poor levels of capacity increase through the use of renewable energy auctions in several countries, results frequently ascribed to insufficient fines for participators placing their offer at too low a level and therefore being uneconomical. These early outcomes were not recognised by many in the interview group, with a focus on auctions not being used early enough, as per the ex-CEO of an Irish government-owned incumbent and present large investor in solar *'I think if we could go back to the beginning, I would have jumped straight to some kind of auction system. '(Interview IU13)*. This changed during the first decade of this century, and now the use of auctions is clearly one of the most important renewable policy mechanisms in use by policymakers. As another ex-minister for energy states below, commenting on the UK ROCs systems and how to integrate auctions, given that the use of auction would allow much better cost efficiency by the government than ROCs.

> *And although you could auction ROCs, that's not the way the system had run. Moreover, if you were moving to auctions, you want to look at the instrument. And the problem with ROCs it was price plus top-up ..And given these were long-term contracts ,you wanted to know that if the price in a market was high ,,that they wouldn't just be having super profits, and they would have to pay money back (Interview GU13).*

By 2014 the Commission had stated a preference for member states to use auctions rather than other processes for allocation of contracts to renewable generation (EC, 2014), that preference filtered down to national policymakers such as this Irish official,

> *And basically, that [use of auctions] will mark a very significant shift in […] how we stimulate renewable electricity development, for want of a better phrase, and specifically renewable generation, because it moves from a guaranteed feed-in tariff to a competitive auction-based scheme and support. So, […] in terms of policy, currently what I'm in charge of and what I'm hopefully delivering, it's forward looking rather than […] whatever we might have delivered in the past … (Interview GR23).*

Many researchers have put forward the idea that the renewable energy auction forms part of an obvious progression in how renewable energy policy should develop over time and that the best value for the state and consumers will be found through the use of auctions; policymakers have enthusiastically taken up this idea. *'We were driven by need to have low carbon, but we needed to do it in a way that was affordable to consumers. So, we simply go pursuing ambitious projects which, ultimately, were going to lock us in and we wouldn't get that better cost-benefit at the end of it' (Interview GU12).* Auctions were generally considered inferior to FiT, either in delivering an increase in renewables energy capacity or in their cost-effectiveness. However, it became the prevailing view that to achieve the scale of deployment required by public policy goals, auctions were the route to pursue, *'When you're looking at massive deployment, you needed to have a more competitive system, and so you needed auctions' (Interview GU13).* Auctions allowed governments to contract for significant amounts of renewable energy at the lowest possible price while giving the ablest firms the knowledge or incentive that they would be competitive in a level field.

Renewable electricity auctions are likely to be characterised by two primary elements. The auction itself is closed to bidders whom the state does not believe can complete the development. This differs from other support instruments such as FiT or TGC, in which all investors are able to participate. The value of the contracts given to winning participants varies as per their bid, unlike contracts under a FiT, where the value of the contract is the same of all who operate under the mechanism, or with TGC, given the value of the credit is shaped by market forces through the period of the operation of the asset. These support mechanisms have been, up to recently, a cost to the public regardless of how the mechanism worked.

> *It's in effect a tax, it's a tax on consumers, because everybody is connected to the grid, pretty much. […] So, they set that and, of course, the amount that you can do is a combination of two things: what's the bid price and what's the real price. So in the power market, because as the real price goes up and the bid price comes down, you can issue lots and lots of contracts because the support mechanism is much, much smaller, there's less of a gap (Interview FU12).*

Thus, a renewable energy auction allocates, instead of simply supporting the sector through an instrument, a role that can improve policy makers' ability to control the capacity of new renewable energy assets whilst utilising competitive pressure to offer their true costs.

> *Of course, what we've seen is power prices have continued to fall, meaning that they can't issue too many. But […] what has also happened through the auction process, is the safety strike price has fallen dramatically. And so they run an auction roughly every year to 18 months and the lowest price wins. So, we have seen it work, I think it's a successful policy (Interview FU12).*

The most frequent offers are a flat per unit value for energy generated, which are the same as those given through a FiT or other support instruments.

Ireland and the UK have both followed the EU preference for auctions, but at very different paces, with Irish financiers expressing their frustration with the pace of Irish policy developments, *'The only driver seems to be that the EU are telling us to do this stuff and then the counterbalance of that is politicians basically trying to keep their constituents happy' (Interview FR12).* Each country, though, has increasingly moved to an auction process as the most important tool to encourage renewable energy growth. This has been motivated by various factors, such as the opportunity to better plan the capacity of new renewable energy assets, to control better the costs associated with the support instruments, a lessening of the information asymmetry and increased competition among participants. This last point has been the focus for policymakers in their hunt for lower costs, *'We were driven, undoubtedly, by a desire that we should be having a more sustainable energy policy. We were doing it a at a time when people were seeing quite a lot of cost falls in bills and so in the initial period, people were not so worried about bills. But as prices went up, particularly gas prices, […] people did become more focused' (Interview GU12).*

Renewable energy auctions generally concentrate on established and cost-competitive renewable energy technologies. This overwhelmingly means onshore and offshore wind and solar PV, as is the UK and Ireland case. The total volume of 4GW of new-build assets was allocated through auctions in 2019 in both states, all of which was solar and wind power

(EirGrid and SONI, 2019; IRENA, 2019). When we examine pricing during the period 2010–2015, we can see that there was a significant decline in the cost of manufacturing of wind turbines and to a greater extent that of solar PV panels, this supported the marked decline in prices in the auction results. The research data also highlights this efficiency of auctions, brought in in the later years, becoming a factor, '*And price is always really important. That was why we knew, to hit our targets and the climate change targets and the EU target, that we had to get cost down from where it was. We had to dramatically reduce cost. And the choice of instruments was designed to try to do that*' (*Interview GU13).*

Price results for the solar and wind auctions, then, have seen a remarkable decrease in the value of the winning bids to the end of this study period and beyond (IRENA, 2019), *'And you've got to remember, this was at a time before offshore wind […] and solar costs were really plummeting' (Interview GU13).* Those same cost reductions also spurred policymakers in other countries to look at auctions as a means to capture some of that reduction, as well as giving individual countries the ability to assess several contextual variables (which need to be accounted for to achieve successful outcomes) which determine the effectiveness of auctions (Matthäus, 2020; Winkler et al., 2018). These include renewable energy resource strengths, the existing energy market make-up, goals and existing policies, and the various costs of finance, land and labour. As a renewables investor and former CEO of an Irish government-owned incumbent, in both roles a large buyer of wind turbines and solar PV panels, talks to how he was looking for the auctions to reveal the real costs of the manufacturer's product,

In fact, we welcomed it because we knew it would drive the costs down and reveal it's true costs. of players like Siemens and the manufacturers and we didn't know this for a fact, but we believed they were pricing for the market, when we needed some kind of mechanism which would force the true costs to be revealed and the auction process was that (Interview IU13).

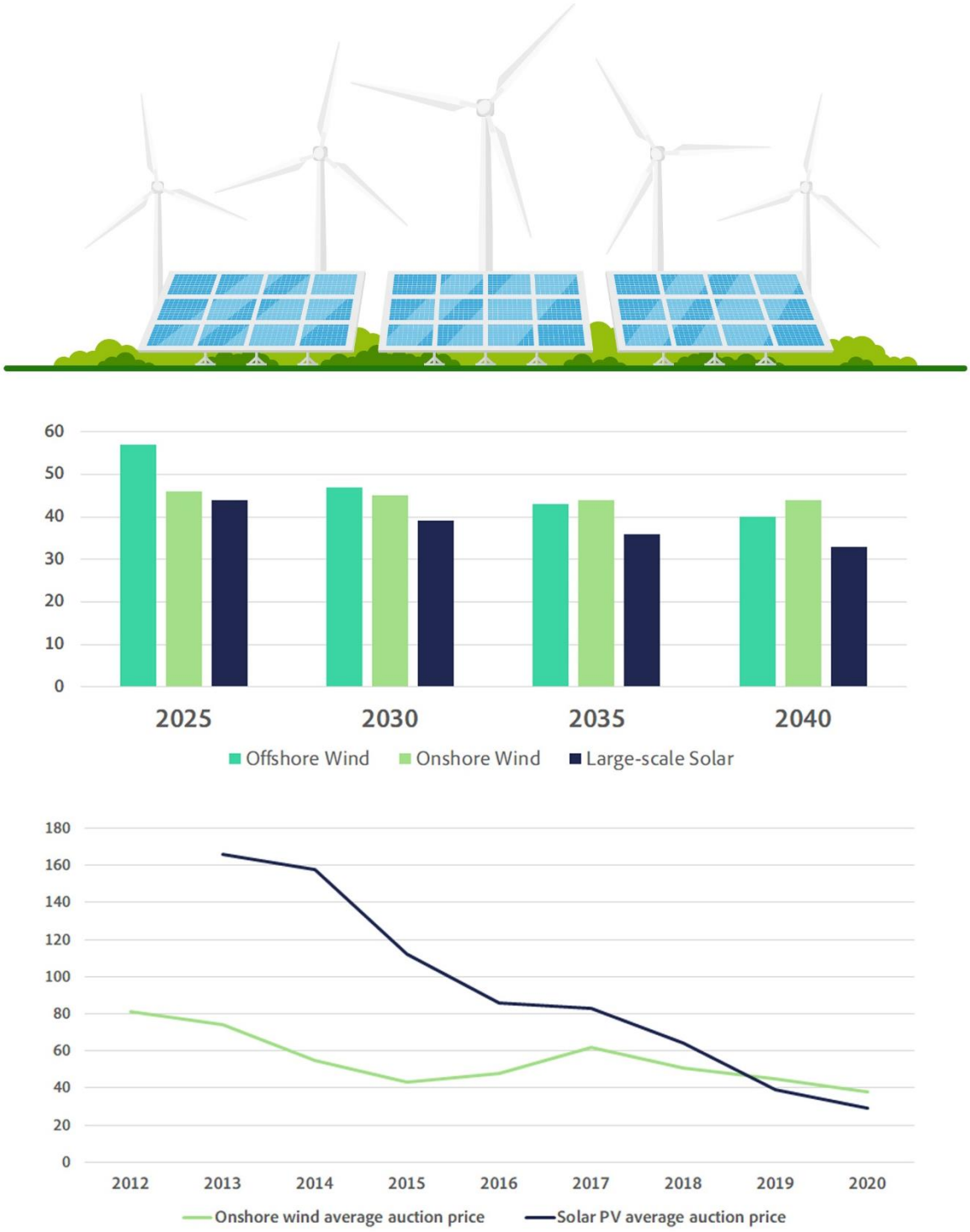


Figure 6.2 Auction prices over time for global solar PV and onshore wind (data source: IEA, 2019)

An auction creates numerous additional market variables for policymakers to deal with: ensuring that enough competition exists to allow for best pricing to be , making sure that actors do not collude in that market process and guard against other distortion. The reliance on the market though to provide solutions, coupled with state intervention, is clear from the data, here put forward by a senior Irish civil servant, *'So it's just a matter of creating market structure so that you get the best, lowest price. But to manage it, and manage everything, it does require state intervention'(Interview GR21).* The particular methods of state intervention to manage complex market interactions are very dependent on the context of that market, and therefore those interventions might not automatically be appropriate for other contexts. Also, particular changes to an auction process could alleviate several problems but affect other aspects of the system, e.g., qualification regulations and fines can boost realisation levels and create more risk, and therefore the cost participants. Alongside these issues, policymakers are frequently concerned with additional policy objectives,

> *[David] Cameron personally moved away from that aspect. He became quite strongly against onshore wind. I had a discussion with him where I felt that we needed to separate the economics and the politics and so the subsidy level should always be related to the economics. But you set a political goal and you say, okay, this is how much we want and when we have reached that we stop. So that investors understand how much the total scope was going to be (Interview GU12).*

Realising a way to support various different policy objectives without conceding on correct price creation has been challenging.

With the maturity of the renewable energy market and the entry of new actors, many of whom brought new skill sets and experience to the regime, auctions have become progressively more complex to better deliver on the policy goals. At the same time, they must continue to fit into the policy makers' view of the need to take market approaches, *'[I] think that was a primary motivation, and the introduction of auction schemes was fitted sufficiently with a market approach' (Interview PU21).* They have delivered a significant cost reduction and have been enthusiastically taken up by the market, even while reducing their profits, but have also led to a consolidation in actors participating driven by the increased complexity of the auctions. Multiple interviewees, from different perspectives, point to a theme that auctions are the right

policy to enact and that both Ireland and the UK were late in utilising auctions, with Ireland being the worst offender. Here, an interviewee directly commenting on auctions says,

> *Yes, I think it worked […] I think it could be done quicker, I think there should be more auction processes, they should be more frequent because when you come from a world where you can see offshore wind drop by 50% per cent in two years, then that's too much of a gap. You should be running smaller auctions more frequently and following that curve down (Interview FU12).*

The potential to achieve low prices meant that the effect of a delay in the use of auctions was an increase in the cost to the state of contracting for new renewable energy capacity. This cost to the state is firmly centred in the thinking of state officials; here the CEO of a state-owned incumbent illustrated that point,

> *Politicians and governments always worry about what the price of the delivered product is going to be. So therefore, […] in the event that you had a high penetration of wind and that price was going to be high, then get a price that basically was going to drive electricity prices upwards. That really was about […] what's the cost of the overall subsidy to the renewable market? Because politics, […] looking at this from a governmental point of view, is all about that [Cost reduction.]… So, I think any time I interacted with the government they were always wondering what the level of public service obligation is going to be this year (Interview IR12).*

Renewable energy auctions are de facto the set mechanism by which Ireland and the UK now contract new renewable generation capacity, and any delay is a significant opportunity loss and real cost for policymakers.

> *A lot of it is post facto rationalisation. Basically, I was convinced that it could only be a good thing if you had a private sector-minded, government-owned entity that's supported with commercially feasible projects, but that needed help to get over the line. Or, where the drawback to raising capital was because there was policy uncertainty (Interview GU13).*

6.3 Market Leader and Market Follower

A Tale of Two Winds

Industrial policy is a phrase that, for many, belongs to an earlier period (Pack & Saggi, 2006). The term describes how governments have played a 'top-down' role with a goal of improving existing or embryonic sectors' position, which the states believe to be significant, with a series of multiyear policies. This has, in the past, taking the form of different financial loans or grants, export financing, and tactically focused support in skills and training (Klimenko, 2004). Policymakers have reviewed ideas on industrial policies again whilst looking at the energy transitions that Ireland and the UK are engaged in and have pointed to the value of having clean technology-based industrial policies to help the sector.

Governments should be motivated to implement an energy policy that maximises the economic benefits of the transition to a low-carbon economy whilst pushing forward with that transition itself. A critical mechanism in the energy transition, as has been discussed in earlier chapters, that also could benefit a state economically, is the creation of a protected niche. These niches can be set up to protect new business models or technologies that might have widespread applicability once accepted at scale in the regime but require protection to get to that scale. States do have the ability to create a competitive position in a regime through supporting niches, through creating the pathway that allows those niches to reach a scale that allows them to be applicable to the regime. The policymakers and industry executives interviewed understood that new technologies required time and protection to bring the cost of that technology down a cost curve, requiring a partnership between government and the market. Here the head of a major solar lobbying firm states, *'What I really liked about the industry-government partnership, I call it, was the cost reduction was […] a time plan agreed between the industry and the government, although there was a couple of hiccups along the way' (LU12).*

A government can be involved in the development of new markets, in the regime, by stimulating firms to invest in emergent technologies, business models and deployments. This can be clearly seen in action in multiple countries in our transition to a low-carbon economy. Japan and the U.S., alongside several countries, invested in solar PV generation capacity since the 1980s, but by the early 2000s Germany was clearly the most important market for solar PV through its use of aggressively priced FiT policies. Subsequently, China, somewhat in reaction to the market opportunity presented by Germany, invested at scale in PV manufacturing and brought solar PV to a cost-competitive position. This series of clean technology policies have included a multi-year plan on supporting new economic activities in related manufacturing and services, in which the state performs a vital role in directing initiatives that can deliver significant benefit to the economy and society. Both the UK and Ireland have significant wind resource at a cost level that makes it very attractive for exploitation that drives benefits across both economies. One of the largest investors in offshore wind in the UK makes clear that his firm was encouraged to focus on wind, and offshore wind in particular,*'Over the years, I think it's been a sort of positive experience ultimately in terms of where policies end up. But no policy is perfect and there's winners and losers and there's always basis on which you can criticise policy. But generally, I think it's been well structured, well consulted on. And sort of bringing that through has generally done a good job'. (IU123).*Thus, a series of policies aimed and supporting industrial development for different parts of the renewable energy value chain could be important in delivering value to local communities and the overall economy, alongside the consequences of the energy transition.

The UK: Market Leader

The UK has wished to be an industry innovator in offshore wind for many years (Wieczorek et al., 2013), and that interest in doing so was, to some extent, enabled by the pressures that the state received from the community in deploying onshore wind capacity during the 2000s. *'They were sort of represented among the donors of the Conservative Party who were dead against it and Cameron was ultimately […] captured by that approach. So, the willingness to accept on-shore wind, in particular, changed' (GU12).* The UK is now clearly the leading country in its deployment and likely to remain so for some years to come (BEIS, 2019). This is an area of much rejoicing for UK policymakers, '*But for offshore wind, Britain is the world leader by a long way, and Britain produced the policy and our policy led that. So, I do take some pleasure and pride in the fact that the measures we put in place, the instruments we chose and the policy*

options we designed, have done what we said they'd do, but have actually done it better' (Interview GU13).

The development of offshore wind in the UK started with an allocation of 12 offshore sites, which were placed into the market in 2000, with over 1000 MW of capacity, the success of which led to offshore wind being seen as a promising source of technology in our transition to a low-carbon society (Higgins & Foley, 2014). Round 2 started in 2003 with 17 offshore wind assets, containing 7GW of capacity. By the time of the third round in 2009, this increased to 36 GW of capacity. There was, therefore, a rapid deployment of offshore wind that swiftly positioned the UK in a leadership role in terms of deployment and ambition. Given changes in government in the UK and multiple ongoing debates upon the correct policy framework, there was not another round until 2019, with another 7 GW of capacity.

Given the magnitude of recent cost reductions, *'Offshore wind is cheaper, therefore growing faster than we would have expected' (Interview GU12),* and as the likelihood of a subsidy-free sector approaches, the UK looks set for a renewed stage of development.

> *And I would argue that in the case of offshore wind in particular, but you could […] say all renewables, the costs have come down fast and quicker than even I thought, and I was on the optimistic side. It's been […] I would argue, […] a staggering success for renewables. Now, I'm not saying simply costs, because, of course, you've got other drivers as well (Interview GU13).*

The expansion of the offshore wind sector can be described as a market-enabled construct driven by government policy, with the swift enlargement of the sector since 2000 encouraged a succession of programs to encourage manufacturing and engineering base-servicing wind developments as well as the build-out itself.

> *So, we didn't lead onshore wind and, ultimately, we obviously moved significantly […] away from it. But we did lead on offshore wind, and because there was a government strategy, because we had the willingness to accept a higher price to begin with, without which we would not have been able to do the work to drive down the cost, we set up the offshore wind cost-reduction task force, we moved to an auctioning process. All of those*

helped to move it to a position where it is unbelievable, the reductions in the cost of offshore wind (Interview GU12).

The UK developed multiple protected niches with firms in operations and maintenance (O&M) and across the deployment chain, successfully leading to developments in manufacturing. Examples include the Siemens investment in Hull, *'Siemens lobbied hard and the government pushed them very hard to establish the factory up in the North East, which got put in on the back of a CFD regime, to support offshore wind' (Interview FU12)* and the decision by Vestas to adapt its previous Isle of Wight blade facility from onshore to offshore manufacturing. The protection and development of these niches, through grants, tax benefits, and R&D support, combined with significant capital investment, were successful in that they led to a massive reduction in the cost of offshore wind. This cost reduction allowed the technologies to grow from a niche into the regime; offshore wind has now become the dominant component of the UK renewable energy mix. *'So, I suspect it was simply how are we going to get there and what's the fastest and most available renewable resource that the union had access to, and plainly, […] around the UK, wind, offshore wind was the one to go for' (Interview FI12).*

Offshore wind power has thus emerged as an important renewable technology with its own policy considerations in the UK, one whose growth has been driven through a series of policy actions. That growth was viewed as an important position for the UK to deliver on, what with its standing in the international community, as well as possible economic benefits. As a head of the UK energy regulator puts forward, '*What the UK does on a global scale doesn't matter other than as a signal to other countries that this can be done, and also for an economic reason that you want to be […] this is the change we want to make, do you want to be ahead of it or do you want to be maximising the capacity for your economy to adapt?' (Interview GU14).* It should be acknowledged that this growth originally arose, to some extent, from the UK's decision not to deliver upon renewables targets through the development of onshore wind.

Ireland as a Slow Adaptor

An examination of the data in relation to the Irish case shows a much different picture. Though it also begins with significant community pressure against onshore wind, this context is one of slow progress to develop what many interviewees describe as a critical part of the energy mix. Unsurprisingly, the regional CEO of a major wind turbine manufacturer complains about lobbying against the wind industry,

> *The anti-wind establishment has probably been the key protagonist in making sure that the landscape is left unspoiled, so to speak, and therefore, unwilling to accept any changes to the environment. So, it is a strange one in that we have got more intensive farming techniques coming through that […] are increasing your CO2 emissions and then you try putting something that might offset that, or anti-carbons or electricity supply, and it is not accepted, because it doesn't suit the anti-wind sites to have it there. I am a bit perplexed on that one, but they did seem to have an undue influence (Interview IR21).*

Interviewees, especially private-sector actors such as the interviewee below, expressed a high degree of frustration with regulatory and policy initiatives focused on pending initiatives rather than regulatory or policy measures currently in place. *'And so it was […] always frustrating and to this day, which is almost 20 years later, […] there's no effective policies for offshore wind or solar in Ireland' (Interview FE11).*

This slow pace of development and the absence of an effective regulatory regime through inefficient policy support and legislative architecture was criticised for not providing the industry with mechanisms to develop. '*There was [a] little bit of excitement and momentum but, and lots of things were encouraged like offshore wind […], they came up with a life cycle in Ireland but really it was all talk' (Interview FE11).* Interviewees also commented on the lost opportunity for Ireland in terms of learning from other jurisdictions' regulatory and policy advances, '*...where other European policymakers took that long-term view, and Ireland took somewhat of a reactionary view' (Interview FR11),* so speaks an ex-senior executive of Ireland's sovereign fund. Furthermore, opportunities to benefit from increased cost reductions across the sector had been missed.

In terms of how the government viewed the potential for offshore wind, comments were also negative, '*At a very early stage the Department was communicating to us that they didn't see value in supporting offshore wind, even though in something like the Arklow Bank, Ireland was actually a leader at the time in offshore wind'* (*Interview FR11*). Interviewees, even in this case an ex-minister for energy for Ireland, pointed to a low level of confidence in the realisation of offshore wind development in Ireland, given the experience with onshore wind, *'Plus, and it has to be said, we didn't always get it right in terms of onshore wind'* (*Interview GR15*). It was also pointed out that this seemed a deliberate decision by the state to not develop the offshore wind industry, possibly due to the existing low cost of onshore wind in Ireland, *'At one point, offshore wind looked like it could be supported alongside onshore wind, and then for […] a couple of different reasons, offshore wind was dropped by policymakers, I think probably because the levelised cost argument […]' (Interview FR11).* This would have been compounded by the economic circumstances in which Ireland found itself post-2009, '*I think the recession in the country basically completely pulverised any form of policy thinking […] and […] we've lost that half-decade. Between '08 and '13' (Interview FR12).*

The interest in developing offshore wind in Ireland has, since 2015, become much more pronounced, in part driven by the clear success that the UK has achieved with the development of the sector. In addition, lobby groups that have traditionally been focused on the battle for onshore wind have turned their attention to offshore,

> *Then, now, The Ireland Association, which is The Offshore Wind Association, which has had long periods of inactivity, but certainly in the last two years has been very active again in pushing the offshore wind agenda. And, I think, very successfully, because there was a huge concern that we would never do offshore wind (Interview FE12).*

It is only in 2020 that an agreement was reached for the state to allow the commencement of offshore wind farms (Cummins & McKeogh, 2020) .

6.4 Summary

The examples in this chapter show the significance of government support for new innovations, allowing them to compete with proven technologies and business models. This requires countries to transform their own energy systems through different schemes supporting specific technologies or business models. This discussion, around what pathway of business models and of what political will needed to bring about that transformation, then underpins the answer to the following research question, **What are the main determinations which have defined policy effectiveness?** As a sector, UK offshore wind has brought about some remarkable cost reductions, achieved from 2008 to the present. The learnings gained should allow countries such as Ireland, who have been followers in this sector, to make the process of transition easier, but the political will needs to exist to develop this sector, even as a swift follower. The cost of not being a leader can be seen though in Irelands failure to meet the EU targets and in a lack of expertise in a critical part of the energy system.

Given the revived attention on policies to support industry (Bailey et al., 2015), the UK case study highlights the need to support developing niches, requiring academic research combined with industrial partners, and economic support for the establishment of the key compounds of renewable energy technology. Examined on the basis of spatial policies, the UK example shows how local decentralisation and manufacturing, or utility partnerships encourage research and innovation. In this situation, a variety of actors develop an interest in new technologies and new business models, such as solar + storage or offshore wind, most ably demonstrated in the example of Siemens and Hull. The analysis also highlights the importance of creating a stable and coordinated series of activities (for instance, rounds of auctions) to allow growing and innovative businesses. This is especially important for those businesses that are established upon large infrastructure assets, which have to put in place extensive timeframes. As change dynamics are often mutually reinforcing, the implementation of renewable energy policies necessitates a degree of community approval.

In Ireland, the ‘reactionary view’ and the ‘anti-offshore wind establishment’ from the interview data are clearly regime-level blocks on niche developments. This should be seen in contrast with the supportive UK situation and reflects on how the UK looked for the advantages to be gained from the growth of RE rather than the Irish context of RE being a problem to be solved. These differences which this research argues is driven by the relative power of the utilities in Ireland versus their counterparts in the UK. The establishment of a series of market-based incentive schemes, such as auctions in the UK, is a good example of the need for renewable energy policy to be stable and consistent whilst creating a mechanism that allows for the best outcomes for the public. Without those characteristics, investors will be unable to navigate the system to allow them to deploy capital correctly, at a clearing price which does not disadvantage the public (through overly rewarding the investors) whilst generating an acceptable return. The two interlinked characteristics of a level of policy certainty combined with a long-term horizon are critical. Investors require reassurance before they will put capital at risk in new technologies or new business models. Taking the regime actors' perspective, there has been a high potential for incumbent energy firms (such as the utilities) to expand their participation in renewable energy assets after those technologies and business models had been protected in the niche level. These firms have a significant amount of experience from their longevity in the energy system, as well as the funds, projects and human capital that are applicable to the nature of large-scale renewable energy projects (which is where the market has become established).

In the UK, there are two differing examples of solar and offshore wind. The solar industry, after significant growth, went into near collapse after sudden changes in the policy framework. From 2019, with the continued reduction in manufacturing cost, it has recovered, even in the absence of policy support. On the other hand, offshore wind has benefited from long-term policy certainty, which has continued to support the sub-sector's significant growth (offshore wind in the UK has become the most cost-efficient renewable energy technology). Policy certainty has also created opportunities for the industrial companies that are manufacturing renewable energy technologies (though in the main not UK-headquartered firms), for large developers to have additional partnerships and initiatives with energy companies and for significant expertise in the financing of these assets to be created. This situation should lead, one would hope, to further innovation. In Ireland, the effect of a lack of support from policymakers for either solar or offshore wind policy initiatives (up to very recently) has led to the total absence of the offshore wind or solar industry as percentages of the energy system.

In conclusion, this chapter discussed the various aspects that highlight the significance, in our transition to a low-carbon society, that renewable energy policy holds. That transition requires creativity and actors to create and protect innovations through niches, and, critically, for those innovations to be not only technologies, but also business models.

7. Who Wins in the Energy Transition?

7.1 Introduction

In previous chapters, the consequences of various factors, which were described and explained by different actors, were analysed in terms of renewable energy policy development in Ireland and the UK. The resulting insights were then used to analyse those factors' effects on the progression within the three levels of transition processes as defined by the MLP (niche, regime and landscape). Additionally, this research analysed each level's relationship to another to facilitate our understanding of the difficulties and benefits in designing and implementing renewable energy policies. Together, this work highlights the actors' perspectives on how and why certain renewable energy policy was created and what the effect of it was. Building on this work, this chapter concentrates on how key groups have fared and who has 'won' in the

transition to a sustainable energy system. These empirical findings, therefore, address Research Question 4.

Research Question 4:

Which groups benefited most from the implementation of policy instruments?

This chapter aims to answer this question through an analysis of how different actors have fared from different renewable energy policies in the UK, Ireland and the EU. The research framework, derived from the MLP and which has been explained in previous chapters, has been used to illustrate the socio-technical nature of the renewable energy system. How actors in the regime are affected by both landscape and niche developments is a key part of this research. The aim then must include exploring the role of renewable energy policy development in socio-technical transitions to be further able to understand the interactions between social actors as they exist in certain contexts. Various actors, such as utilities, NGOs and developers, are discussed and evaluated in terms of how they fared, both in the UK and Ireland and by comparison with each other.

7.2 Renewable Energy as a Catalyst of Change

As discussed in Chapters 1 and 4, renewable energy has expanded rapidly as a percentage of individual countries' grids. This change is transforming the technical, economic and political dimensions of multiple markets. As in all major socio-technical transformations, this process creates both winners and losers, clearly put by this ex-minister for energy in Ireland '*There is not going to be a successful transition that isn't going to cost somebody, somewhere, in some way, in some sector' (Interview GR13)*. The energy socio-technical transition entails changing how different socio-technical systems work (Cherp et al., 2018). Such reconfiguration involves negotiation amongst various actors in the regime and involves various designs and pathways, as protected niches become established in the regime (A. Smith & Raven, 2012). Interviewees spoke about how policy that aims to change pathways involves multiple stakeholders and how

the influence of external parties on government is felt closely whilst developing different iterations of policy, *'The policy has to be made by the government be made by the minister […]. Now the fact that the policy coincides with the interests of certain, some, perhaps even many private-sector players, is not of itself a problem […*]' (*Interview GR13).* The reconfiguration also involves different phases, community debate and high levels of co-development, complication and ambiguity (Bolton & Foxon, 2015; Moss et al., 2015).

A locality's level of renewable resource clearly affects the prospect of being able to generate energy nationally, which then profoundly changes power relationships in the regime (Lockwood et al., 2019). Relations are altered between producer and consumer countries, between industrial players and government, and between individuals and their energy supplier. All of this creates significant contested spaces (Bridge & Gailing, 2020), described here by a UK ex-minister for energy, '*There was quite hard, painful consolidation that took place in the industry' (Interview GU13)*. This shift is further characterised by a combination of resource scarcity and geographical concentration. When every country has the ability to utilise their available renewable resources to generate energy domestically, and countries have further embarked upon a set of policies to support that generation source, the effect has been to create a new set of actors who become potential producers in the market (Bohnsack et al., 2020). The presence of many producers limits dramatically the ability of incumbents to maintain a privileged position in that market (Kelsey & Meckling, 2018). As a result, various possibilities arise for a significant change in the incumbents' market position, remarked on here by a head of the UK energy regulator, *'I think the incumbents are losing, they did not anticipate the change that's been there and I think they responded slowly and poorly to it, and I think they're suffering for that. And I think that, to some extent, this could have been done more cheaply, and if it can be done more cheaply, consumers would have paid less,' (Interview GU14)* .

The importance of renewable energy technologies is propelled, across EU member states, including Ireland and the UK, by, among other factors, the trilemma of climate change, energy security and cost (Newbery, 2020). These technologies are enabled by a set of policies that represent a viewpoint of the economy in which institutions and history are embedded in a social context (Foxon, 2010; Gales et al., 2007). Those policies have supported the growth of renewable energy, allowing it to become a disruptive factor in the energy systems of both Ireland and the UK.

The EU is generally regarded as having a social economy based on a neo-corporate model, whereby a social partnership exists between multiple actors, such as government, firms and workers (Moulaert & Ailenei, 2005; Tassinari & Donaghey, 2020). Those actors negotiate in support of their own positions as well as for the social good. Proponents of a neoliberal perspective would argue that this model is rigid and unresponsive to changes in society, such as those caused by climate change (Ciplet & Roberts, 2017; Leibetseder, 2018). Many researchers and commentators have argued that a neoliberal model, which allows flexible unfettered organisations to better adapt to changing social conditions (Flynn & Hacking, 2019; Kashwan et al., 2019), allow those entities to protect themselves or to use coercive power. Within this data, a general theme emerges relating to acts by the EU that were negative for the market, in the eyes of UK-based interviewees, and was enabled by the EU position in the energy system regime. This also highlights the exceptionalism perspective that some UK policymakers and politicians had of their country regarding policy development and the role of the private sector versus the role of government compared to other European countries.

> *I'm going to say 2013, that the commission were pushing through trade tariffs on imported solar PV, that would have significantly increased the price of installed BP in the UK. Now, the system that I very painfully put in place was a one-way street, it was digression based mechanism, there was no mechanism to then put the tariff back up if prices went up. It only anticipated falling prices. So my much hard-fought reforms, looked like being buggered up by Brussels as part of their trade war* (*Interview GU13).*

The roots of the neoliberal perspective lie in anti-statist interwar Vienna and the 1920s Geneva School, and it was further propagated through the ideological debates of the Cold War (Turner, 2007). Austrian school economist Friedrich A. Hayek, as a key thinker in this tradition, criticised states who chased 'the mirage of social justice' (Fisk & Hayek, 1976). The market is the only construct that can correctly allocate resources and compensate individuals for the value they deliver to society, he argued (Fisk & Hayek, 1976). The ideology was particularly effective since it was presented simply as an impartial statement of economics instead of another theory of complex society. Unrestricted markets will safeguard justice and liberty as the profit motive was the only fair way for value in society to be allocated to individuals, based on how much society valued their contribution. The growth of this position was clearly understood by the civil service, as illustrated here by an ex-first secretary of the energy department of Ireland, *'It was a sort of a common belief across the developed world, certainly,*

and even in the World Bank and the developing world, that liberalisation of markets was a good thing.' (Interview GR21).

Neoliberalism started as an approach and theory developed in academic economics departments and was then taken up by the government and policymakers of the 1960s (Centeno & Cohen, 2012). In the US and UK, it became interlinked with anti-communist rhetoric and then became widespread through both regimes' various arms and organisations. Over the coming decades, neoliberalism became a dominant policy approach in both Ireland and the UK (running counter to the majority of the other EU member states), which brought about corporate tax reductions, a strong focus on deregulation, and privatisation of public entities and services including infrastructure and the energy system (Dukelow & Kennett, 2018). The private sector was viewed as better able to allocate resources and manage critical operations than the public sphere. Private-sector actors, such as this senior executive in one of the world's largest investment firms, points out the issue, *'You've got to look at the context. I think what's shown to be most effective is some form of competition option, that where, you know, kind of credible participants were required to put credible amounts of capital at stake […]' (Interview FE11).* As U.S. President Reagan stated, the hoped-for consequence was to allow the release of *'*the magic of the marketplace' (Reagan, 1983, p. 2). This belief in the power of the market to enact social change has been identified in Chapter 5 as a leading factor in the development of particular forms of renewable energy policy.

Taking a broadly EU perspective by focusing on those EU nations, this model was viewed as short-term and prioritises individual over societal value (Hermann, 2007). That said, there are considerable differences between groups of EU member states with liberal, conservative, social democratic and Southern European welfare state models (Bellamy, 2017; Jänicke & Quitzow, 2017; Johnston & Regan, 2018); and among specific member states within these models, as a result of their individual national path histories. Within the interview data, strong opinions were taken by several UK-based government and industry participants upon the orthodoxy that the market would enable the transition and a hostile perspective towards entities (such as the EU, referenced in the quote here) viewed as putting forward different approaches *'…and what it is, it's not a religion, it's not an ideology, it's a means to an end, and that's the good functioning of markets. And if the Chinese want to subsidise solar for my consumers, I'll take every penny they can get, thanks very much. But the net effect of your tariff inputs is to set back our renewable energy policy. And so bugger off*' (*Interview GU13).*

These distinct paths and viewpoints have brought about widespread variations, given the concerns across the EU about the neo-liberal model, throughout the EU. In the stated hope of producing more competition and therefore more choice and value for consumers, the sectors that have significantly deregulated and the benefit of deregulation remains a much debate space. *'[It] seemed to be very consistent with our light touch, using market regulation to drive policy outcomes' (Interview GU13).* The outcome of light-touch regulation has, in the main, brought about the consolidation of market actors (Etienne et al., 2018). Incumbents and well-capitalised new entrants, using their political clout, have placed pressure on and pushed out their competitors and promoted increased deregulation, which in a feedback loop further consolidates incumbents' positions. The goals of multiple small firms operating and driving efficiencies through a competitive marketplace, as per neoliberal ideology, has in fact brought about a market controlled by very large firms. Critics ask whether these entities were delivering enough investment to support policy makers' renewable energy goals, given the privileged position they occupied. *'We haven't seen enough investment for many years and the market model had delivered cheaper prices to consumers, but it had done it by not investing enough in the longer term' (Interview GU12).* This trend is easily visible in the data for renewable energy policy outcomes in the UK and Ireland.

Ireland: Shifting Model

The Republic of Ireland has unique characteristics due to the remarkable expansion of its economy since the 1990s and its social partnership arrangements (Baccaro & Simoni, 2004; Teague & Donaghey, 2009), which we have explored in Chapter 5. Ireland has transformed its economy over the last 40 years by implementing significant aspects of neoliberal orthodoxy (O'Donnell, 1998; O'Hearn, 2018) whilst still operating based on a more neo-corporatist and social partnership-oriented society. It has used the existing institutions, which are based on the UK combination of the liberal welfare state and industrial relations arrangement, adding to these EU integrations and an FDI policy focused on US corporations (Mcdonough & Dundon, 2010). Therefore, this Irish model is a combination of local customs with British, European and American influences. While they differ from the Irish institutional social economy, including its employment relations, labour market and welfare system, these external influences have taken precedence in recent years. Some of these external influences can be

seen in how the model has accepted the requirements for the growth of renewables. Here a leading Irish politician and ex-minister for energy acknowledges that the argument for renewables has been won, driven by the global demand for renewable energy technologies (wind and solar) and the subsequent reductions in cost,

> *It's game over […]. And it's the same in China, it's the same in Japan, everyone realises it. Anyone who knows what's going on realises it. So, let's be part of the revolution. Whereas in Ireland, the government and all the rest are thinking, let's wait ten years and see what happens, and then we might buy into that at a cheaper cost. And I think, no, we're good at this, go for it (Interview GR15).*

This shows a clarity of the international macro theme but an acknowledgement that the model in Ireland pushes back and supports a slow approach. At the socio-economic level, the Irish model tries to put forward a North American-type individualism whilst maintaining some aspects of collectivism, which is the prevailing European model (Boucher & Collins, 2003), and avoiding at all costs challenging powerful entities such as the state utility.

UK: Finance vs Industry

Several growth models have dominated in the UK over the past 150 years (Coates, 1999). Putting aside exceptional periods, such as the two world wars, these models have had an overriding theme: the finance sector has been consistently advantaged (Jansson, 2018). As we can see in the following comment from a leading global investor in the renewables sector, who is remarking how well they have done from the frameworks put in place, '*I think that financiers, on balance, where they deployed capital have done fine, I think developers, it's been more of a mixed bag…. But I would say, you know, on balance developers and financiers have done okay' (Interview FE11)*, the system has benefited those involved in the deployment of capital.

Meanwhile, domestic industries have been a less significant area of attention for policymakers, whether in sector-focused policy or in changes to other policy that affects them. The following UK-based leading industrial executive demonstrates and reinforces that point whilst talking of the success of offshore wind initiatives, *'So, an unintended consequence of policy, on the move,*

can actually crush the very thing that you're trying to create which is the entrepreneurial climate in this space' (Interview IU21). But outside of the financing function, and as discussed in the previous chapter, and to some extent the services required for the maintenance of wind farms, no UK domestic produced protected niche became a successful part of the regime. As covered in Chapter 6, the UK's position at the forefront of offshore wind development has not given rise to a leading position in the manufacture of products for the offshore wind market but has undoubtedly led to a world-leading position in the financing of offshore wind projects.

The lack of an industrial policy is a reason regularly used to explain the UK's comparative manufacturing underperformance compared with other advanced countries (Moloney et al., 2014). Here the data shows a complete lack of interest from the interviewees on the development of an industrial policy either in the UK or in Ireland, apart from the rare mention. *'It did come in […], not so much right at the beginning, but more in the 2013/14/15 timeframe and you know, there was a time when Michael Fallon was both secretary, he was Energy Minister in DECC and also responsible for industrial policy over in business, whatever it was called at that time' (Interview GU12)*. By contrast, the UK has frequently implemented policies that have strengthened the finance sector's importance over other parts of the economy. *'Obviously, individual businesses and investors and innovators will have profited, because, as you roll stuff out, those people who get ahead of the game and maybe play the system a bit, clearly they're going to make super profits. But that's how technology adoption works; as long as you don't allow that to go on too long' (Interview GU13)*.

Thus, in the UK, the focus has been on creating and defending the conditions for the prosperity of financing institutions and their related service providers instead of assisting in the industrial sector's advancement and growth. *'Financiers just saying "Look, you pick a system, stick to it," but you've got to get all of these other things lined up like planning and, you know, you name it […], route to market' (Interview PU21)*. This has been highlighted as causing delays with the extension of renewables in some cases.

7.3 Actors and Transition

As has been discussed in Chapter 4, it is necessary to examine how actors operate within a society in order to improve our knowledge of the development of policies enacted to support our energy transition. Such examination can also increase insights into the position of power, the functions of actors, and how the pathways of the transition are formed and altered through relations among various actors (Geels, 2014b)

The UK and Ireland are usually, as discussed above, seen as corporatist states (Jahn, 2016) with strong neoliberal influences. These influences provide multiple groups, such as trade unions, finance houses and industrial organisations, with easier access to policymaking. Consequently, how different policies are presented in individual states should not be wholly controlled by any particular groups. The benefits from that energy policy might also be expected to be shared. *'The private sector operators or indeed any other lobbyists or any of the entities that we've mentioned, they shouldn't ever be the drivers or the authors of the policy, but that doesn't mean that they don't have the right to try to influence it and ultimately benefit from it' (Interview GR13)*. As previous chapters clearly show, different actors have played their roles in determining policy in the UK and Ireland, but the utilities, finance houses and the EU are overwhelmingly regarded as the dominant players. The policies in these countries are, therefore, the outcomes of interactions between the government and these dominant interest groups; as these various actors discuss and interact over different approaches to policy. These policies have been proposed based on landscape themes which themselves arise through the formulation of new ideas by different actors.

It is useful to analyse the transition to a low-carbon society through the perspectives of key actors, the different levels they operate at and the political economy. The focus should be on those various actors and how they work to impact societal transformation. In this context, and as we have seen in Chapter 5, policies can aid the creation and maintenance of space for niches and experiments, thereby increasing the attractiveness of the renewables market, whether or not that aid is viewed as favourable by the incumbents. By increasing risk-sharing, thus

appealing to the private sector to deploy capital into renewable energy assets, the government puts itself in a position to make decisions that favour one group over another. And though the incumbent actors' integration of knowledge, values and interests gives them a significant ability to help address the challenges involved, that very advantage in position and skills has also benefited the incumbents in maintaining their position.

Among the many researchers who have worked on perspectives on actors in transitions, Avelino and Wittmayer (2015) and Wittmayer et al. (2016) develop work on a multi-actor perspective used to understand transition politics, specifically in conceptualising shifting power relations. The value of this work can be seen clearly when considering an example of large importance and in which there exists a clear contested area, which is the management of the grid itself. The process around obtaining possession and of decision rights regarding the grid is complex in both the UK and Ireland, acknowledged by the CEO of an Irish incumbent firm, *'EirGrid imposed a moratorium on wind and that's not government policy, but EirGrid as a state agency imposed a moratorium on further wind connection, until grid stability issues [were resolved]' (Interview IR12)*. Given this situation, the transition to a low-carbon society involves cooperative, complicated, and long-term processes. It also requires agreement from different actors around key issues such as grid stability and the addition of more renewable energy assets. These processes would involve various actors to create essential social innovations that can bring about social change. The stated intention and consequence of those innovations is to bring about equality and equity, the effects of which are hoped to become widespread. Two key issues arise from the data. The first is the distribution of the costs and the advantages of building and operating a centralised renewable energy system: Who develops, owns and operates the energy system? Which actors provide the finances for renewable energy assets, and who chooses where they are built? The second issue is about the goals of society: do citizens win in terms of cost and output?

As we have seen, the government is one of the most influential extrinsic actors in commencing and directing a range of policies that encourage other actors in the regime to bring about changes in the energy system. The data points to four different types of actors strongly affected by renewable energy policy and provides important insights into the winners from those types of policy: producers of both renewable energy and hydrocarbon generation, civil society and

finance houses. Within these categories, the market and industry (incumbent energy firms) actors appear to have the largest impact on the transition to a low-carbon society.

The Public

Overall, most studies (B. Anderson et al., 2017; Ladrech & Little, 2019) and this data reflect widespread approval for policies that support renewable energy in the case study countries. Here an ex-UN senior executive reinforces that point, *'I think the population, in general, and I think that is the only case, has always supported renewables. I haven't seen a poll or a questionnaire or something where there was a negative attitude by the population in any country' (Interview PI12).* An exception being with regards to specific developments in particular places where local communities were often against those developments. While several researchers believe that civil society actors during the transition have undefined roles (Seyfang et al., 2010) the public have been seen to want communities based on sustainability themes and a transition to a low-carbon society, even at a cost to themselves, *'And you know, this is a huge cost to the British energy consumers, […] but the majority of people seem to still support renewable energy' (Interview GU13).* This change in attitudes is generally caused by societal awareness of the huge issues caused by climate change (B. Anderson et al., 2017),

> *So, in some senses you know, we wouldn't be doing any of this unless there was pressure from the public, politicians respond to what the public wants but there is some, a green economy, a greater share of renewables, a less carbon intensive economy than we had previously. And I would say to that extent the public has won in the sense of getting their wish (Interview GU13).*

These public concerns offer a normative position that the society collectively acknowledges the importance and deployment of renewable energy innovation and assets, *'I think it's been positive for the environment insofar as we have been able to decarbonise our electricity system' (Interview LR21).* It also strengthens and promotes the utilisation of renewable energy versus hydrocarbon-based energy, requires economic actors to consider low-carbon solutions, and creates situations that disturb the regime and change the policies and methods of other actors. The lack of communication to the public from policymakers was highlighted in the data in both

the UK and, here from a CEO of a Irish government renewables initiative as not being carried out to allow the public to consider correctly those solutions,

> *I think it went back to a fundamental misunderstanding within the general population in Ireland and that's between urban and rural, right. In terms of what we were trying to achieve, was there ever a process where people were sat down and said this is what we're actually trying to achieve, this is where the benefit, what you will achieve as a community and I think you only have to look at Europe and other jurisdictions to see the different path they followed and actually how they brought communities into even co-ownership of these assets (Interview GR11)*

They are possibly involved in practices of socio-technical change as a group of actors that is either positive or negative towards technological innovation overall or in specific locations or contexts, whilst also choosing to pursue and support changes in the regime by supporting new policies.

Wittmayer at al. (2017) discuss how civil society actors seek out chances to assist the continuing transition to a low-carbon society. This action then encourages the development of the public debate, fosters social agreement, and brings about an understanding of the role individuals have to play in transitioning toward social benefit – even if it is only the expectance of higher energy costs. *'It's all of us that have to pay, if we're going to make rational decisions about moving technology on to tackle climate change. Climate change will have a cost if we do nothing, it's just that that cost will be so massively huge, and we'll all die, or you could try and get investments at a reasonable cost, but consumers will pay' (Interview GU13).*

This means that the public (and the increase in numbers of individuals searching for and then purchasing renewable energy for their own needs because of their concern around climate change reinforces this idea) are a significant factor in the transition to a low-carbon society through their willingness to pay more and to move to firms which offer renewable energy supply. In the UK especially, a significant number of households also became generators of energy to the grid through the installation of solar on their houses and becoming market participants in the energy system. *'We've ended up with near to a million households […] owning solar panels. And we've ended up with x gigawatt of solar in return for the levy control framework, when the levy basically comes off consumer bills. So they've got the maximum bang*

for the buck in terms of low carbon transition' (Interview GU13). Individuals' interest in purchasing renewable energy has been growing considerably in the UK and Ireland, a trend supported by government policies in both states. The data points to how this trend has affected the regime, especially considering the rise of community activism against renewable energy assets being built in their locations,

> *…a strong influence on the energy citizen, the prosumer, all the issues of ownership, the co-operatives in respect of for example, renewable energy projects, so can we extend supports to them, can we interest the consumer more in energy, the whole debate about off-grid, about the grid and so on. So, we were trying to open up those areas for debate, as well, but ultimately the beneficiary is, and must be, the citizen (Interview GR13).*

Governments, both in the UK and Ireland, have realised that individuals had direct ownership as consumers of electricity and through their power from community activities, and therefore needed to be accommodated. Whether that has made a difference to how individuals benefited from renewable energy in terms of cost has been questioned, *'But the […] consumers, you know, had paid up' (Interview FE11).*

In terms, then, of the public gaining from the significant number of renewable energy policies enacted over the period of this study, the data points to a level of cynicism as to the financial benefit of lower electricity costs for the public. *'Look, I don't know whether it's been successful for tax payers. […] I think wind generally would make electricity cheaper and that would benefit tax payers so I think that's balanced out by the PSO's, I'm not sure tax payers or consumers really feel any benefit of it' (Interview LR21).* However, individuals in the EU, and in Ireland and the UK, progressively have positive opinions around the idea of renewable energy (Noblet et al., 2015) (with the notable exception of community groups in both the UK and Ireland opposing local developments), even though the benefits of that renewable power have not been seen in cheaper power, *'I think consumers continued to get screwed' (Interview FU11).* The benefits of cost reduction are discussed by the interviewees as having not been shared between individuals and companies, *'I think linking the PSO levy to energy consumers' bills, one of the, I would say, critical policy flaws with that is obviously fuel poverty, and is it okay that everyone's paying 10, 15% of their bills, or should it be a little bit more targeted towards larger […] energy users?' (Interview FR11).* That transition, though, has been

highlighted as a major benefit to the public, as one interviewee who heads an industry lobby organisation stated, *'Consumers [benefit], because they now have an indigenous source of energy production, with much more security of supply and much cleaner air to breathe' (Interview LR13)*. In other words, consumers have benefited greatly from the growth of renewable energy outside of cost. Of course, this would have happened anyway, regardless of how the cost was distributed.

Bureaucrats and Politicians

The success or otherwise of bureaucrats and politicians also needs explanation. In general, membership of key committees and policy-setting bodies in the UK and Ireland is controlled by state and regional civil servants, by individuals from different government entities, and by delegates of political parties (McGauran et al., 2005; Richardson, 2000). Data on the performance of those individuals are mixed, as one would expect given the breadth of the makeup. Generally, the interviewees felt that several of the government goals had been achieved through the work of bureaucrats and politicians, *'And I think the policy makers, because they've aimed to do something and have achieved it' (Interview LR13)*, but more by creating an even playing field than via strong market guidance, *'There is always a transition period, and I think the government policy makers have left that transition period wide open' (Interview FR12)*.

The difference of a civil servant and the employees from the states organisations is significant since the former are more easily swayed, and many specialists are employed by those organisations (e.g., Sustainable Energy Authority of Ireland). These representatives have been viewed in both Ireland and the UK as having worked hard and achieved many of the goals which were set out for them. Though frustration, here expressed by a private sector investor, on the ability for them to gain the required knowledge and skillset is clear in the data, *'What we have now is a lot of people who came into a position who really, you know, spent the first two years trying to get up to speed on what's happening and then actually the third year they get moved to another department' (Interview IR14)*. Two areas are highlighted by Irish interviewees, here illustrated by a climate scientist. First, a lack of vision, *'It needs to be informed by this major transition, and that transition has not been articulated at a national level as well as it should' (Interview GR22)*. Second, explaining the benefits to the public from the enactment of policy, *'The other thing that's missing – big time – is the benefits. It's all*

burden sharing, effort sharing, this, that and the other' (Interview GR22). In both contexts, the performance and, therefore, public representatives' success in meeting the public's requirements have been questioned in the data. Those in the UK were deemed to have taken care of the interests of the finance community, whilst in Ireland, public needs were subject to the requirements of the incumbent utility.

Environmental Groups

Here data has shown how environmental groups in the UK and Ireland have a role in policy-making processes, but their impact was viewed as low. As an ex-board member and investment committee member of the UK Green Investment Bank puts it, '*I don't think the environmentalists; […] it didn't really materially change the trajectory of the low-carbon transition,' (Interview FU11*). In the past the environmental NGOs had rallied vigorously against nuclear power; but from the 90s, when Irish energy policy was framed more in accordance with economic goals rather than environmental ones, the movement started to become less important. It was unexpectedly lacking in the deliberations on energy regulations during the 90s (Komor & Bazilian, 2005), as the head of an environmental NGO states *'We weren't actively involved and I don't even know if we've submitted a – like I'm sure there were public consultations that we didn't take part in' (Interview LR11*), an absence which continued, as far as some policymakers interviewed were concerned, in both the UK and Ireland. When we examine their stated goals in terms of decarbonisation of the electricity system in both countries, it is hard to argue that those goals, laid out at the beginning and throughout the period of this study, have not been met.

Market Actors

Market actors, in this context, can be thought of as companies who attempt to create profits for their shareholders through the creation of new products and by applying existing and new business models to their deployment. Here the data highlights three main groups: manufacturers, finance firms and energy producers.

Manufacturers

The role of wind turbine manufacturers has been especially commented on by interviewees. These firms' behaviour has been viewed as predatory, to achieve higher profits, though the statements of the head of a large investment fund, and a buyer of the products of those companies, need to be viewed in the light of his interest in cheaper solutions and therefore more profits for his investors,

> *People, it's easy for them to obfuscate delay etcetera. and it's easy for Siemens to effectively allow the base to believe the wrong thing. And it's easy for Ofsted to do the same, well it's not easy it requires a lot of effort, but then they've achieved it again and again [..]. And it's kind of been difficult to foresee what the consequences of that is and how expensive it's then been for us as an economy and for the, you know, we could have had three times as much off-shore wind for the same price if only we hadn't had those lies told and believed for instance (Interview FI11).*

Such economic benefit-seeking behaviours have set back renewable energy growth by forcing governments to contract for renewable energy power plants at higher costs than should have been available. Furthermore, the overall policy framework was not able to keep up with the cost reductions in production *'[…]and I would argue that in the case of offshore wind in particular, but you could also say all renewables, the costs have come down fast and quicker than even I thought, and I was on the optimistic side' (Interview GU13).* While the price of turbines and solar panels has fallen rapidly over the course of this study, the benefits of that decline have, as the majorities of the interviewees' state, been captured by manufacturers and developers rather than for society.

Two important determining factors of an individual market's potential to achieve higher profits are how large the market is and how fast it will grow. While the falling price point has affected market attractiveness, it should also be noted that it has not always been easy to achieve those profits despite actors' best efforts. *'For manufacturers and equipment suppliers, you know, the volatility has been challenging and ultimately a lot of players don't exist today that once did. […] so there's a bit of an element of a boom bust dynamic, that's been very challenging to manufacturers' (Interview FI11).* The effect of this volatility in the sector favoured those firms which were well-capitalised *'…the people who were successful were those who grew in economies of scale, who could be far more efficient and who had a lower cost of capital'*

(Interview GU13), such as Siemens or GE. The growth of firms engaged in the supply of turbines and solar panels throughout this period has been significant. They were viewed as negative to the sharing of benefits from production cost declines, yet the value capture of that growth has been seen in the profitability not of the manufacturers but of the finance houses and the asset owners.

Finance firms

Researchers have proved that overall, in the EU (a post-industrial advanced economy), the financial system has vast effects on the Union as a whole, as it affects not only individual businesses through the provision of equity and debt, but also the spending of member states through the provision of debt. Given its role, the financial system must be a major actor in promoting the transition to a low-carbon society, as it has the capability to generate considerable transformation. Given the landscape factors which were discussed in Chapter 4 and then the support new pathways through policy makers' actions, investing in renewable energy assets became increasingly attractive. The lobby groups such as the one this interviewee chaired, aggressively put forward the position of accelerating the transition, *'In 2010, the coalition government put together the Clean Growth Strategy – a document prepared by the industry and by the government, which resulted in what we see today, massive deployment of solar in the UK reaching around 12.5GW' (Interview LU12*). This situation encouraged actors whose existing operations and resources could be applied to the value chain of renewable energy, including different technologies or services, to advance innovation which, once expanded from their niches into the regimes, would be able to generate returns. Finance firms and banks whose product and services are the provision of financing to those actors, then became major actors themselves in this sector, *'Of course, you know, there is a large chunk of finance necessary for renewables more so than a conventional, so I think it was an interesting place for banks and […] investors' (Interview PI12)*. Banks, particularly those operating from London, given its position as a global financial capital, have a range of skill sets and knowledge that help investors increase their investments, connecting possible investors with renewable-energy developers through the use of new securities. All of these activities have been significantly profitable for those players and, in the UK case, have created a large skill set and competitive advantage in the financing of renewable energy projects. The difference between the UK and Ireland has been commented on, with the UK viewed as a more favourable environment for the finance houses to operate in, *'I think we had a comfort with the UK policy environment, we were always challenged by the Irish policy environment' (Interview FE11).*

Financial markets are acting in their own interests through their investment participation in renewable energy projects. The Paris Agreement signatories' continued inability to meet the goals of that treaty presents overwhelming risks for the world economy, thereby operating within it. This has long been recognised by conservative institutions. Mark Carney, the former governor of the Bank of England, as relayed by the BBC (5 February 2021) from an interview he gave, said *'When you look at climate change from a human mortality perspective, it will be the equivalent of a coronavirus crisis every year from the middle of this century, and every year, not just a one-off event, so it is an issue that needs to be addressed now.'* On the reverse side, preventing and solving the incredible damage caused by climate change also opens new areas of economic activities for firms and the financial markets; again, as Mark Carney stated in the same article, *'The scale of investment in energy, sustainable energy and sustainable infrastructure needs to doubled.'* As has been discussed, the magnitude of the capital required is in excess of what the public sector feels able to bear, though the policies that have been enacted in both the UK and Ireland contain a significant transfer of value from the government to market players.

Banks have been providing advisory services, working to put in place complex vehicles and arrangements to support investments, and pushing investments to interested firms and investors. During the period of this study, investors, incentivised by the supported policies put in place in the UK and Ireland, have been increasingly interested in investing directly into renewable energy projects, *'It became less of a "Here's something that's going to support some local landowners and local community" "Here's something that's supporting institutional investors" and […] I think that has forced a change, to some extent, in policy' (Interview FR11)*. Usually, pension funds or insurance companies (the significant majority of capital) have their capital managed by specialist private-equity firms, which creates friction and a cost in the deployment of that capital. More recently, those investors have started bypassing the intermediaries and are allocating capital to renewable energy assets themselves, thereby increasing both the quanta and the size of investments into this sector and becoming the most important financial actors. *'So, we still have challenges, I think […] banks benefit, quite clearly, institutional investors now benefit because they're the players that are actually most active' (Interview IR12).*

Heightened demand, combined with momentum in the number of firms participating in the sector, has strengthened its attraction. As this market pull has continued through multiple economic cycles, and the sector has therefore become regarded as mainstream, this feedback loop strengthens the transition by mutually supporting actors' perception of the sector.

> *So, I think […], what we have is […] an industry in Ireland […] that basically is seen as mainstream. It was in mainstream, when the first wind farms were going in the ground back in the 90s, today it's a systematic risk that should be taken by pension funds, and they're willing, many of them now, to be involved in the development of these projects, they get a hold of an asset base. So the worm has turned (Interview IR12).*

The United Nations Environment Programme (UNEP) reports interestingly lay out three ways (UNEP Finance Initiative [UNEP FI], 2015), here illustrated in Figure 7.1, in which actors in the financial sector might support the transition to a low-carbon society:

Figure 7.1 How finance actors might support transition. (Source: UNEP FI)

The level at which the sector as a whole has taken these three points into their activities has radically changed over the last decade, with a now almost universal realisation that the risks in investing in carbon-intensive industries and in events driven by climate change need to be both managed and hedged. This realisation has occurred in parallel with a series of activities as part of the integration of the finance sector into the world of renewables. The integration has allowed the finance sector to accrue significant value from advice and the provision of debt and equity. The City of London's position as the centre of renewable energy finance execution is acknowledged throughout Europe (Corporation, 2016). As we have seen in Chapter 6, policymakers viewed the satisfaction of the market requirements as the key enabler for the

growth of renewable energy. The data, furthermore, clearly shows UK policymakers as favouring the position of those companies involved in finance over other types of actors.

Energy producers

Energy actors represent two different types of interests: the suppliers and generators of RE) and the actors who concentrate on the supply of energy using hydrocarbon resources (as well as nuclear). The latter group has been incumbent in both Ireland and the UK and has therefore occupied privileged positions of power.

> *You had this dual thing about the companies themselves looking to the future. They had State salaries, in the sense that they had the best of the private sector and they had the best of the State, they had the State pensions and the State conditions of service, but they had the private sector salaries. That was very challenging then, because they made it really difficult for other competitors to come in (Interview GR21).*

This group, though, has faced mounting pressure on their position in the regime and has been challenged by new actors, *'I think the incumbents are losing, they did not anticipate the change that's been there and I think they responded slowly and poorly to it, and I think they're suffering for that' (Interview GU14)*. Within the UK, this group no longer occupies the same position of power as it once did. Industry lobbyists in both countries, including the Irish lobbyist quoted below, reinforce that viewpoint,

> *I think the losers are the industry that you're trying to replace. So the likes of coal, oil and gas industries that have lost out on market share because policy has decided that that's not the future that they want. So, I think all of the above that you mentioned and then maybe just add to that, that the only losers I think here is the industry that the policy looks to replace (Interview LR13).*

Those new actors include both the developers and asset owners of renewable energy plants. It has been shown that actors in the value chain of renewable energy generation play an influential part in the making of both EU and UK energy policy (Sung & Park, 2018), though the data points to a much smaller one in Ireland. However, as new actors, renewable energy suppliers

are inadequately managed and require collective plans. Even with that disadvantage, researchers and the data have demonstrated that several new market-entry renewable energy developers and asset owners are the overall 'winners' in a large majority of renewable energy markets in the EU(Kelsey & Meckling, 2018). *'Well, I think […] developers quite clearly did benefit, I mean we've seen successful developers in Ireland and elsewhere that, basically, had very good returns when they sold' (Interview IR12)*. This is a uniform trend, and though in Ireland, the ESB as an actor maintained its position of power to some extent, it ceded a considerable portion of market dominance to new entrants.

The findings support previous research that has suggested that political support for renewable energy policy comes from challengers in energy markets who have been clear winners in terms of their growth and profitability in the UK. In Ireland, similar themes are visible, *'I think a lot of wind developers have made a lot of money in Ireland so it's been successful for those guys' (Interview LR21)*, but the picture is more mixed. The traditional energy sector actors, ESB in Ireland, is a strong example, are a major factor in our transition to a low-carbon society. The sector has attempted to define their activities and the expertise needed to carry out critical functions to legitimise its independence, intending to protect its privileged status within the regime,

> *[It's] a very technical area, there's not that many politicians understand it or want to understand it. So, you have to watch out for the possibility or the risk, that the people who do understand it may be the private sector players and that their influence may be unduly prominent. In other words, that the very fact that they have the information and the expertise on the analysis available to them and they're willing to impart it to you as a minister, you've got to guard against the risk that they are actually driving the policy (Interview GR13).*

Examining the data, the results of this effort in the UK context has been mixed,

> *[…] not very beneficial for the income of utilities […] they didn't seeing it coming, then they missed out on the opportunity to invest and you know, they ended up being squeezed out of the market because the marginal cost of renewables is much lower than if you had something that requires fuel […] so once you have paid for it the marginal*

> *cost is zero so that goes first and then you end up having to go and support gas-fired power plants. So, for utilities, it has not been a good time (Interview PI12).*

However, other subjects pointed out that even though their traditional business had suffered, the incumbents that moved to invest in renewables did well, *'[m]ost development profit was made in offshore wind, arriving out of the UK renewable energy policy. Then you look at the participants in offshore wind development and I think all of them, bar a small portion of, a small percentage of activity relating to Centrica and Scottish and Southern' (Interview FI12).* Overall, the importance of traditional utilities in the UK has been massively lessened across a range of factors (Kattirtzi et al., 2021), even taking into account their attempts to generate profit and remain relevant through their activities in offshore wind projects.

In Ireland, the ESB is viewed as having maintained its position of dominance in the regime first by slowing down renewables' development and then attempting to squeeze out competitors.

> *You had this dual thing about the companies themselves looking to the future. They had State salaries, in the sense that they had the best of the private sector and they had the best of the State, they had the State pensions and the State conditions of service, but they had the private sector salaries. That was very challenging then, because they made it really difficult for other competitors to come in (Interview GR21).*

To do so, ESB was able to leverage a range of capabilities, such as resourcing, capital and access to policymakers. Such professionalisation, and therefore advantage, keep societal development dependent on the state utility and its role in the socio-economic structure, *'We just didn't have the expertise in-house, and we had talented people, but the ESB will roll out the top experts in the world because they can pay them. But finance wouldn't allow us pay people or bring them in' (Interview GR21).* At the same time, ESB undertook massive propaganda campaigns, initially focusing on the lower price of fossil fuels relative to renewables and consumers' preference for lower energy costs even if produced by hydrocarbons, *'So, it has been more the conventional producers have suffered' (Interview FE11)*. These activities by ESB promoted a position that there needed to be a larger percentage of hydrocarbon generation in the grid, negatively influenced the transition to a low-carbon society whilst reinforced their position as a powerful incumbent in the socio-economic

framework. *'So I think it's been pretty successful if you were to talk to an RWE, I think an SSE, they would all be reasonably happy with that' (Interview FU12).*

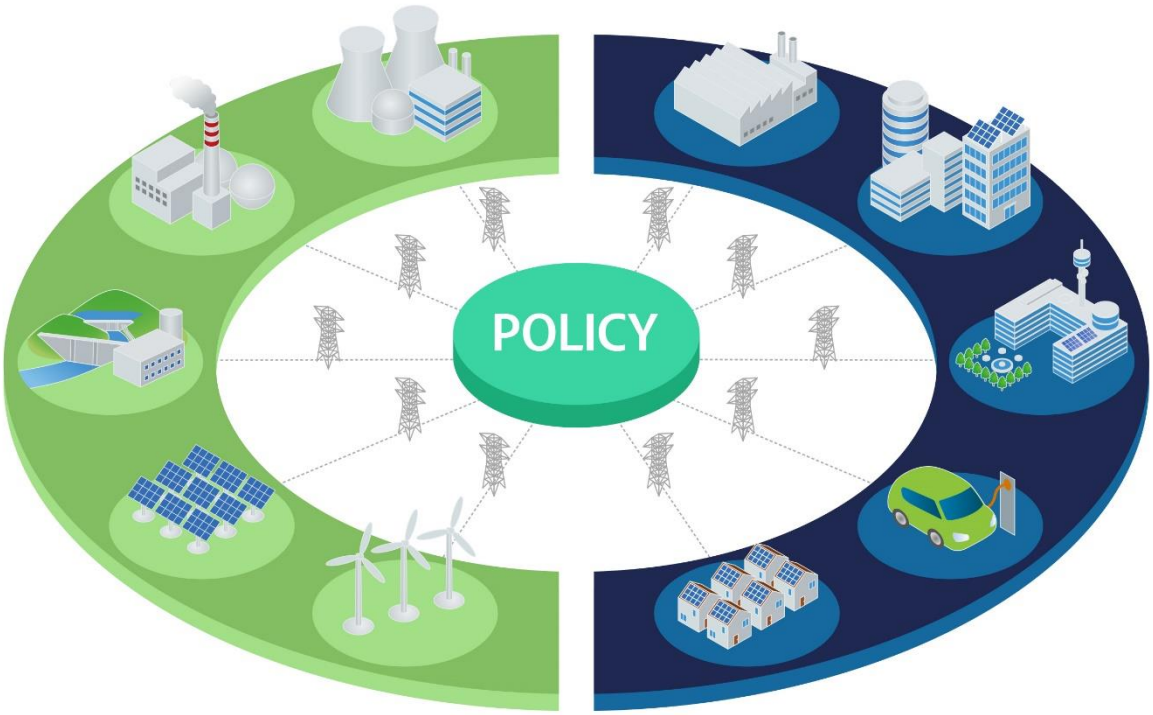
7.4 Summary

This chapter addressed the fourth research question, **Which groups benefited most from the implementation of policy instruments?** It identified that previously discussed key drivers for transitions, such as the energy trilemma, are changing the development of new technologies and business models. It was also noted that the advance of neoliberalism into policymaking had placed a significant amount of faith in markets rather than government/communities. In Ireland, this advance needs to be considered in the context of tensions between a statist model which favours incumbents, such as the ESB, and neoliberal policies preferring deeper deregulation of the market. Whereas in the UK, the neoliberal approach dominates, with policy focused on finance over the industry, concentrating gains from the transition in a small number of actors, and potentially even damaging the transition.

There is extensive research on how intensified social and economic problems, including those relating to economic development, energy and the environment, manage to create some level of social consensus on combating those problems (H. Farrell & Quiggin, 2017; Jasanoff, 2010; W. Pearce et al., 2017). It is this consensus that policymakers attempt to translate into effective policy, driving the need for many states to address socio-technical transitions as they attempt to build a low-carbon society. That process depends on how energy is produced and distributed. It thus creates a contested area for emergent and incumbent actors, as can clearly be seen in the separation of the Irish state utility of its generator and transmission operations. ESB fought hard against that process with energy expertise far above what policymakers could command, which the EU and this civil servant, quoted below, had recommended and was the standard in other EU member states, *'[I]n the whole review of the electricity market with ESB in particular; we had a study done on the ESB which was very sensitive obviously, and […] we were involved prior to that in establishing EirGrid, and there was a huge tension with ESB about breaking EirGrid off as a separate entity' (Interview GR21).* It is in this space, and alongside the new

technologies and business models that are growing in protected niches, that challenges to established incumbents take place.

As such, this research allowed the observation of how key groups reacted to those contested spaces creating changes to the regime. Though a large and diverse grouping, the public has accepted extra cost for environmental benefits but was poorly supported by the environmental NGOs whose impact on the actions of the policymakers was seen as limited. Communities during this period are increasingly active in renewable production, distribution and location selection, but again, they have not been seen to be benefiting economically. Market actors have demonstrated significant tensions over the accrual of economic and knowledge benefits to the finance sector over manufacturers/distributors whilst cementing the power of finance in the energy market and, by extension, policymaking.



8. How Can There Be More Effective Policymaking?

8.1 Introduction

Hydrocarbons still form the basis of the overwhelming majority of energy production globally, contributing about 80% of the total energy supply and 64% of electricity generation in 2020 (British Petroleum, 2020). We face society-changing environmental and climate challenges, driven, in the main, by the use of hydrocarbons. The deployment of a range of renewable energy technologies is required to help us overcome our reliance on hydrocarbons, and, enabled by several decades of experimentation, many of these technologies are now available for accelerated rollout.

This transition of the energy system depends on a protected set of innovation niches, which become available to the regime and allow actors to adopt and deploy an ever-increasing amount of renewable energy assets. Policymakers have been trying to enable, through their use of a range of different policy tools, a fundamental change in our energy mix. Due to their scalability and distributed character, renewable energy assets like solar PV and onshore wind can be

invested in by a larger group of actors than is feasible when investments need to be made in large hydrocarbon generators (Curtin et al., 2018). In both the UK and Ireland, throughout this study, multiple actors have emerged and had a significant effect upon the regime as they take on roles and change those roles previously held by incumbent players. In the community example, individuals have developed from passive consumers of energy to actors whose opinions on cost, location and form have to be accounted for by the energy system.

The transition from a centralised, near-total hydrocarbon-dependent energy system toward a more widely distributed grid that includes a substantial amount of renewable energy generators massively affects the energy sector (Defeuilley, 2019). Though originally their impact on the energy system was marginal (Kattirtzi et al., 2021), these newer sources of electricity are now having a substantial impact in lowering the carbon footprint of the electricity grid (Wang & Zhan, 2019), as well as transforming the operation of the grid operators themselves (Romero Aguero et al., 2016). They are developing into industries in their own right, with powerful government policies promoting their rollout and allowing for further development in the future. As the CEO of one of the UK's Big Six utilities explained,

> *[…] the point is it was an amazing success and it developed an entire new industry for Europe, tremendous technological innovation and just as importantly it paved a way for the rest of the world to follow. So it's not just Europe that's deploying this renewable energy, it's the rest of the world as well now and solar and wind are growing like poppies everywhere and I think[…] we must take some credit in the UK and Ireland and Europe more generally for having driven that (Interview IU13).*

As we have seen the policies in Ireland and the UK supporting electricity from renewable sources, the majority of which relate to the now-established technologies of wind and solar, have been in place for more than 20 years. Ireland's policies over that period received consistent criticism for their (lack of) ambition and narrow focus by the interviewees, including the CEO of a key government renewable energy initiative,

> *I think they tend to take a very reductionist approach […]. I would have preferred much more open-minded kind of policies and just said look, […] we want decarbonisation, or we want indigenous resources, or we want whatever else, diversification, […] but*

they tend to start with that question but then decide what the answer is and then legislate and incentivise for the answer as opposed to the broad theme, if you know what I mean (Interview GR14).

This, despite the multiple iterations of policy types put in place.

In the UK, by contrast, the research data shows a generally positive view that the policy had led to a successful outcome, especially as stated by executives such as this interviewee, who headed one of the largest developers active in both the UK and Ireland,

In the UK, we were down to around […] 3% from wind energy, which is up above 20% now in 2019 in terms of full capacity. 2019 where we've got over a third of energy from renewables. You have to look at it and say it's been overall a success story. Late nineties, eighties, early 2000s, we couldn't have dreamed of being where we are in terms of capacity and stored wind and solar particularly and where the cost curve has got down to, which is just remarkable (Interview II123).

Those iterations of policies have in the main either been utilising fixed feed-in tariffs or various types of quota systems as the core mechanism to support renewables; though recently, as we have explored in great depth in Chapters 5 and 6, more and more countries are introducing auctions as part of their incentive support system (Botta, 2019).

In evaluating the success of those policies, multiple metrics have been proposed by researchers and policymakers, such as efficiency and effectiveness, as criteria on which policymakers assess the performance of those renewable energy support schemes. These various criteria have been discussed in Chapter 2. Based on some of those criteria, policymakers interviewed have been quick to congratulate themselves, both in the UK and Ireland, on their successes. They have also received the congratulations of industry and finance both in Ireland the UK as seen below, *'Consumers [benefit], because they now have an indigenous source of energy production, with much more security of supply and much cleaner air to breathe' (LR13).* And *'So if you are looking at it from the government's perspective, did I deliver the megawatts? Yes. Did I get the cost down? Yes. Is there a vibrant market? Yes' (Interview FU12).*

How, then, does this research and data inform policymakers seeking to design better renewable energy (and other) policies, policies that depend on government-led action in sustainability transitions? This section presents a series of policy-relevant insights which are apparent from the data and can aid policymakers in their future endeavours.

Research Question 5:

What can be learned from the analysis that will contribute to more effective policymaking in the case study countries?

There are three areas of focus for policymakers that can be determined from this research. These are the timing of policy changes and the value of policy mix to support niches, an assessment on the limits of the private markets when faced with the power of an incumbent industry, and the need to acknowledge the importance of energy democracy.

8.2 Value of Niches in a Policy Mix Approach

In furthering a transition to a low-carbon society, it is clear that individual policies, market-based or not, are not enough, could be seen as somewhat myopic in scope and have taken far too long to implement or change. As one think tank policy expert explained, *'I think what happened was that we'd gone through a long process, a very long process, to get an outcome which was supposed to be a level playing field across the market and then in fact it ended up being this tiny little section where the renewable sector alone was having this level playing field amongst itself' (Interview PU21)*. The delays in policy implementation or alteration have been identified as rendering policies inefficient in changing our energy mix, in delivering best-cost outcomes and in avoiding the effects of climate change. Environment and innovation policy research is beginning to reflect a newly understood need for analysing the ideas of a

policy mix (Rogge & Reichardt, 2016; Rosenow et al., 2017). Commenting on the situation in Ireland, a senior finance executive stated how that analysis needs to be and should have been carried out,

> *[…] other European policy makers took that long-term view, and Ireland took somewhat of a reactionary view, […] saying "We've signed these international agreements, what do we do, how can we do it as cheap as possible, how will we do it as quick as possible, onshore wind is the way to go." And we're still living in the wake of that, and that's why Ireland is such a climate laggard, because we haven't really developed our policy thought process (Interview FR11).*

From a transitions perspective, changes in policies or policy mixes and overall changes in socio-technical systems are highly interdependent (Andersen & Markard, 2020; Edmondson et al., 2018), and that interdependent nature requires a flexible approach in policy. For instance, policies can support and protect niche innovations (e.g., R&D programmes, deployment subsidies) and constrain incumbent technologies (e.g., emissions performance standards, fuel taxes). Policymakers utilising a policy mix becomes helpful in light of the complicated way in which actors at different levels interact over different periods (Cunningham et al., 2013; Flanagan et al., 2011). The resulting changes in the socio-technical system should then inform and lead to amendments in the policy mix in response to how the original policy choices fared. It is clear that transitions will follow different pathways, pathways which are hard to foresee and subject to a range of influences, both macro and micro, but these pathways are also shaped by policies and by the strategies of the actors involved (Geels et al., 2016; Geels & Schot, 2007; A. Smith, 2009), highlighted here in the words of a leading Irish climate scientist,

> *The people who devised the system had envisaged that the price would be significantly higher than it is now, because obviously, a key tenet of climate policy is that carbon emissions should have a price, and that price should be commensurate with the impacts of those emissions on our climate system, society, etc., etc. That has not happened and, the reasons why that hasn't happened are, I suppose, interesting (GR22).*

Multiple interviewees stated that policy strategy should contain a long-term set of interlinked but evolving policies that are aligned against abstract policy goal(s). The strength of using a policy mix lies in its explicit and systematic recognition of aspects exceeding single instruments, such as interactions of instruments, the relevance of a policy strategy with long-term targets, and the importance of all-encompassing attributes such as comprehensiveness, reliability and stability (Flanagan et al., 2011; Rogge, 2020). The strategy should further consist of policy objectives and a principal plan required to achieve those objectives. However, interviewees noted that policymakers often held a short-term view, *'Whether at the time if you'd asked them is it going to be this policy all the way to 2020 or are we going to go through five-year iterations, I honestly don't know what they would have said ten years ago' (Interview GR14).* The hope is that a strategy that builds a set of interlinking and related policies whose combined use by policymakers is believed to give a higher degree of effectiveness than single policies alone can achieve. A prime example can be found in Ireland, where single policies were created in isolation without reference back from the market. Here, the CEO of a critical state-owned infrastructure firm is dismayed by the lack of a feedback loop from the market's reaction to a policy and new policy is created, *'How much of Ireland's success in RES was by accident and how much was by design? I think the jury is very much out on that because having put in place the recess model, the industry got into a hiatus' (Interview IR13).*

Therefore, a policy mix should contain conceptual policy goals, policy strategy, an instrument mix, and concrete policy instruments (Costantini et al., 2017; Guerzoni & Raiteri, 2015; Rogge & Reichardt, 2016). The instrument mix itself should contain multiple policy instruments to attain the objectives of a policy strategy, and each policy instrument should relate to a specific policy target that contributes to a policy objective. This framework is regarded not to have been used in an efficient way in the case study countries, and the policies which were implemented would have delivered a more productive approach if the UK or Ireland had used a more robust policy framework. This led to much frustration in the private sector with policy development in both the UK and Ireland, recognised here by one of the key policymakers, *'[…]everything else was bilaterally negotiated and then you moved almost instantly to auctions despite the fact that people had been told they weren't [going to be used]. Now people were able to participate in that, but it wasn't, […] I don't think it was a well-executed policy' (Interview PU21).* The view from the politicians was rather different, as illustrated by an EU elected official, *'Do you know I wouldn't have done nothing differently. I think we did it — I think we did everything well. We used our heads. We nudged it along' Interview (GE13).*

This research shows that policymaking is not an activity that exists only through a rational technocratic process. Rather, it has to account for various visions and values, differing voices from various lobby groups and, critically, the power of existing stakeholders as well as historical and cultural influences. As this ex-Irish minister for the environment points out, the connection between centralised policy goals and local government interest in making decisions based on their financial needs and own perceptions of their rights led to multiple policy failures,

> *Well actually, if there's no joined up thinking behind the policy, you know, sometimes you've got to say […] it isn't what the policy is actually saying, a local County Council is not linked in and they've just blown up the entire policy and that means that the cost of capital is gone up by X and therefore you suddenly close off the following coming into the Irish marketplace (Interview GR11).*

The policies, regulations and standards have also acted to stabilise regimes around incumbents. In the Irish case, this prevented actors from searching for solutions outside the regime and slowed progress, as explained by another ex-minister for energy,

> *I would say, look at the context, look at what we were trying to do, look at the state of debate, look at where the government was at, look at a host of different things and say […] you did this, it's incremental, all of these things, I believe. I'm a social democrat and there's a lot of things I want to see changing in the world, but I do think that change comes incrementally (Interview GR13).*

It was also clear that, given the capital-intensive nature of investments in energy generation, the regime in Ireland has been focused on protecting those assets from devaluation, which further strengthened the status quo.

> *You'd have to say on reflection it's been successful because we've got down the cost curve and we have got stuff built, right? Of course, […] the rear view mirrors is a fabulous thing. And you can say, well if you'd waited until [...] later, you would have saved more money. But then if you had done more later maybe you wouldn't have got that on a cost curve (Interview FU12).*

The Dangers of Lock-in

This points to how both the regime in general and the energy system are not constructs that are easily changed. Although policymakers were very aware of this situation, as we have seen, it was challenging to prevent, even at the level of a UK minister for energy, *'We were driven by [the] need to have low carbon, but we needed it to do it in a way that was affordable to consumers. So, we simply go pursuing ambitious projects which ultimately were going to lock us in and we wouldn't get that better cost benefit at the end of it' (Interview GU12).* As has been discussed, socio-technical regimes are affected by landscape factors, such as the prices of hydrocarbon resources, global GDP, security situations, demographic trends and environmental difficulties, as well as how often government changes and the subsequent changes in priorities. Interviewees remarked on the latter factors,

> *The one positive thing you could say is that there is an acknowledgment at the highest level of government that we do need to have a very strong climate change action policy. It is just, how do you transfer that down from the highest levels into the actual Department in a meaningful basis that goes beyond just a five year[…] or a potential two-and-a-half to five-years term for an elected official. That is the area we struggle with. We just haven't managed to find an elected official yet who had the strength of voice to advocate strongly for a strong change (Interview IR21).*

This lock-in can, in socio-technical regimes, produce an innovation culture that reinforces existing technological paths.

The data provides broad evidence that challenger firms are the major beneficiaries of the energy transition in the UK, and to a somewhat lesser degree in Ireland, *'Listen, […] I think certainly the wind energy industry did very well from the policy' (Interview GR21),* as an ex-first secretary of the energy department laments above. Among this grouping, the medium-sized and large renewable energy developers and asset owners are the primary beneficiaries in both the UK and Ireland, rather than small producers or independent community-based asset owners or those involved in distributed generation. This situation was acknowledged by a leading

backer of those larger firms through his role as CEO of one of the largest pools of capital available to renewables in the UK, *'[...]but at the end of the day, onshore wind developers who scraped in, in the long transition period and sold their projects under the RO, made enormous development profits and premiums' (Interview FU11).*

This situation was most pronounced in Ireland, where not only did the larger firms benefit, but the incumbent utility also maintained its position of dominance, much more than the UK utilities. In the UK the firms lost market share while gaining excess profits for a period, *'[…]all of the European utilities have I guess the lion's share of the development profit … out of the UK energy policy in renewables' (Interview FI12).* Protected niches supported these challenger firms, and without their activities, this research would point to a much slower transition due to the lock-in exerted by the incumbents, as can be seen in Ireland with ESB *'They're owned by the State and they would have had the technical knowhow, the financial knowhow, they've been around for a long time, they know how to go in and inform and influence in a positive way towards what they need to do.' (Interview GR11).* This shows a broad trend toward the substitution of incumbent utilities by challenger firms in the transition toward renewable energy across the EU. The downfall of German utilities such as E.ON and RWE may just be the early signs of a much broader shift in power markets, unsurprisingly put forward by the CEO of a renewables industry lobby group, *'I think the losers are the industry that you're trying to replace. So the likes of coal, oil and gas industries that have lost out on market share because policy has decided that that's not the future that they want' (Interview LR13).*

A policy mix allows for innovations, which could then form the technical basis for different pathway developments. Socio-technical regimes are produced in niches, which develop in ways that cannot be predicted. This research shows one of the most important innovations has been the protection and development of the offshore wind sector in the UK,

> *I suppose the industrial dynamics and the economic dynamics have changed immeasurably and of course technologies have changed, I mean we now […] have a situation whereby in Southern Europe solar dominates, North Western Europe wind dominates. And now, of course, offshore winds — and nobody would have thought [that] when the actual banks were being built (Interview IR12).*

Niche Management

Innovations that could disturb regimes and enable new pathways to the transition require a level of protection due to them possibly being risky to develop. To bring them into the regime also entails a high cost, whilst by their nature, they are not in keeping with the present operation of the socio-technical regimes. It is clear that offshore wind was thought of in those terms in both the UK and Ireland, explained here by a senior civil servant of the UK Department of Energy,

> *The context was, of course, the decarbonisation targets set by the climate change act which had just at that point been passed, the renewable energy targets and the 2020 package. We clearly knew that the UK was not going to hit those targets without major policy reform. At the time there was deep, deep scepticism in Whitehall about the ability for us to even make a fist of meeting those targets. So, when we think ten years on from the climate change act and renewable energy targets it's important to note the amazing success the UK has had in decarbonising its economy (Interview GU16).*

Innovations protected in different niches are critical in the transition, and the management of those has to be supported and achieved through strong government actions.

> *But then when the coalition government came in, in May of 2010, the policy became, for electricity, […] part of the overall electricity market reform discussion. So we were working together […] on how we were going to set up the electricity markets in the UK. This was one big team effort, including the renewables people, or me anyway, and my Chief Executive and a few other people (Interview GU12).*

Niche expansion is dependent on several factors to create the required events for achieving commercial sustainability and subsequent advantage over regime technologies. These include a sympathetic institutional structure and socio-cultural environment (Roberts & Geels, 2019), and approaching goals with a creative and holistic understanding.. As one interviewee commented, *'[...] it wasn't so much looking at alternatives, it was thinking about okay, […] converging on this is what we want to do for electricity in the UK, electricity markets in the UK. And these are the goals we are committed to achieving and how do we evolve towards that' (Interview GU12).*

Socio-technical regimes are complicated and developing systems, and as such, it is vital that a portfolio of niches is retained to achieve multiple options for pathways (Johnstone et al., 2020; Stirling, 2011; Zeppini & van den Bergh, 2011). As discussed in Chapter 4, the increasing environmental concern of individuals and communities should be thought of as a landscape change. This creates a requirement for government, companies, and organisations to react to those concerns whilst creating space for niche alternatives to be adopted and grow to compete with the leading technologies. Policymakers in Ireland and the UK could create opportunities to improve the design and evaluation of policy instrument mixes if they thought more of policy mixes rather than sequential initiatives. The policy mix lens emphasises the need for advocates, communities and other decision-makers to understand combinations of instruments and the ways in which they may or may not correspond with the desired outcomes. As an interviewee who approaches policy development from his background as a climate scientist states,

> *[Policy] needs to encompass not just the transition for the energy system, the dependencies […], the infrastructures, the transport system, which obviously will need to be decarbonised as well. It will need to enable all of those community engagements and whatever. That's more than rural electrification. It's to the nth degree of rural electrification (Interview GR22).*

8.3 The Limits of the Private Markets

The global asset management industry had USD 89 trillion of assets at the start of 2020 (BCG, 2020), and as such is a vital enabler of our transition to a low-carbon economy (Busch et al., 2016; Louche et al., 2019). Private-sector institutional capital activities in renewable energy have proved to vastly increase renewable energy growth through large-scale infrastructure investment, though not yet to a scale consistent with mitigation scenarios that achieve the goals laid out in the Paris Agreement. The transition to a sustainable low-carbon economy has and will continue to have multiple and different implications for the financial system (Marx, 2020). It is clear that the transition requires physical, financial and expertise reordering changes and for investments to be allocated towards a set of new beneficial activities that work to

decarbonise the economy. The policy makers' role is paramount in that process, with the importance of government recognised by the interviewees, such as this policy expert from a key environmental lobby group, *'We'll say because […] the most recent Oireachtas Committee that was set up on foot of the citizens assembly is a really positive step in the right direction in terms of how government is thinking and the importance of climate issues' (Interview LR21).*

Different actors invest against different risk-return strategies, and therefore in other portfolios with different requirements for what risk they should bear. This matters not only for the path that the transition in Ireland and the UK takes but also for the investment pace. As we have seen in Chapter 4, the single most crucial market driver of the transition and its pace is the significant decrease in the cost of solar and wind renewable energy technologies. *'The bit that we did not know, and we got completely wrong […] – I don't think I'm alone, or Britain's alone in the world on this – was the speed of decline in the cost of solar. And we clearly over subsidised solar' (Interview GU13),* one interviewee admitted, which, given his role as a UK government minister who oversaw the same subsidy regime, demonstrates the significance of the decline. This decrease, leading to a growing cost advantage of these technologies, has played a crucial role in raising the interest of firms and financial investors. That interest has also been a destabilising factor for the incumbents (in particular the utilities), but it has also highlighted the limits of the private sector's ability alone to create the necessary conditions for the transition. Recurring financial crises have also shown that the financial system is practised in generating substantial global volatility (Bardoscia et al., 2017). As such, the system's ability to maintain a focus on the transition has to be managed through strong government attention. It must be complemented by public policies and the continued strong role of government. Yet neither the private sector nor government leadership has generated the situation which allows Ireland or the UK to have any chance of success in meeting the Paris goals (Glynn et al., 2019; Roelfsema et al., 2020).

While pushing financial resources toward renewable energy technologies, both market and policy drivers have been too concerned with adverse effects on financial stability triggered by the writing-off of carbon-intensive assets. In the Irish case, this has been exacerbated by the protection of incumbents, clearly frustrating to the new actors, such as this CEO of a new renewable energy investment house, '*I think it's all pretty straightforward and clear, I think that the government do a lot sometimes to obfuscate the […] less politically acceptable choices […] that are being made' (Interview FI11).* Government still has a critical role to play. While

innovation, private-sector actors and landscape factors have played a significant role, as has been discussed in earlier chapters, states need to continue to push new ideas on how the state and the market interact. This interaction is informed by the crisis of climate change and is an evolutionary process involving learning from the market developments which have already taken place. According to one renewable energy lobbyist interviewee,

> *[...] if you look at the new industries, which is energy storage and easy charging infrastructure, the reason these two industries are now riding so fast and so well, it's because they invented policies and infrastructure of renewables for the success. And, we are managing now, having something in place and learn from those things the last eight years, in order now to be able to go to the next level of development of this infrastructure (Interview LU12).*

The government, therefore, has enabled some significant development in renewable energy, but that progress has also encouraged other actors to believe, and require, that government maintains its key involvement in the transition. Those actors will also look to crucial landscape factors such as global economic activity and, therefore, economic growth rate whilst making decisions on further investments in innovation and technologies to enable the transition. But government's role cannot be overstated. These factors are not necessarily averse to the transition, and it should be noted that even though a period of global economic slowdown post-2008 (and during 2020 with the COVID crisis) the increase of renewable energy generation as per the overall grid did not decline. These profound changes of the global environment also create space for new concepts and proposals, recognised by this finance leader from the private sector as being supported by the state, *'Where we are seeing a lot of activity and intervention and interest from the government is in the innovation end of the spectrum. Areas such as battery storage, electrification energy, charging networks, maybe even at the technology end' (Interview FI12).*

Sluggish growth and changing patterns of employment have favoured using the move to a low-carbon economy as a growth narrative. The Green New Deal initiative in the U.S. is a prime example (Galvin & Healy, 2020), arguing for the introduction of carbon pricing and other instruments aimed at decarbonising the economy whilst creating incentives to expand economic growth. Indeed, in the UK, the leadership position in offshore wind, and in general around the financing of renewable energy, is regarded as a positive for the economy. It is

considered now as an essential industry and, though the interviewee here, a former chief scientist of an oil major, comments on 'development', he uses that term to refer to the financing of those power plants,

> *Because we have proven that we can produce […] clean, green, affordable electricity out of renewables. We have also established that apart from our own electricity generation and consumption, it also has become an export product for us, hence, a lot of British companies are now enrolled, including the company that I am involved with […] we are involved in development of gigawatt of solar assets globally, whether it's in South America, North America, Asia, Australia, Africa (Interview LU12).*

From Enabler to Leader

Monetary incentives and private initiatives are clearly not enough to save our societies from the threat of climate change. are met the UK and Ireland commitments under the Paris Agreement (Daggash & Mac Dowell, 2019). Large policy interventions are needed to support the initiatives which are required for the energy transition. That those interventions as enacted by policymakers, regulatory bodies and executive, points to how the government cannot merely facilitate, rather it has to lead in creating the pathways of the transition to a low-carbon society. This leadership would require not just framing policy initiatives so as to encourage investment but punishing hydrocarbon pollution. The ability of the government to correctly set the level of monetary incentives to achieve the best outcome must also be questioned, given the expertise of government actors. In the words of one Irish executive in an international manufacturer,

> *I think REFiT was one of the most generous support schemes for either a project finance banker, or an equity investor, in the European market. I think it was very low risk, because the 80-odd euro that was being paid out for onshore wind, versus the marker price, and how that differential was being supported through the PSO levy, didn't take a whole lot of […] it didn't take a genius to work out that that was a very stable, robust income stream. […]again I'm talking about even five, seven years ago, people making very nice double digit IRRs off the back of the wind blows, and I get my support structure […] I think it was […] a fantastic structure for a decade, for both bankers and equity investors (Interview IR21).*

Policymakers cannot be concerned solely with the idea of fixing a market but with the creation of new markets and new means of participating in the activities that will combat the effects and direction of climate change. The data indicates that without a wholesale re-evaluation of the market, the positive use of regulatory measures, the innovative use of public capital, a long-term perspective and openness to multiple different pathways for our transition, the government will over-reward a small number of actors through incremental changes to rules – a situation in which they are very comfortable. Government needs to mobilise all other stakeholders across society to change our current path. The new paths, if followed, should lead to some radically different outcomes, here explained by a UK minister for energy, *'Alternatively, if you can get the cost of capital construction thereby so low, you've got zero costs, a zero marginal cost system. […] And by the way, it creates really challenging questions about how energy markets work in the future, how power markets work in the future, if you've got zero marginal costs and trying to get investment in' (Interview GU13).*

These outcomes can shift the private markets from their usual model of operation. Put another way, the determination to take the faster route to a low-carbon economy requires government direction and an approach that places government as the leader rather than the enabler, as mentioned above, as articulated here by an Irish government minister, *'But, as to the actual more hardcore decision making that needs to be made, it's a matter of judgement as to whether you […] or others, anybody, thinks the Irish system is moving quickly enough, in terms of its renewable energy plans' (Interview GR13)*. This approach reflects an area of significant concern for private-sector players, given the state's ability to crowd them out.

The private sector has progressively put in place more and more incentives for short-term returns, the opposite of how investments in climate change-related areas should be judged (Harmes, 2011; Louche et al., 2019). The data also reflects this point, as stated by the CEO of a major government finance arm in the UK, '*So, private equity taking development risk for higher returns at one level of risk tolerance, versus infrastructure capital on pension fund money, which was needed with lower risk and lower returns, which was needed to get that into cost curve and to deploy stuff at scale' (Interview FU12)*. Even within pension funds, which are customarily judged on long-term performance, those actors are often evaluated and rewarded using short-term metrics. These criteria are completely ill-suited to rewarding

investments in areas such as R&D and innovation, which by their nature have a very long time horizon, but are precisely the activities which need to be undertaken, as illustrated by the CEO of a major international finance house, *'And therefore, […] if you're setting policy, that I guess the outcome of that policy is that there's a development risk-return equation, you want to make sure that there are enough market participants playing in that, in order for there to be a vibrant development community' (Interview FI22)*. Overall, these arguments emphasise the major constraints on firms' and investors' climate change responses, even while more and more firms acknowledge the existential risk of climate change to themselves. The extended time horizon of both the cost of climate change as well as the opportunities are ill-suited to the, all too familiar, short-term perspective in which investments are evaluated and decided.

The history across the EU and in Ireland and the UK has been one of the government playing a crucial initiating role and creating a framework of support for private-sector entry (Craig, 2020). That initial role has often been viewed as critical, to allow innovation time to prove itself as mature, as recognised by the UK minister here, *'I think the government […] was trying to move a bit too quickly to that competitive approach because it doesn't give enough support to emerging technologies' (Interview GU13)*. Innovations sponsored and encouraged to grow in protected niches combined with multiple positive landscape factors have been responsible for a massive growth in renewable energy. That positive environment has not always been consistent though, with government policy being subject to change or longer-term commitments being cast into doubt (S. Bell, 2020). The removal of solar subsidies in 2012 in the UK is an example of where an unexpected move by a government led to the complete collapse of the market (OFGEM, 2016).

Interviewees then expressed surprise at how long the state needed to remain a key player, described here by a UK Conservative minister for energy, '*Much longer than needed, because we consistently underestimated…' (Interview GU15)*. Subsequent market developments, some of which were out of the state's control, prove that point and have largely reinforced the necessity of the state's continued involvement. The issue of control of cost recurred in the data, as explained here by another UK minister for energy,

> *[T]he lights have stayed on and bills have risen, and that has caused political controversy and of course resulted in the price cap that has just been introduced. But that was to some extent the price of decarbonisation, there was going to be an impact*

> *and of course, wholesale price movements and nobody can control the price of gas, plainly. So I think to some extent that is out of any government's control (Interview GU13).*

And again, by the chair of a major industry lobby group,

> *Whether we can achieve all of these goals in four years or three years or ten years, it really depends on who the government is at the time, what is the general economic situation of the country, and how quickly technologies can be developed so they can become more efficient, more advanced and more affordable. Then that policy can get adjusted depending on these parameters, which is outside the directing movements of the policy makers (Interview LU12).*

Nevertheless, we are not yet at the point noted above, where economics will take over from politics.

To maintain the transition to a low-carbon society, the state as an investor must be comfortable with the long-term nature of the investments and acknowledge and understand their risk with public finance. Given the massive task of replacing a decades-old infrastructure using new innovations and technologies, to build capital-intensive infrastructure assets, it is difficult to imagine that indirect public policies and private capital are all that is needed. The history of the development of the renewable energy sector, as well as from other historical transitions (Meadowcroft, 2009; C. Roberts & Geels, 2019), points to the role of government supporting (through the capital, direction and benefits) and working with an active group of actors who can foster innovation in niches and bring them to an established position in the regime. This raises questions on how socially desirable different transition pathways are, in particular, a more disruptive substitution pathway versus a more incremental transformation pathway. However, policy design is likely to influence whether there is also a substantial constituency of smaller distributed self-producers and solar PV generation ownership. This speaks to broader debates on the distributional dynamics of policy responses to climate change, such as the debate around energy democracy.

Energy Democracy

The transition towards low-carbon and renewable energy has occurred concurrently with some movement away from a solely top-down approach, where power lay with the regulatory bodies and the utilities, toward a combination of communities and NGOs able to exert a significant amount of influence (Eriksen et al., 2015; S. Hall et al., 2018). Local energy transitions have become a focal point of interest in both well-established and emerging fields of research, such as energy and environmental policy (Markard et al., 2016; Mattes et al., 2015; Stokes & Breetz, 2018), regional development (Goldthau, 2014; McMeekin et al., 2019; Monstadt, 2007) and sustainability transitions (Coenen et al., 2012; Hansen & Coenen, 2015; Farla et al., 2012). This transition process, which enables local communities, is apparent in diverse countries, from EU member states to regions of the U.S. and countries in Africa and Asia. The latter also brings to the forefront ideas around non-centralised renewable energy and how to accelerate the development of countries in the Global South in a sustainable way. Such ideas are also seen in communities' growing participation in choices about the energy mix and where new renewable energy assets get built. Many interviewees state that it has been a considerable component of the way the UK and Irish governments need to have developed a transition to a low-carbon society, here clearly summed up by a leading climate scientist,

> *You need this overall transition plan. You need it at a technical level, then you need it at a human level. Doing that is the key challenge, but first you need it at the technical level, and you need to have these pathways, you need the discussions between the practitioners — the engineers, the economists, the agriculturalists, all of those things. You need those pathway discussions to happen. […] once you've got a fairly coherent narrative among the practitioners, you then have to sell it to communities (Interview GR22).*

This transition process was less commented on concerning Ireland's approach, though Irish policymakers from the climate change and energy department gave some acknowledgement of the problem, *'Other metrics we will be considering and we will want to keenly follow will be […] the level of […] community participation that we achieve with the new policy' (Interview GR24)*, perhaps for reasons we will touch on below. By contrast, the UK Low Carbon Transition Plan on National Strategy for Climate Change and Energy (2009) (Department of Energy and Climate Change, 2009) made much of supporting local through providing funding for them to have new local projects.

The expanding role that societal actors play in decisions on how renewable energy assets get built, under what ownership and for which community is increasingly important and has now been grouped under the broad term of 'energy democracy'. This importance needs to be reflected in policymakers' work and was highlighted by the global manufacturers, such as this CEO of one of those firms, as critical for local acceptance,

> *We strongly believe, I say this as [though] we're some sort of cult or religion, we're not, but we do believe that allowing people and giving people in communities the opportunity to generate their own renewable power, connecting to renewable energy, that is more important than the megawatts or gigawatts that they may or may not be producing through their roof in terms of their acceptance of the transition and acceptance of renewable energy, so it's bigger in their area […] (Interview LR21).*

Three areas have been identified which support energy democracy initiatives in practice: to change the dominant energy agenda, restructure the energy sector regime, and pursue high renewable energy deployment levels (Burke & Stephens, 2018b). These goals support further aims, such as decentralising and distributing economic and political power; forming new coalitions of social groups; and normalising the community control (by improving the strength and capacity of that community) of the energy system. It was clear that many policymakers in the UK were aware that there needed to benefit local communities in the advancement of renewable energy, and much effort was made on that basis. As described by the CEO of a large developer operating in both the UK and Ireland, the private sector's reality was that requirements of these complex projects with an international supply chain and short lead times meant that the local context was minimal.

> *Planning is difficult enough, but when you're developing a renewable energy project and you're shipping in turbines from […] Denmark or Germany, it's very difficult to point to many jobs. They're relatively short construction periods. There's no manufacturing to speak of and from an ongoing operations perspective, again very light in terms of boots on the ground, and then the turbine manufacturers who sort of ship people in. So, that's always been a bit of an Achilles' heel, frankly, for the UK and Irish industry (Interview II123).*

It was also clear from the research that the position taken in Ireland was one of grave suspicion of communities and their involvement in local decisions, even from the level of this ex-Irish minister for energy, *'And we can't afford to be indulging in this bullshit, in relation to wind, I mean I'm not saying you put wind turbines everywhere, of course there has to be planning, but you can't be going backwards'(GR13).* As discussed in Chapter 6, this approach led to significant contested areas around onshore wind development, where communities felt that policy was determined in Dublin with little reference to their needs. As expressed by another ex-Irish minister for energy, the challenge was that politicians felt they had little choice but to be seen to run against government policy in support of local communities.

> *And that depends on them [politicians] thinking, actually yeah, the public are with us on this. And the problem you have with people like Prime Time on RTÉ ….. And that as a minister, being honest, is probably your first thing, is thinking, shit, I need this to be seen as the public (Interview GR15).*

This lack of engagement with communities and with the demands of the energy democracy movement, in general, could be argued to have led to a much slower transition in Ireland. Ireland, therefore, appears likely to not only require a strengthening of existing policy instruments and the development or adoption of other policy instruments, but the communication of the benefits to local communities. As an ex-Tánaiste of Ireland articulates.

> *The resistance to the building of, the erection of wind turbines and, that was strongly resisted by lobby groups throughout the country. ... They were very, very vigorous in their opposition to the roll out and that proposal. In some cases, the Local Authority had proposals to limit and restrict what was being done. There was a perception that the wind turbines were going to create noise. That they were going to destroy bird life. That they were going to be dangerous and so on. (Interview GR12).*

8.4 Summary

This chapter presented a series of policy-relevant insights apparent from the data and can aid policymakers in their future endeavours. In doing so it answered the fifth research question, **What can be learned from the analysis that will contribute to more effective policymaking in the case study countries?** This research and subsequent data inform policymakers seeking effective renewable energy (and other) policies. Systemic change is interdependent and unpredictable and requires a flexible approach, and in support of that, policymaking has to manage a diverse set of values, visions, interests and stakeholders. Three focus areas for transition are clear from this research: the timing of changes and the value of a policy mix, the power of incumbents' vs the power of 'free' markets, and the importance of energy democracy.

Identifying gaps and inadequacies within the mix of policy instruments and thoroughly assessing the implications for an intended outcome is a valuable process. Thus, there needs to be a feedback system involving advocates, communities, and decision-makers, which helps in identifying weaknesses in the policy mix. This method reflects the complexity of socio-technical transition and its requirement for a lateral, not a top-down, approach. Financial markets have a role in allocating capital to decarbonising activities, but the government needs to provide leadership in the form of long-term focus, creation of new markets and ways to participate. Utilising a policy mix builds ways to transform and strengthen the mix in order to make it more effective. The policy mix lens also urges more significant consideration of potential trade-offs among policy instruments (Costa-Campi et al., 2017). Temporal trade-offs among policy instruments intended to address different overarching goals represent one kind of important trade-off, i.e., some policy instruments emphasise more immediate effects. In contrast, others are designed for long-term system change.

Strengthening existing instruments could involve finding ways to better relate a given instrument to a broadened set of intended outcomes, thereby shifting from a modest to a strong relationship to the associated energy democracy goal. A meaningful example might be improving the capacity for participatory planning and deliberation within the public sector and among local communities. The necessity to innovate policy instruments is also likely,

especially to enhance the effectiveness of efforts to resist incumbent regimes. More direct instruments may be developed or brought into the core set of policies to address additional outcomes, for example, democratising energy companies in the private sector through employee-ownership options or joint public-private enterprises. All of these point to a series of trade-offs between transition speed and socioeconomic stability, which then necessities concepts of Energy democracy to be made real to allow for a broader buy-in of the transition.

9. Conclusion

9.1 Introduction

This thesis aims to establish how socio-technical changes interact with renewable energy policy, its creation and implementation. To do so it posed the following research questions.

Research Questions	
RQ1	How did renewable energy policies develop, what are the categories of national renewable energy policies and what policies were implemented in the UK and Ireland?
RQ2	What factors influenced the design and implementation of those policies?
RQ3	What are the main determinations which have defined policy effectiveness?
RQ4	Which groups benefited most from the implementation of policy instruments?
RQ5	What can be learned from the analysis to enable policy makers to better design, formulate and implement appropriate policy in their jurisdiction?

These questions are explored through the use of case studies of Ireland and the UK from 1995 to 2015, with renewable energy policy supporting solar PV and wind as the crucial

technologies. Given this research is interdisciplinary, it had to bring together three threads of previous research concurrently: the area of energy policy, policy theories and ideas of socio-technical transition. In doing so it showed that the interaction among actors and their broader context is critical in determining the pathways of the energy transition. Several themes were identified in the literature review as gaps in research to date, which this research addressed.

- Do transitions occur due to practices from landscape, regime or through niche developments?
- How particular policy mechanisms change over time during a transition
- The development and implementation of new policy frameworks to improve transition projects' efficacy at local, regional, national and international levels.

This final chapter synthesises results, identifying key contributions to knowledge emerging from this research. It also outlines several policy recommendations and suggestions for further research which counteract the limitations of this thesis. Those recommendations establish several important actions to support our transition to a sustainable and low-carbon society should be considered by policymakers.

The chapter is structured as follows. First, there is a discussion of the main findings from the empirical analysis, containing several conclusions derived from the work. Second, some of the broader implications of this research project are examined. Finally, some new possible research avenues following on from this work are put forward.

9.2 Contributions of the Thesis

This research has made significant contributions to the literature from multiple perspectives: theoretical, methodological, and contextual. It contributes to understanding by revealing the socio-technical attributes of the EU, UK, and Irish energy systems within transition processes towards a low-carbon society. Additionally, this research contributes to a theoretical

comprehension of renewable energy policy's effect, which contains distinctive socio-technical attributes.

The semi-structured interview supplied essential understandings for methods of advancing renewable energy policy in the UK, Irish and EU contexts and offered a distinct set of empirical discoveries. This qualitative analysis provided personal insights from key actors who participated in the transition process of the energy system. It did so by assessing various factors, comprising landscape themes and the relations between actors, institutions operating in both niches and the regime. Significant work was undertaken in involving the most prominent and important actors, representative of the crucial groups within the sector. All key stakeholder groups have been represented by interviewees at a very senior level, and a wide-ranging and distinct variety of viewpoints were gathered through the fieldwork.

Using a transitions theory framework, this thesis described the main attributes of the EU, UK and Irish energy system and how these attributes were embedded in the UK and Ireland's historical social-economic context, with the activities of actors from industry, finance, technology, and government. From Geels (2018), this thesis showed that the UK and Irish energy regime is being formed by negotiation and contested spaces with new market actors and incumbent actors. As considered during this work, actors' activities in influencing a new socio-technical system, like the renewable energy system, means their role was also found to be a vital concern. This signalled that actors' activities in modifying niche developments and influencing the energy regime pathways are critical.

The research framework delivers additional assessments of the consequences of the interaction among groupings of different actors considering renewable energy technologies of solar PV and wind. The work validates concepts of the niche and regime, and their interactions, which are described in transition research and validates the constructive/ interpretive position of actors in the transition process. The work shows how the regime has the capacity to evaluate how a new niche's advancement relates to incumbent regime arrangements and explains how to recognize transition pathways for the energy regime. Therefore, the data presented in this research enhances our knowledge of interaction within the socio-technical system and adds to deliberations in this field.

Contribution to energy policy theory

This study contributes to energy policy theory by showing empirical cases of renewable energy development according to the changes in policy and policy measures over time and by providing empirical findings and conclusions. While existing studies list key factors for renewable energy development in general, this work presents significant elements and influential factors chronologically to clarify their effects on renewable energy development in the UK and Ireland. In the case of specific features, previous research has dealt with the obstacles or accelerators in terms of renewable energy deployment rather than empirical data gathered from leading actors in policy development.

In this thesis, the various aspects that highlight the significance, in our transition to a low-carbon society, that renewable energy policy holds were discussed. That transition requires creativity and for actors to be able to create and protect innovations through niches. Critically, those innovations are not only technologies but also business models.

Policymaking that aims for significant changes to the regime, which clearly includes renewable energy policymaking, needs to work to bring various actors together and build consensus around creating a pathway to that change. Therefore, coherent and understandable policy processes, with constant and methodical feedback loops containing possibilities for remedial action, are of most value.

Empirical Contributions

This research has developed the literature on the socio-technical aspects of the renewable energy system in Ireland and the UK. The existing research has principally concentrated on the energy system's technological and economic attributes during its transition process. The study delivered a unique understanding of the transitions to a low-carbon energy regime, given its emphasis on interactions between multi-level actors and analysis of incumbents' position. Given the increasing importance of renewable energy as part of both the Irish and UK energy mixes, understanding the consequences of such actions on its development is highly valuable.

At the landscape level, major macro themes, such as the trilemma of energy security, affordability, and climate change, are clearly important themes presented from this research. This affected climate policy in the EU, and in Ireland and the UK as member states, driven by the EU's desire to combat the causes of climate change, and a strategic need to attain greater energy security and affordability; as well the economic opportunities presented by the energy transition. This research clearly outlines how policymakers' perspective on developing a series of energy policies over time is needed to create a successful energy transition. It also shows that a series of policies should be designed to allow protected niches to develop and for the regime to manage pathways to a low-carbon energy system best. The UK took a leadership position through the development of the offshore wind industry, in contrast to Ireland, which has been slow to foster a niche in this sector. The assessment of the exchanges amongst multi-level actors, given the various factors in both the UK and Irish regimes, provides an improved knowledge of the development of renewable energy in the processes of transition to a low-carbon society.

This research found that interviewees deemed the public was willing to accept the extra cost for environmental benefits and, at a local level, increasingly active in renewable production, distribution and location selection, though they do not seem to be benefiting economically. The research found that public entities suffer from a lack of energy expertise, which is concentrated in incumbent firms. Those incumbent firms and other market actors are involved in contested spaces, with tension over the accrual of economic and knowledge benefits to the finance sector over manufacturers/distributors. This has led to a cementing of the power of finance in energy markets and, by extension, in policymaking. Surprisingly, especially given the attention paid to climate change in media and public discourse, a number of interviewees described NGOs' roles in the development of renewable energy policy as having had minimal impact compared to the impact of firms, both utilities and finance houses.

The crucial characteristics of renewable energy policies are remarkable due to the range of landscape effects that affect renewable energies' growth and how the policy was developed to enable that growth. In many debates around the development or implementation of renewable energy policies, these characteristics can be seen only briefly; researchers have focussed on one or more sub-aspects of this subject. This research provided insight into how actors can influence the pathway in a transition to a low-carbon society.

Policy Implications and Recommendations

This research provides policymakers with significant insights and practical ideas in two ways. First, this work identifies the suite of variables and actors who can shape transitions, and points to the importance of context for understanding how transitions can occur and be shaped. Second, this work can help policymakers in leading industrial countries who aim to advance their renewable energy development to prepare for the future (for example, by showing the importance of protected niches). The frameworks developed can act as lenses that magnify and focus on critical elements for other technology-driven sectors by providing insights into policy-making areas.

It is clear from the data that EU policies mobilised actors in both the UK and Ireland to create a policy that would allow the state to meet the EU's targets. Attention to targets from Brussels became the primary focus of policymakers in those countries throughout this period. It is also clear that, without those targets, the other factors at play would not have been sufficient to motivate policymakers around new material initiatives in support of renewable energy. Once those targets were understood, the UK policymakers approached their achievement as a way to push what they regarded as their leadership in energy policy. On the other hand, the Irish position was to see the targets as a burden, with no goal apart from adherence. Meanwhile, industry actors had different viewpoints from government participants on the ambition and organisation required to achieve the new targets, whilst espousing that policymakers deliver a convincing stable policy environment with a flexible policy mix.

Across Europe, incumbent utilities have been negatively affected by the shifts in the energy system over the period of this research and, consequently, have had to work to change their business model drastically. This thesis emphasised the crucial part of the incumbent and new niche actors. Any disruption in an actor's relative position (such as a diminished status of the incumbent utilities) is a material change in the socio-technical system and entails niche developments in technology, business models and types of new actors rising to become embedded in the regime. Therefore, that regime has already undergone a material change in the UK and Ireland, but the data points to a slowing of the rate of change due to the utilities'

actions. The utilities' ability to slow that change needs to be seen in the context of weak institutional capabilities. In this context, the skill sets, and government expertise need to be improved to allow a more level playing field to be reinforced.

This thesis has demonstrated how, in the UK, there are two differing examples of policy approach supporting solar and offshore wind. The solar industry, after significant growth, went into near collapse after sudden changes in the policy framework. From 2019, with the continued reduction in manufacturing cost, it has recovered, even in the absence of policy support (BEIS, 2020). On the other hand, offshore wind has benefited from long-term policy certainty, which has continued to support the sub-sector's significant growth (offshore wind in the UK has become the most cost-efficient renewable energy technology). Policy certainty has also created opportunities for the industrial companies that are manufacturing renewable energy technologies and for large developers to have additional partnerships and initiatives with energy companies. This situation should lead, one would hope, to further innovation. The role of a multi-level actor in promoting niches in various sections of the energy system and integrating these niches into the existing policy mechanism should be supported. Ireland, in contrast, was shown that the effect of a lack of support from policymakers for either solar or offshore wind policy initiatives (up until very recently) has led to the total absence of the offshore wind or solar industry as percentages of the energy system. However, it is clear that the EU and, furthermore, the member states looked to the market to mobilise the growth of renewable energy and to the private sector as the enabling function to bring about this transition. Renewable energy policies needed to be ambitious, building on deployment and cost-supporting niche developments. That ambition needs to be combined with more resources and more extraordinary powers for local communities will ensure local action potential is realised.

9.3 Limitations and Avenues for Future Research

During this research, there was a determination to prevent bias and provide many theoretical and practical contributions, but some limitations do exist. These limitations are discussed

below in terms of the five evaluation categories – validity, credibility, reliability, objectivity, and generality (Robson, 2011; R.K. Yin, 2003) and suggestions for future research are also offered.

Validity, Credibility, Reliability, Objectivity and Generality

Through the use of suitable research methods, this work has attempted to boost both internal and external validity and credibility, reliability, objectivity, and generality. Limitations, though, remain. The researcher, no matter the steps they take, has a biased point of view. The use of multiple sources and confirmation of concepts and themes through interviews is critical to lessen the probability of that basis affecting the research. The researcher's intrinsic bias, formed from their set of experiences and personality, is, though, a possible risk for the entire research, and this work is no different. The group of positions that the researcher brings to the research could therefore reduce validity, credibility, or objectivity as it would hinder the selection of wholly objective, significant events to analyse, as well as and the identification of relationships between the activities. This researcher feels that the set of experiences brought to the work has helped in multiple ways to build an important and unique study, and has identified ways to minimise the negatives whilst acknowledging the benefits of an extensive network of individuals in the sector, and multiple years of engaging with over the planning, development and financing of renewable energy assets across Europe.

There is a possible risk of bias in the data selected, notwithstanding the triangulation for validity, credibility, or objectivity. This research’s data primarily relate to historical events, and the analysis of the effect of different interactions largely hinge on retrospective interviews and existing explanations. Interviewees could have conveyed partial or erroneous answers owing to memory, and that information from documents might mirror the authors own bias (Gray, 2012).

This study could be verified using feedback from interviewees, other researchers and related experts (Gray, 2012; Yin, 2013). The research findings are based on interpretation rather than the immediate adoption of interviewees’ opinions. Therefore, the responses of interviewees and related experts could improve the quality of this research.

Finally, this research is additionally constrained due to time and cost, which reduces the degree to which the work has been assessed for external validity or generality. Even though a multiple-case study approach has been used, only two countries have been included, and as such the research might not be generally applicable.

Opportunities for Future Work

This work has progressed several research issues on renewable energy policy. However, further research is recommended to fill the gaps arising out of the study's limitations and improve the current outcomes. Six topics require ongoing evaluation. The established concepts and frameworks developed from other fields (such as neo-institutional theory, actor-network theories, economics, political sciences) could help deliver different viewpoints.

First, improved insight into how interactions between different actors affect the transition, which actors are important, and their efforts. This is especially important as it is clear that these interactions are a critical factor in new pathways and our transition to a low-carbon society. Foxon (2013) lays out paths to the low-carbon UK in 2050 by focusing on various actors' interactions, who they group into the market, government and civil society. Foxon and Pearson (2008) describe government, firms and other stakeholders as having a central role in a system change and the diffusion of low-carbon technologies. Mitchell (2008) argues that the UK's political and ideological paradigm needs to change before a transition to a low-carbon economy is completed. As the need for transition is immediate, this highlights the challenges faced at the regime level. The enactment of renewable energy policies necessitates a fundamental measure of community approval. The essential need for societal acceptance of renewable energy policies is related to their distributional impact.

Second, as Van den Bergh et al. (2011) point out, policymakers need to control the dynamics of possible transitions and avoid early lock-ins. This point begs the question of how policy can be best set up to develop the transition on a 'least regret 'basis and manage the significant investment not to have wasted efforts.

Third, effectively incorporated economic data and analysis within transition studies could

provide a greater understanding of transitions. While socio-technical perspectives have tried to address the dominant themes of the debate on sustainable energy transition, they have not analysed economic incentives, and financial incentives have dominated policy in Europe's sustainable energy transition efforts. One of the most important is how one incorporates empirical data and its analysis into MLP to determine the context better that renewable energy policies are developed within and the outcomes of that policy.

Fourth, the conceptual frameworks and methodological foundations applied to both past and current transitions require elaboration. Existing conceptual frameworks must be challenged in terms of where they are applicable and what their limitations are.

Fifth, further research could be undertaken to evaluate renewable energy policy development in other countries with different socioeconomic contexts. Finally, research should be carried out to determine how Brexit changes renewable energy policy pathways and the altering role of actors.

9.4 Closing Thoughts

This research has shown how the transition to a low-carbon society and the growth of renewable energy has acted as a forcing function for extensive changes in society and created multiple contested spaces in the energy system, across the UK and Ireland. It also shows that government needs to provide leadership in the form of a sustainable and long-term focus on policy frameworks, to support the creation of new niches and their growth into the regime; and, as is clear from this thesis, to do so whilst understanding the strength, skillsets and market position of incumbents. The role of the ESB in Ireland's transition has been clearly articulated as significantly negative, and one which other actors felt powerless against. The complexity of socio-technical transition requires a lateral, not a solely top-down, approach to be successful; an approach that must also account for the power of incumbents if it is to be successful.

Policymaking must also include multiple targeted instruments in a policy mix as part of a strategy that works towards policy goals. The trend to move to auctions as the dominant policy

mechanism tool is clearly visible, as is the advantage that the UK gained over Ireland in using those auctions to both achieve lower cost to the public and develop new market advantage in the financing of those technologies, as seen in the offshore wind sector. There needs to be a feedback system involving advocates, communities and decision-makers, as the information from those stakeholders is critical in identifying weaknesses in the policy mix. The UK's position as a market leader and Ireland as a slow adopter puts the UK far in advance in achieving a significant acceleration of its transition. The next decade could be the most consequential in human history. We have to address the climate crisis with an urgency that society has not achieved to date, and therefore the contributions of this thesis on how to better accelerate our transition hopefully should, in some small way, help to redouble our efforts against climate change and all its risks.

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