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Energy Policies and Environmental Entrepreneurship: The Cases of Britain, France and Germany.

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Declaration

This thesis is submitted in fulfilment of requirements for the degree of Doctor of Philosophy in Stirling Management School at the University of Stirling, Scotland, United Kingdom. I declare that this thesis is based on my own original work except for quotations and citations which I have duly acknowledged. I also declare that this thesis has not been previously or concurrently submitted, either in whole or in part, for any other qualification at the University of Stirling or other institutions. I am responsible for any errors and omissions present in the thesis.

Signed ______________________________

Christopher Ball

February 2016

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Abstract

To respect climate change goals, reinforced by COP21 in Paris, an overhaul of the energy system in EU countries will be necessary and this will involve a major deployment of low-carbon technology (Stern 2006). Although the relative roles of green new ventures and incumbent firms in the dissemination of environmental innovation remain unclear (Hall, Daneke et al. 2010), entrepreneurship shows promise as a response to environmental problems (Anderson 1998, Schaltegger 2002, Hart, Milstein 1999). Since green new ventures are free from the innovatory constraints faced by incumbent firms (York, Venkataraman 2010, Hockerts, Wüstenhagen 2010), they are in a position to disrupt existing unsustainable markets. Designing and implementing an energy policy with an "entrepreneurial flavour" (Wüstenhagen, Wuebker 2011) could be advantageous in achieving a successful sustainable transformation of the energy system. This thesis examines how entrepreneurs perceive energy policy in three advanced EU countries using a case study approach, with each country constituting a case. Data sources comprised policy documents, interviews with entrepreneurs and key staff in new ventures, and field notes from practitioner conferences. At this critical point at which direct support for renewables is being withdrawn, it is argued that efforts must be made to retain this entrepreneurial force in the energy market. This thesis reflects on the degree to which the market-creating support mechanisms are being withdrawn. If entrepreneurship is to thrive in a post-support context, there must be consideration as to how to better integrate decentralised renewables into the energy market, especially in relation to how they can compete effectively with conventional technologies, namely nuclear and gas. In addition to alternative strategies to incentivise adoption of renewable energy technologies beyond early adopter consumer categories (Rogers 1995), building greater public consent to sustainability policies is crucial to the continued success of energy entrepreneurship. Geopolitical factors surrounding energy security may reinforce the case for continuing to support entrepreneurship in the renewable power sector.

Dissemination

Preliminary results from the current thesis were presented as papers in the following international conferences:

Conference	Paper Title
29th British Academy of Management Conference, Portsmouth, UK, September 2015	From Russia with Love: The Role of Geopolitics as a Driver of Energy Entrepreneurship. A Comparative Study of France, Germany and Britain.
15th EURAM Conference, Warsaw, Poland, June, 2015	Environmental Entrepreneurs and Incumbent Technologies: A Comparative Study of Perceptions Across Three Countries.
Social Transformations in Contemporary Society Conference (6), Mykolas Romeris University, Vilnius, Lithuania	The Transformation of the Energy Sector and “Citizen Energy”: Insights from Germany with Comments on the Lithuanian Context.
British Academy of Management “Born to be Green: The Economics and Management of Green Startups”, University of Southampton, May 2015	The Implications of Crowdfunding as an Alternative Finance Source for Environmental Entrepreneurs.
28th British Academy of Management Conference, Belfast, UK, September 2014	New Ventures and the Energy Industry Transition: The Policy Context in France, Germany and Britain.
59th ICSB World Conference in Dublin, Ireland, June 2014	Green Entrepreneurship in Energy in France, Germany and the UK: New Ventures and Entry Barriers.

Overview

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1 Introduction

It is argued that adopting renewable energy technologies can conserve natural resources and help to halt the worsening degradation of the natural environment by providing clean, carbon-free energy. Hawken, Lovins et al. (2013) call for an economic development which respects the intrinsic value of the natural world, and which takes wider forms of capital into account beyond merely the physical and financial, as under the conventional model of capitalism. Lovins, Lovins et al. (1999, P.146) envisage a natural capitalism paradigm as "what capitalism might become if its largest category of capital - the "natural capital" of ecosystem services - were properly valued". These eco-system services consist of the main components of the natural world upon which human society depends, such as the oceans, forests, farming land and the quality of air.

Likewise, Hart (1995) and (2010) argues that, in a future world characterised by increasing natural constraints, firms' competitive advantage could become contingent on their ability to operate in an environmentally-sustainable manner. Promoting renewable energy is a crucial part of achieving a more environmentally-sustainable economy and public policy has been designed to support environmental entrepreneurs who disrupt the existing energy industry and accelerate the shift to a more sustainable, renewable-based energy mix. This thesis examines how energy policies differ across Britain, France and Germany and how these policies are perceived by environmental entrepreneurs and by key team members within environmental ventures in the renewable energy sector. In section 1.1, an overview of the phenomenon of environmental entrepreneurship is given, covering certain major underlying theoretical bases. Section 1.2 outlines the overall aims and research objectives that will be pursued in the study. Background information in relation to the policy context of environmental entrepreneurship is discussed in section 1.3. In Section 1.4, the theoretical and practical implications of the work are proposed. The overall research design is covered within section 1.5 and the structure of the thesis is displayed in section 1.6

1.1 Subject of the thesis

Although a clear definition is elusive, several parameters are suggested which capture the phenomenon of environmental entrepreneurship. Under Schumpeter's (1944) notion of creative destruction, entrepreneurs introduce innovative products, technologies or modes of organisation which replace existing economic structures and have a competitive advantage in terms of cost and quality. For the case of environmental entrepreneurs, innovations have environmental competitive advantage over existing economic structures, in that they result in less harm to the natural environment (Schaltegger 2002). These innovations challenge the models of incumbent firms which have to adapt order to survive in the market. Environmental entrepreneurship is concerned with radical, disruptive rather than incremental innovation (Hockerts, Wüstenhagen 2010) and acts as a catalyst for the sustainable transformation of the economy. Hence, public policy has identified environmental entrepreneurs as prominent change agents when discussing measures to reduce environmental degradation. This notion of creative destruction, involving disruptive and radical environmental innovation, underlies environmental entrepreneurship.

There is debate surrounding which type of economic actor is more likely to lead these disruptive entrepreneurial activities which overhaul existing practices and give rise to the emergence of new business models. It could be suggested that new, innovative actors are more likely to engage in this activity. Several commentators point to small firms as embodying the characteristics of new and innovative actors – Anderson (1998) argues that small firms are less committed to conventional practices and Burns & Stalker (1961) claim that organic organisations are more innovative, with small, entrepreneurial firms characterised by this "organic" organisational design. Hockerts & Wüstenhagen (2010) describe such firms as "Emerging Davids" – rather small, rather new economic actors which attach equal importance to sustainability, in the form of positive environmental and social outcomes, and economic objectives. They compare these "Emerging Davids" to "Greening Goliaths", corresponding to long-established, large firms which prioritise economic over sustainability concerns. The advantage of "Emerging Davids" is, firstly, their values-based management and, secondly, that they are not afraid of the risk of sustainable innovation destroying the value of their existing products, services and production processes (Hockerts, Wüstenhagen 2010). The fear of cannibalising existing, lucrative revenue sources often leads to organisational inertia on the part of large organisations and this sclerosis prevents them from pursuing environmental entrepreneurship (York, Venkataraman 2010).

Schaltegger's (2002) framework presents an effective guide for identifying instances of green entrepreneurship. His notion is that mass-market actors - large corporations with sales of hundreds of millions of euros - were, indeed, true *ecopreneurs*, in view of their mass-market reach. He characterises *ecopreneurs* not only in terms of having a high sustainability impact, but also as actors with a high market impact, as discussed in section 2.1.

Environmental entrepreneurs reconcile ecological and economic objectives within a viable business model (Linnanen 2002, Parrish 2010a) and may be more commercially- or more socially-orientated (Pastakia 1998). They operate across different sectors – nature-orientated services, environmental technology, environmental management services and environmental products (Linnanen 2002P.73) and are driven by different factors; many are motivated by hard, structural influences (i.e. changes in legislation), whereas others draw on personal and family relationships (Walley, Taylor 2002). Whilst the founder of the environmental venture is important in disseminating the environmental vision within the firm

(Anderson 1998), other key members of staff, part of the entrepreneurial team, play an equally crucial role in implementing this vision; this idea of the “lone hero” in entrepreneurship is unrealistic (Cooney 2005).

1.2 Overall research aims

Hall, Daneke et al. (2010, P.446) identify “the conditions under which public policy influences the incidence of environmental entrepreneurship” as a research gap in the field of entrepreneurship and sustainable development in a special issue of the *Journal of Business Venturing* in 2010 (issue 25), on entrepreneurship and sustainable development. This special issue, in such a respected management journal, reinforced the researcher’s interest in environmental entrepreneurship and motivated the successful application to the Economic and Social Research Council to fund this PhD project.

Focusing on public policy, Hall, Daneke et al. (2010) propose three issues for further investigation, namely: whether public policy should prioritise incumbent firms or new ventures, whether the emphasis should be on demand-side tax subsidies for renewable energy or supply-side R&D subsidies for environmental technology and whether policies in support of economic growth aid the prosperity of communities and benefit the environment simultaneously.

The fact that sustainable entrepreneurship has featured in a top tier entrepreneurship journal is testament to its increased relevance to the academic and practical discourse. The fact that Hall, Daneke et al. (2010) have specifically identified the role of public policy as a research topic further justifies the focus of this PhD project which examines environmental entrepreneurs’ perceptions of energy and environmental policies, comparing and contrasting views in Britain, France and Germany. According to Lenox & York (2012), environmental entrepreneurship has centred on defining the phenomenon as an ethical movement and has yet to investigate its triggers empirically. Through an empirical analysis of environmental entrepreneurs' perceptions of external influences, this study proposes the following research aims:

- To explore and compare the perceptions of environmental entrepreneurs and key members of the entrepreneurial team within environmental ventures of common environmental and energy policies across the three countries featured in this study. Policies directly aimed at promoting entrepreneurship generally fall into two categories: more interventionist, social market environmentalist policies and more free-market environmentalist policies, focused on enabling markets for environmental goods and services (Isaak 1998). Social market policies include environmental regulations and public intervention to create a context more conducive to entrepreneurship whereas free-market policies may conform to approaches involving defining property rights relating to natural resources and, thereafter, creating incentives for entrepreneurs to develop innovations to conserve these resources and to halt their degradation (Isaak 1998). Attitudes towards wider energy policy will also be examined, as this indirectly impacts on environmental entrepreneurs - policy towards nuclear energy, for instance, has implications for the renewables industry.

- To explore and compare the perceptions of environmental entrepreneurs and key members of the entrepreneurial team within environmental ventures of policy differences across the three countries. Britain, France and Germany envisage the energy transition differently, in terms both of the energy mix –

in relation, for example, to the role of nuclear in a the future energy system – and the design of policy instruments to be employed to accelerate the deployment of renewable power. The evolution of energy policies may also be rooted in historical political decisions regarding the energy mix which influences the future development of the energy system. There may also be perceived differences in the public's willingness-to-adopt renewable energy technologies across the three nations.

- Through integrating the findings from the three cases, reflections on the "entrepreneurial flavour" (Wüstenhagen, Wuebker 2011) of the countries' energy policies will be made and suggestions will be advanced as to how to support the further expansion of renewable energy through entrepreneurship in the EU.

1.3 Background and context of this study

Following the seminal Brundtland Commission of 1987, global efforts to tackle climate change were initiated at the Rio Earth Summit in 1992, with annual UNFCC conferences taking place to attempt to reach agreements about how to minimise climate change. Global processes targeting climate change have had limited success, with Kutney (2014) describing the Kyoto Protocol as a failure, and John Kerry (2015) lamenting the lack of progress since the Rio Summit.

Helm (2005) attributes the lack of credibility associated with the Kyoto Protocol to its weak enforcement mechanisms which reduce the overall incentive for compliance and, therefore, innovation. In light of the flaws of Kyoto, the European Union would do well to reinforce its own strategies in this policy area. Jordan, Huitema et al. (2011) claim that climate change will be the dominant policy issue facing the European Union in the 21st Century, but that this challenge can also be harnessed to create jobs, stimulate technological innovation and ensure energy security. The fact that the EU exceeded its obligations under the Kyoto Protocol, committing itself to a cut of 8% on its 1990 baseline emissions by 2012 under the Kyoto Protocol compared to 5% for the other Annex-1 (developed) nations (Walz, Schleich et al. 2009) is perhaps testament to Europe’s desire to take a lead in combating climate change. To implement this ambition, the EU developed its own framework, in the form of the Climate and Energy Package, stipulating that member states must fulfil emissions cuts in addition to increasing the share of renewables in the energy mix and improving energy efficiency by 2020 (European Commission 2015a), with a new package having recently been developed for 2030, with more ambitious targets. EU member states must comply with the targets set out in the Climate and Energy Package, but they do have flexibility in designing policies to meet those targets. There is variation in approaches to energy policy across the three countries in this study. The abandonment of nuclear power by Germany, the heavy reliance of France on this source of power and the building of new reactors in Britain, covered in chapter 4, are an example of a stark difference in approach across the three countries. These factors are relevant, as the structure of the wider energy system has implications for new ventures in the renewable energy sector.

Britain, France and Germany are particularly interesting settings in which to study environmental entrepreneurship in the energy sector, as they have shown leadership on sustainable development. Britain’s Climate Change Act, featured in section 4.1.2 indicated a strong commitment to long-term decarbonisation, although the Britain has been criticised recently by the UN Environment Programme’s Chief Scientist for cutting subsidies for renewable energy (Clark 2015). In 2015, France pledged €1 billion to support developing countries adapt to climate change and hosted the international climate conference, COP21, in December 2015, demonstrating its leadership in advancing global efforts on sustainability. Germany is associated with sustainability, especially since the Socialist-Green coalition came to power at the end of the 1990s which made early advances in promoting renewable energy. In addition to being role models in sustainability, Britain, France and Germany are large, advanced and prosperous economies with correspondingly vast energy infrastructures and, therefore, face greater challenges in shifting to a sustainable power system. This makes them particularly interesting contexts to study.

This thesis intends to study how policy stimulates and supports environmental entrepreneurship in Britain, France and Germany and how these policies have been perceived by environmental entrepreneurs and key staff in new ventures in the renewable energy sector in the three countries.

1.4 Practical and theoretical relevance

The Academy of Management places emphasis on the theoretical contribution of submissions and authors are urged to explain how they will "change, challenge or advance the conversation" in the particular field of research (Colquitt, George 2011, P.874). Theoretical relevance is intrinsically linked with the choice of topic, with Colquitt & George (2011, P.432) stating that this will often give submissions "clear momentum right out of the gate". They suggest that topics that address "large, unresolved problems" in "less conventional ways" and citing problems outlined in the Millennium Development Goals, including global disease and poverty as examples. Environmental degradation fits into this category, as it is characterised by its vastness and complexity. This study cannot possibly deal with such an immense problem in its entirety, but does operationalise it within both an industry (energy) context and a geographical context (Britain, France and Germany) and, therefore, makes a contribution in this sense. In studying environmental entrepreneurship, a relatively novel phenomenon, this project takes a bold and unconventional approach in addressing the problem of how to respond to the environmental crisis. In addition, through studying three countries, it has substantial scope which Colquitt & George (2011) also cite as a criterion for topic selection. Suddaby (2012) highlights the increasing interest within the academic field of business and management in how business models can be used to tackle social problems, namely climate change and poverty and this study is directly relevant to this aim, as environmental entrepreneurs are using business models to bring about innovations to conserve the natural environment.

There is growing emphasis on how practitioners use the results of management research in their work (Kieser, Nicolai et al. 2015) and attention must be given to the practical relevance of management research. It is argued that this study will be of particular value to policy makers concerned with energy and environmental issues and influence their thinking in how to design energy policy with an “entrepreneurial flavour” (Wüstenhagen, Wuebker 2011). The comparative element of this study will further enrich insights for policy makers, as there will be learning opportunities from the comparison and contrast of practice across the three countries. For practitioners in the energy industry, this study will offer insights into how the energy policy context is perceived by entrepreneurial actors and could influence how they represent their interests to government; lobbying is identified by Schaltegger & Wagner (2011) as crucial to changing the “rules of the game” in favour of sustainable innovations.

The theoretical and practical relevance has driven the choice of topic for this study and underpins its relevance to academics and practitioners. The scope, resulting from the comparative quality of the work, enhances its relevance further.

1.5 Outline of the research design

A case study research design is employed (Yin 2009, Eisenhardt 1989) which is rooted in the naturalistic paradigm (Lincoln, Guba 1985), with Britain, France and Germany each constituting a case. Within each case, substantial background information had to be collected and this is presented in chapter 4. This contextual information is integral to the understanding of each case.

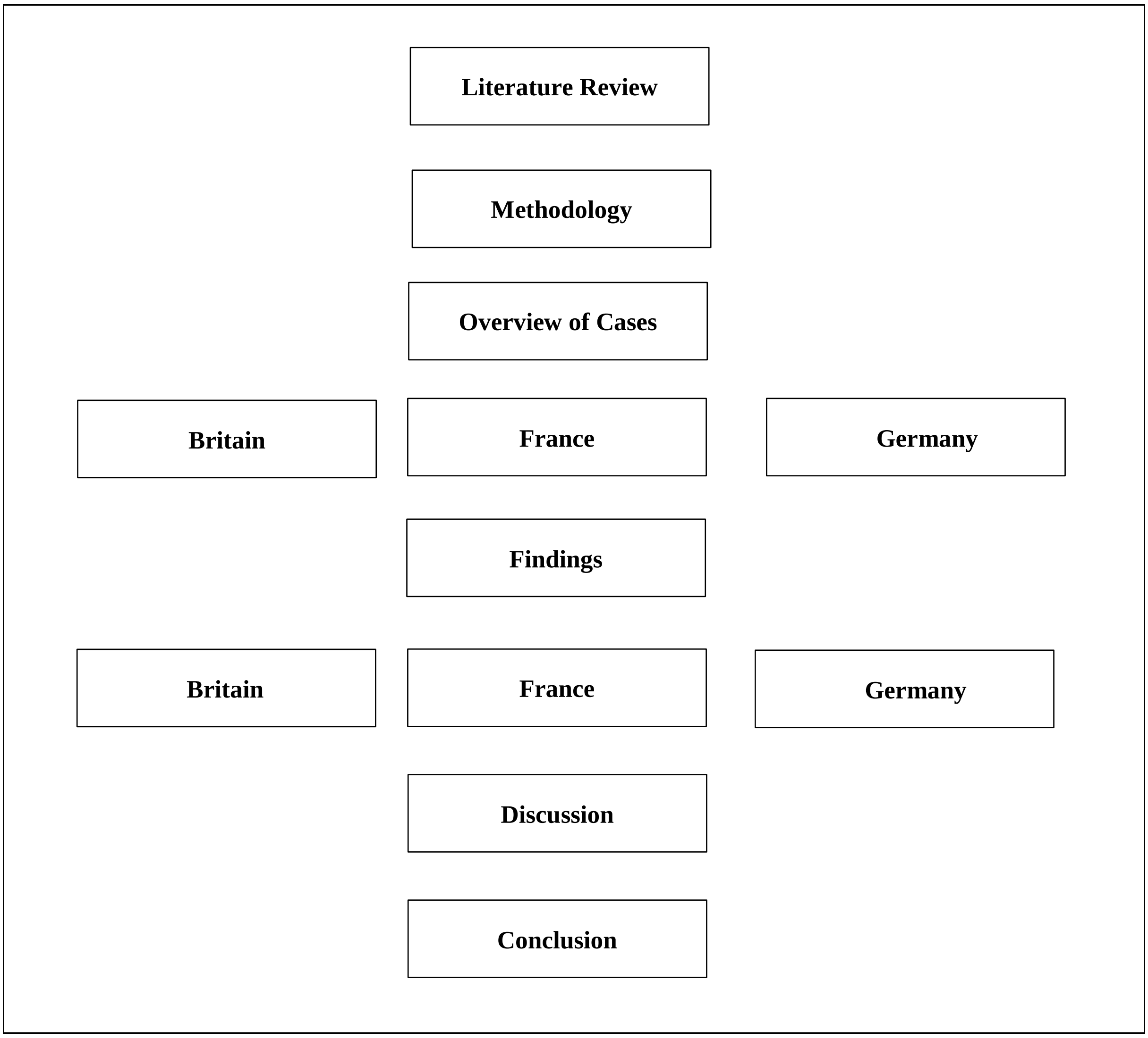
Two main data collection instruments were used in the study. The principal instrument was twenty eight extended semi-structured interviews with respondents across the three countries. These extended interviews were accompanied by five shorter interviews with German respondents that were conducted additionally to the main body of interviews because of particular reforms that were taking place to the support mechanisms for renewable energy in Germany at the time. The second data collection instrument came in the form of field-notes from six practitioner conferences across the three countries which served to enrich and triangulate the data collected from the extended and shorter interviews (Eisenhardt 1989).

Qualitative data arising from fieldwork was analysed according to open, axial and thematic techniques, developed by Glaser & Strauss (1967) using the qualitative data analysis software NVivo to facilitate this process.

1.6 Structure of this thesis

The current chapter has introduced the thesis, analysed the background and context of the study and defined the problem under investigation. This final section includes the outline for the remainder of this thesis, presented below:

Figure 1 Thesis structure



Chapter 2 reviews the literature systematically and applies appropriate exclusion criteria to a body of literature in order to arrive at an analysis of the main themes underlying the topic and the main research strategies and approaches conducted by others in the field.

Chapter 3 features the methodology. This chapter will consist of detailed research questions in addition to the case study research approach. In addition, the way in which the case study approach has been operationalized and the instruments employed to conduct the research approach will be explained.

Chapter 4 presents an overview of the three research settings, namely: France, Germany and the United Kingdom and discusses the energy mix in the three countries, the climate change policies that they have enacted, their renewable energy policies and other relevant policies.

Chapter 5 features the findings of the qualitative interviews with the entrepreneurs and is divided into the three countries. In each country, there are three sections. The first section presents the respondents' perceptions of the dynamics within their own country, and the second and third sections give the perceptions of policy differences in the other two countries.

Chapter 6 discusses the main narratives emerging from the findings chapter and integrates the three cases.

Chapter 7 offers the main contributions to theory and practice, reflecting on the aims of the study. Ultimately, policy recommendations are suggested in addition to an assessment of the limitations inherent to the study and the possibilities for future research to which the project gives rise.

2 Environmental entrepreneurship and its social, economic and political contexts

Initially, research placed business at the root of sustainability problems and focused on how organisations could reduce their negative impact on the natural environment through, for example, reducing waste and pollution. In the late 1990s and early 2000s, the field of environmental entrepreneurship emerged which presented a very different view on the role of business in sustainable development. It argued that entrepreneurs, who commercialise environmental innovation, could be a powerful force in responding to sustainability challenges. Research on environmental entrepreneurship has been sporadic, with a lot of attention around the turn of the millennium, followed by a relative lull and then a greater concentration of papers around 2010.

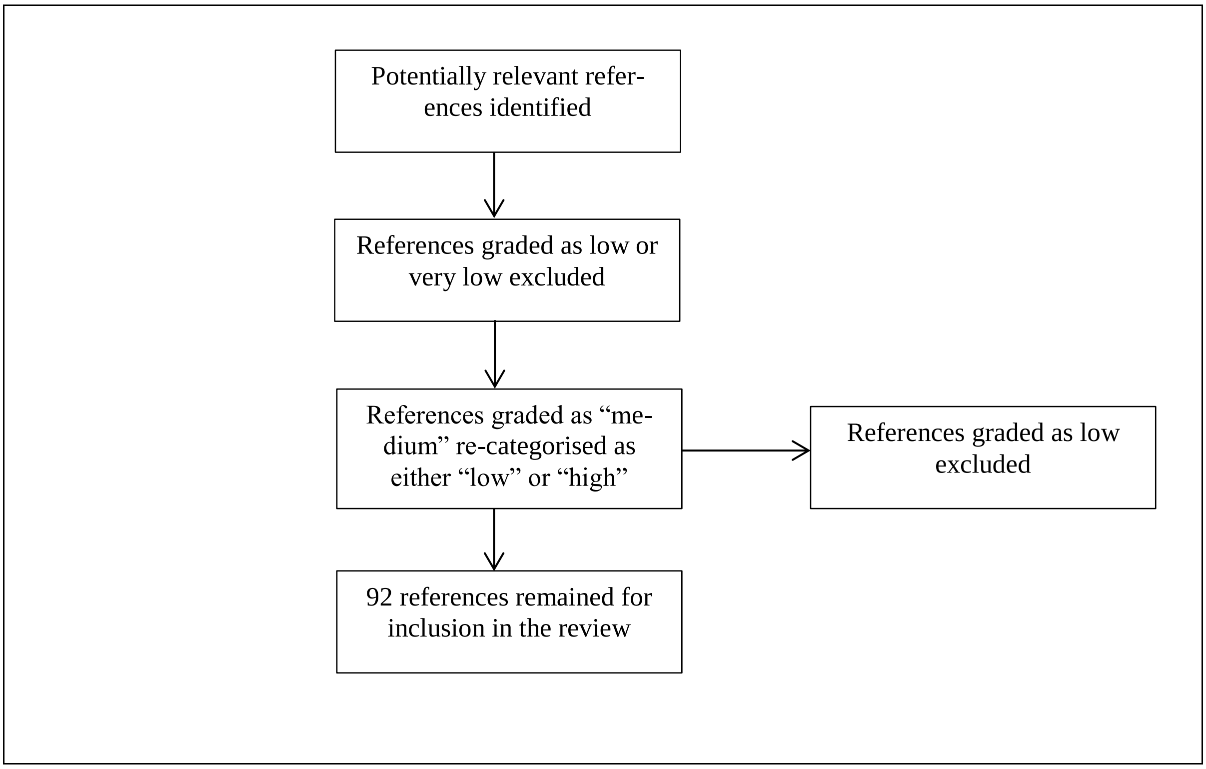
This chapter seeks to synthesise the literature on environmental entrepreneurship systematically, presenting and integrating the dominant themes underlying the field. The earlier part of the review concerns the contribution that new environmental ventures can make to the sustainable transformation of industries and the human dimension of environmental entrepreneurship, namely the characteristics, motivations and influences of the entrepreneurs. The latter part of the review focuses on the social, economic and political contexts in which environmental entrepreneurship is situated. It is important to stress that these overviews all feed in to the final overview, “policy and environmental entrepreneurship”. For instance, covering the importance of new ventures to environmental creative destruction, in section 2.2.1, is necessary to justify why policy makers should take an interest in environmental entrepreneurship. Understanding the characteristics of environmental entrepreneurs is necessary to understanding the structural influences that govern their actions. The economic and social contexts both influence and are impacted by the political context.

The next section describes the steps which were followed in order to conduct a systematic review of the literature. Subsequent sections are overviews of the themes in the literature. In the conclusion section, the main implications from this review are presented.

2.1 Review method and criteria

Systematic review techniques have been adopted from medical science and aim to be “replicable, scientific and transparent” (de Menezes, Kelliher 2011). Their growing prevalence in management is in response to a need for a more rigorous (Keupp, Palmié et al. 2012, Denyer, D. & Neely, A. 2004) and evidence-based approach to reviewing in the field (Thorpe, Holt et al. 2005). Traditional narrative reviews have been criticised as susceptible to reviewer bias (Tranfield, Denyer et al. 2003, Denyer, D. & Neely, A. 2004) and as not being conducive to critical evaluation (Tranfield, Denyer et al. 2003). The steps involved in conducting this systematic literature review are given in Figure 2 below:

Figure 2 Literature review structure



It was necessary to deconstruct the term “environmental entrepreneurship” with the help of seminal literature in order to form suitable search terms to retrieve sources. It was necessary to consider the variety of possible permutations of “environmental entrepreneurship” that were likely to exist. The keywords below, which were refined as the search progressed, emerged from a study of this initial literature. Subsequently, an exhaustive search was conducted using these terms in the applicable electronic databases provided by the library at the University of Stirling. The following databases were searched using the terms above reproduced in Table 1:

Table 1 Overview of key search terms and databases

Search terms and combinations	**Databases used**
"green entrepreneur*	Business Source Premier
"green" AND "entrepreneur*"	Cambridge Journals Online
"green venture"	Emerald
"ecopreneur*"	Google Scholar
"eco-entrepreneur*"	Greenfile
"enviropreneur*"	ISI Web of Science
"environment* entrepreneur*"	NBER Working Papers
"environment*" AND "entrepreneur*"	Oxford Journals
"sustainab* entrepreneur*"	Scopus
"sustainab*" AND "entrepreneur*"	Stirgate
"sustainab* venture"	Web of Knowledge
	Wiley Journals

In addition, searches were conducted in databases containing “grey literature” (Petticrew, Roberts 2006), such as MetaCrawler, OpenGrey and Copac. Petticrew & Roberts (2006, P.88) describe “gray (sic) literature” as “literature not obtainable through normal publishing channels and they suggest that sources such as working papers, website reports and informal publications correspond to this sort of hidden literature.

Searching these databases led to the retrieval of 311 sources of potential interest and these served as a starting point for later discussion. The abstracts of these sources were then scanned to gather information regarding the reliability and relevance of the particular study to the focus of the PhD. This information corresponded to:

- The type of source (journal article, book or other)
- Whether or not the source is published either in book or journal article form
- If the source is published, the quality of the journal according to the Association of Business Schools ranking or the Thomson Reuters citation impact factor in which it is published
- The methodological approach used by the study
- The main themes of the study
- The relevance of the study to issues directly related to the policy context for environmental entrepreneurs, the understanding of the research field at large, the formation of methodological approaches or to the identification of research problems in the field of environmental entrepreneurship

Each reference's value to the study was evaluated using the criteria above and then categorised on a likert scale (De Vaus 2012) ranging from "very low" to "very high" (very low, low, medium, high, very high). Following an initial grading, all references assessed as "very low" or "low" were excluded from the study. In cases of dubiety, in which references were graded "medium", these sources were re-examined and either re-categorised as "high" or "low", with those ranked as "low" excluded and those ranked as "high" included. This process resulted in the retention of a total of 92 references to be included in the review. Subsequently, the searches continued in order to locate sources that were published following the initial search and these new sources were then evaluated and included or excluded according to the criteria described above.

2.2 The literature on environmental entrepreneurship

Although environmental entrepreneurship is a recent research phenomenon, the nexus of the environment, economics and entrepreneurship has existed for a long time – Kyrö (2001), for instance, talks about the French physiocrats' acknowledgement of the significance of nature in economic terms. There was also some early interest in relating environmental and economic issues. Dorfman and Dorfman (1993) compile a selection of papers dating from the 1960s highlighting the problem of environmental degradation and the role of economic solutions. However, a starting point for a more intense scholarly debate is frequently seen as the end of the 20th century (Outsios, 2012) with contributions like Isaak's "Green logic", Keogh and Polonsky's "Environmental commitment", or Pastakia's "Grassroots ecopreneurs" all published 1998. The publication of a special edition on environmental entrepreneurship in 2002 by *Greener Management International* further contributed to the development of the subject as a field in its own right. Seminal work featured in this special edition set out to offer a more precise definition of environmental entrepreneurship and how environmental entrepreneurs are distinct from other economic actors (Schaltegger 2002). In addition, there was discussion of the barriers green entrepreneurs confront (Linnanen 2002) and the triggers of ecopreneurial activity (Pastakia 2002) alongside other valuable contributions to the nascent discipline.

Despite this initial surge in interest, aside from several isolated, yet influential articles, such as those written by Dean & McMullen (2007) and Cohen & Winn (2007), there was not a sustained focus on environmental entrepreneurship until the special edition on sustainable entrepreneurship, appearing in the *Journal of Business Venturing* in 2010. This special edition dealt with more complex issues associated with environmental entrepreneurship, such as the relationship between new ventures and incumbents in environmental creative destruction (Hockerts, Wüstenhagen 2010), why entrepreneurs may thrive on the uncertainty inherent in wicked environmental problems (York, Venkataraman 2010) and the institutional constraints hindering environmental entrepreneurship (Pacheco, Dean et al. 2010). In addition to this special edition in the *Journal of Business Venturing*, there has been attention, although not as much, on sustainable entrepreneurship in the equally prestigious *Entrepreneurship Theory and Practice* journal. Publications in these prominent journals have been accompanied by a substantial body of other research to develop this emergent field since the late 2000s/2010s.

It is possible that the lower attention in the field in the mid-2000s is attributable to economic circumstances. In the late 1990s, there was widespread economic prosperity, owing to rising stock market values and there was perhaps greater concern about the conservation of the natural environment at this time. Following the stock market collapse in the early 2000s, it may be that concern about the environment was displaced by greater worries about the state of the economy and this may have led to a fall in interest in environmental innovation and environmental entrepreneurship in these years, with environmental issues considered secondary to economic difficulties. The resurgent interest in environmental entrepreneurship from around 2010 onwards could be attributed to the dawn of Barack Obama's presidency and the prominent efforts undertaken at the climate conferences held in Bali, 2007, and in Copenhagen, in 2009. These developments indicated renewed political will to address climate change.

Environmental entrepreneurship is inextricably linked with eco-innovation which relates to ecologically-superior goods and/or services, production processes or modes of organisation underpinning the delivery of those goods and services. A comprehensive definition of eco-innovation, featuring in the EU-funded project "Measuring Eco-Innovation" is provided by Horbach, Rammer et al (2012, P.113):

> *"Eco-innovation is the production, application or exploitation of a good, service, production process, organizational structure, or management or business method that is novel to the firm or user and which results, through its lifecycle, in a reduction of environmental risk, pollution and the negative impacts of resource use (including energy use) compared to relevant alternatives" (P.113)*

What is missing from this definition is reference to the magnitude of the impact of eco-innovation; it encompasses both rather incremental eco-innovations which do not lead to substantial improvements in sustainability and radical eco-innovations which lead to transformations in sustainability performance, but does not distinguish between the two.

Henderson & Clark (1990) distinguish between component innovation, corresponding to the change of one or more parts within a system and architectural innovation which concerns overhauling the system itself and the way the different parts of that system interrelate (Henderson, Clark 1990). They associate component innovation with "end-of-pipe" solutions, whereby the production process itself remains fundamentally the same, but there is better management of wastes and emissions arising from that process. They contrast this with architectural innovations which are system-changing and would perhaps concern the replacement of an entire production process or the creation of a fundamentally different product compared to what exists currently.

Incremental innovation is still important, however, according to Wagner & Lutz (2012) who explain why incremental innovation is a necessary counterpart to radical, longer-term innovations which they say “massively improve the environmental or social performance of goods or production processes while not altering consumer benefits and utility” (P.2).

Effectively, incremental innovation helps to improve sustainability performance in the short-term period, characterised by lock-in of high carbon technologies in industries attributable to path dependencies from which it is difficult to deviate (Wagner, Lutz 2012) - these path dependencies could result from institutional forces which have favoured high carbon development, as discussed in section 2.2.3.

Understanding the forms that eco-innovation can take and the difference between incremental and radical eco-innovation is crucial to the study of environmental entrepreneurship. Environmental entrepreneurs are engaged in radical environmental innovation across the activities featured in the EU project definition above and must fulfil at least one of the outcomes listed in the definition.

The dominant themes, emerging from the analysis of the literature, are presented in the following section to build a narrative on environmental entrepreneurship. The major themes identified as relevant to this thesis relate both to the nature of environmental entrepreneurship, namely its contribution to *environmental creative destruction* and the characteristics of environmental entrepreneurs. It then goes on to discuss environmental entrepreneurship’s social, economic and political context, culminating in the relation of policy to environmental entrepreneurship.

2.2.1 The role of new ventures and incumbent firms

The core environmental entrepreneurship works are rooted in classical entrepreneurship theory, principally Schumpeter’s (1928, 1934, 1944) works on creative destruction and entrepreneurial leadership. Scholars of environmental entrepreneurship draw on these theories to justify the importance of entrepreneurship in the sustainable transformation of industries. Entrepreneurial actors disrupt industries and create new industrial revolutions by disseminating their innovations. Environmental entrepreneurs bring about a sustainable industrial revolution.

According to Schumpeter's theory of economic progress (Schumpeter 1928, Schumpeter 1944), capitalism is inherently unstable and is continually evolving through innovatory processes. Innovation involves the deployment of "new combinations of existing factors of production", with these new combinations manifesting themselves in the following forms: new commodities, new methods of production, new markets or new sources of supply (Schumpeter 1928). Schumpeter (1928) stresses that the employment of factors of production, namely land, labour and capital, in these new combinations means that they cannot be used in existing combinations, and, thus, the decline of those existing combinations. Innovation is radical and leads to industrial revolutions in which new combinations replace the old ones. These revolutions alter the circulation and equilibrium of the economy, ultimately resulting in greater aggregate wealth despite short-term financial losses and unemployment due to the substantial disruption caused (Schumpeter 1944). In effect, creative destruction drives economic progress and both existing and new firms are part of this process.

Within Schumpeter's (1928) and (1944) works on creative destruction, there are two themes which are of particular significance. The first is the position of old and new firms in the process of creative destruction and the second is the nature of the entrepreneur, responsible for the activities of the new firms. He argues that it is new firms that are predominantly responsible for the introduction of new combinations. These radical innovations are not developed by old firms, as they are detrimental to their current market position – Schumpeter (1928, 1944) uses the analogy that stagecoach owners do not in general build railways, as this would render their current business model obsolete to illustrate this point. Under the creative destruction model, these new technologies, commodities, sources of supply or types of organisation erode the profit margins of incumbent firms and eventually undermine their very existence (Schumpeter 1944). This leads to the replacement of incumbent economic combinations by new economic combinations introduced by the new firms.

Although he appears to suggest that new ventures trigger discontinuous innovation, he highlights that large firms may have certain innovatory advantages over new ventures. Failure is much less costly, incumbent firms have greater access to credit and a number of dramatic innovations which took place in the agricultural machinery industry in the late 19th and early 20th centuries resulted from the efforts of large firms (Schumpeter 1934, Schumpeter 1944). Whilst these two positions appear contradictory, Solo (1951), critiquing Schumpeter's theories, is sceptical of the assumption that innovation is brought primarily by "new firms". She claims that innovation is, in fact, a "normal business activity" that all firms, old established and new alike, engage in to gain competitive advantage or to adapt to changing market circumstances. Schumpeter is drawing a false dichotomy between old firms and new firms in understanding which actor leads the creative destruction of industries; it is, rather, a question of which one is the "more efficient innovator" and this could be either (Solo 1951). This may hold true on a wider level, but it may not apply to environmental creative destruction which is based on environmental competitive advantage. Environmental competitive advantage may not be valued by the market in the same way as other types of competitive advantage and established firms may struggle to determine that environmental changes are altering the market circumstances for their firms.

The second strand of *Schumpeterian* entrepreneurship theory is this “entrepreneurial function” which is distinctly different from the general management/head of enterprise function. Someone is an entrepreneur “…..only when he actually ‘carries out new combinations’ and loses that character as soon as he has built up his business, when he settles down to running it as other people run their business” (Schumpeter 1934, P.78)

It is this "carrying out of new combinations", through identifying opportunities, taking risks and applying radical innovation that characterises entrepreneurs. This entrepreneurial characteristic is lost once the business grows and the focus shifts to administrative duties which are inconsistent with this execution of these “new combinations”. Certain personal qualities characterise this “entrepreneurial function”. Firstly, since entrepreneurs face considerable uncertainty about success, they rely on instinct and have the confidence to act on the basis of that instinct; careful planning and analytical skills may hinder entrepreneurial action in uncertain contexts (Schumpeter 1934). Furthermore, entrepreneurs are able to escape from the constraints of the subconscious and received ideas of society and have the mental capacity to conceive of new, different possibilities (Schumpeter 1934). Schumpeter (1934) claims that entrepreneurs must be able to withstand the opposition from society which their innovation will, inevitably, generate. By its very nature, entrepreneurial activity deviates from society’s norms and, as a result, tends to be perceived negatively, especially from groups who stand to lose out from new combinations and entrepreneurs must persevere to withstand the opposition form those adversely-affected groups, to convince financiers of the merits of their proposed innovation and, finally, to persuade consumers to adopt the innovation (Schumpeter 1934).

“Economic leadership” is central to this *entrepreneurial function* and this is not so much about invention itself, but rather implementing that invention and directing factors of production into new directions and, in so doing, provoking other economic actors to follow suit (Schumpeter 1934). Throughout his seminal works, Schumpeter emphasises that entrepreneurship is not necessarily or even predominantly, about scientific invention – it is the putting into practice of that invention or new technology which matters. Entrepreneurs demonstrate leadership in doing this which triggers a trend and, ultimately, widespread change throughout an industry. In contemporary terms, it is the commercialisation that is made possible by this *entrepreneurial function*.

In applying Schumpeterian theory to environmental entrepreneurship, Schaltegger (2002) distinguishes continuous improvement from discontinuous environmental innovation, employing the term *environmental creative destruction* to describe the latter form of innovation. Corporate greening, common among mass-market corporations, is situated within the logic that sustainability is a "trustee duty" and supplementary to the organisation's core activities (Schaltegger 2002). He employs two criteria to decide whether an economic activity conforms to environmental creative destruction, undertaken by ecopreneurs – a synonym he employs for green entrepreneurs. In order to meet the threshold for ecopreneurship, the activity must have both a high sustainability impact and mass-market reach. This mass-market reach serves to amplify the sustainability impact the innovation will have, as the greater the dissemination of the innovation, the greater its effect on the sustainable transformation of an industry.

This mass-market reach is important, as an innovation must be sufficiently disseminated throughout an industry if it is to transform economic structures regardless of its intrinsic sustainability performance. Petersen (2003) makes the contrast between eco-efficiency and eco-efficacy and this is a way of judging the sustainability impact of an economic activity. The eco-efficiency strategy of environmental managers and administrators aims to reduce the environmental burdens per good or service produced, whereas it is firms which are actively contributing to the solving of environmental problems through their innovatory activities which pursue an eco-efficacy strategy. Eco-efficiency is insufficient to achieve sustainability, as economic growth driving increased consumption of these goods and services outweighs the lower environmental cost per good resulting from the eco-efficiency measures (Petersen 2003). His concept of eco-efficacy involves innovation which actively leads to lower levels of aggregate emissions and this is, arguably, more consistent with Schaltegger's (2002) ecopreneurship. Similarly to Petersen (2003), Hart & Milstein (1999) are critical of "corporate greening" programmes, as such schemes serve to increase the legitimacy of current industry practices which are inherently unsustainable and, in the long term, they say that large firms that focus only on corporate greening will fall victim to the forces of environmental creative destruction, as these corporate greening programmes have been a distraction from undertaking radical innovation necessary for sustainable development. Environmental entrepreneurship seeks to wreak disruptive environmental creative destruction whereas other activities attempt innovation that is more incremental.

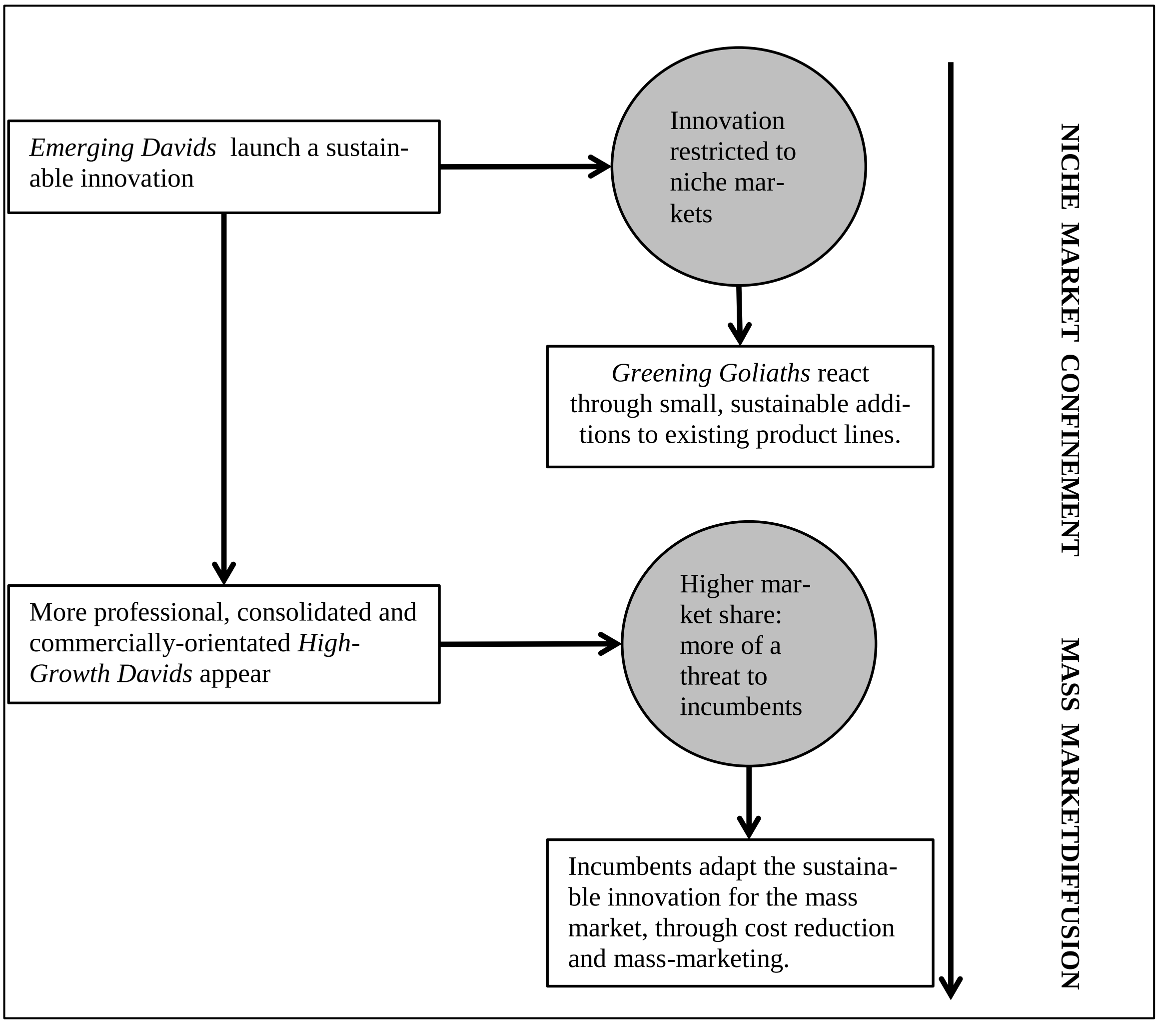
Certain authors, such as York & Venkataraman (2010) and Hockerts & Wüstenhagen (2010) highlight the innovatory disadvantages of incumbent firms in the pursuit of environmental entrepreneurship. Radical eco-innovation in the form of environmentally-superior goods, services and technologies lead to the obsolescence of existing infrastructure and product lines in which substantial sunk costs have been invested (Hockerts, Wüstenhagen 2010, York, Venkataraman 2010). There is an inherent conflict if firms produce both environmentally-damaging and ecologically-friendly products – for example, the commercialisation of renewable energy threatens to render fossil fuel generated energy and the infrastructure associated with it redundant (York, Venkataraman 2010). In addition, York & Venkataraman (2010) argue that the complex nature of the problem of climate change leads to ambiguity regarding the rewards for sustainable behaviour and this makes incumbent firms reluctant to abandon profitable product lines based on existing unsustainable infrastructure, in order to develop economically superior products which have higher market risk (York, Venkataraman 2010). York & Venkataraman (2010) also stress that there are frequently low levels of agreement about the need for environmental innovation and its potential to respond to climate change within established organisations.

They argue that only entrepreneurial actors, free from this scepticism of the legitimacy of sustainable behaviour, can deliver environmental innovations, especially if they are based on localised production or ethical values. Entrepreneurial actors thrive in situations of uncertainty, as they take advantage of the vacuum caused by the inaction of large incumbent firms and, in launching radical environmental innovations, provide feedback to incumbents about the costs and benefits of sustainable solutions prompting the incumbents to, subsequently, enter the market (York, Venkataraman 2010). Indeed, it is this feedback which spurs large firms to enter the market as "*fast seconds*" and to convert these "radical markets", niche markets pioneered by the entrepreneurs, into "mass markets" in which their superior capacities for marketing and customer segmentation are crucial (Markides, Geroski 2005). Garnsey, Dee et al. (2006) warn that the current discourse on environmental innovation can be too biased towards large incumbents and towards the importance of economies of scale in certain important industries, such as the chemical and power generation sectors. They stress that these industries are often impenetrable to new entrants and that this undermines environmental innovation. It is arguably the case that, whilst incumbent firms play an important role in diffusing environmental innovation as "*fast-seconds",* it is, in fact, the new ventures which trigger radical environmental innovation in the first place.

In this capacity as “*fast seconds*”, market incumbents may adopt an “innovation-based green strategy”, in which environmental innovations which result in radical enhancements in environmental performance and the pursuit of opportunities to market green products in new markets drives sustainability strategy (Azzone, Noci 1998). This innovation-based green strategy contrasts with more passive approaches, namely: a reactive green strategy responding to changes in regulation and an anticipatory green strategy whereby the motivation for sustainability is cost-driven (Azzone, Noci 1998) According to Hart & Milstein (1999), incumbent firms can embrace opportunities inherent in sustainable development. They stress that such firms must not be dissuaded by the “ill-defined” and “contestable” nature of sustainable development opportunities and must break free from the pattern of continuous improvement consisting of incremental sustainable innovations. Hart & Milstein (1999) refer to creative destruction in the chemical industry, where large firms, such as DuPont and Monsanto developed new competencies in “green chemistry”, involving the increasing substitution of petroleum as an input with ecologically-superior biological materials as evidence that visionary large firms could, in fact, exploit opportunities for sustainable entrepreneurship.

Hockerts & Wüstenhagen (2010) argue that incumbent firms and new environmental ventures have a symbiotic relationship in which incumbent firms contribute to the process of creative destruction, but in different ways and at different stages in the cycle of an industry’s sustainable transformation. They propose a process of co-evolution whereby market incumbents and new innovative actors, poetically called “Goliaths” and “Davids” respectively, each advance the sustainable transformation of a particular industry, with “Greening Goliaths” reacting to the innovatory activities of the “Emerging Davids”– this process is adapted and recreated in Figure 3.

Figure 3 Co-evolution underlying the sustainable transformation of industries



Source: Hockerts & Wüstenhagen (2010)

Whilst radical environmental innovations are restricted to a niche market, incumbent firms do not adopt this innovation and this can be attributed to the reasons given by Hockerts & Wüstenhagen (2010) and York & Venkataraman (2010), discussed previously. However, once new ventures become more commercial and professional and begin to acquire greater market share, incumbents react. They begin, not only, to fear the competitive threat to the endurance of their business model presented by these innovations, but, also, perceive the attractiveness of these innovations as business opportunities for themselves. They proceed to adopt the sustainable innovation and adapt it for the mass-market through conducting process innovation to reduce the unit cost. In addition, they use their resources, marketing know-how and distribution channels to sell the sustainable innovation on the mass market. Hockerts & Wüstenhagen (2010) consider this to be the way in which environmental creative destruction progresses in practice.

This concept of co-evolution highlights the relative advantages of large and small firms at different points in the innovatory cycle. Start-ups have the creativity and freedom from conventional practices to initiate sustainable innovation, but, due to limited knowledge, expertise and resources, they are constrained to niche markets. In contrast, large market incumbents, although initially reticent about sustainable innovation, have the financial power, the expertise in process-innovation and marketing to convert the niche market innovations of start-ups into mass-market successes (Hockerts, Wüstenhagen 2010). At the early stages of transformation, focused on niche markets, the qualities of the sustainable start-ups are important. However, in order to achieve mass-market dissemination of innovation, the characteristics of large incumbents become crucial. In essence, the weaknesses of one actor are compensated by the strengths of another.

Although environmental ventures may owe their radical character to their small size, growth permits greater penetration of the sustainable good or service; the more “mainstream” their eco-innovation becomes, the higher the sustainability impact it has within the economy (Nazarkina 2012). However, there is a danger that this growth, whilst increasing the market reach of the sustainable good or service, compromises the original environmental principles of the venture (Nazarkina 2012). Given the limitations of organic growth, Nazarkina (2012) argues that straight sell outs to large incumbent firms offer access to enhanced capabilities, markets and resources, yet present the greatest risk of dilution of environmental and social goals. Although *acquisitive* and *hybrid* growth strategies are alternatives to this sell-out strategy, they too entail challenges – the integration of an acquired firm requires high capital and can undermine the core values of the initial venture and there is potential for lower quality, in relation to environmental goals, under franchising and licensing arrangements (Nazarkina 2012).

Wüstenhagen, Hamschmidt et al. (2008) apply theories relating to industrial transformation to the renewable energy sector, referring to the emergence of a new "technological paradigm" in these industries. This paradigm shift occurs when a particular type of technology begins to prevail in an industry, accompanied by consolidation and firm exits, following a period of "variation", during which a large number of firms with different designs compete for market share (Wüstenhagen, Hamschmidt et al. 2008). Wüstenhagen, Hamschmidt et al. (2008) identify a period of substantial experimentation (the variation stage) in the solar industry between 2003 and 2005 whereas they suggest that the wind turbine sector has exhibited signs of consolidation between 2002 and 2004 with buyouts by market incumbents, like General Electrics and Siemens, and mergers of bioneers, such as Vestas and NEG Micon. The renewable energy sector is in a process of transformation and different subsectors (such as wind and solar energy) are at different stages in this process – this transformation can be conceived using the co-evolution model described previously. Green start-ups "Emerging Davids" were creating disruption in the solar energy sector between 2003 and 2005, leading to substantial variation and testing of different designs. Between 2002 and 2004 the phenomenon of the emergence of "High-growth Davids" (see section 2.2.1), resulting from consolidations of bioneers, was accompanied by the interest demonstrated by corporate actors, like Siemens and GE, in targeting lucrative opportunities through disseminating wind-energy in the mass-market. This consolidation effect, where larger firms have acquired smaller ones, has been identified in the waste management, green technology and solar energy sector by Holt (2011), especially as the latter (solar power) has increasingly become a “mainstream business”.

New ventures and incumbent firms both contribute to the diffusion of environmental innovation, but the literature in this section argues that they play different functions. New ventures are pivotal in exploring markets for radical environmental innovations and providing feedback, but theory indicates that incumbent firms’ capacity for operating on the mass-market is important to the wider diffusion of these innovations.

2.2.2 Characterising the environmental entrepreneurs

The characteristics which make certain individuals pursue entrepreneurial opportunities are a major preoccupation of entrepreneurship research (Shane, Venkataraman 2000). Scholars of green entrepreneurship are concerned with what makes individuals recognise and act upon opportunities for sustainable development. Seminal environmental entrepreneurship research constructed typologies aimed at capturing the nature of green entrepreneurs, addressing the values and motivations of these entrepreneurs and the sectors in which they are likely to be found (Isaak 1998, Linnanen 2002, Pastakia 2002, Garnsey, Dee et al. 2006).

As regards values and motivations, the extent to which environmental goals are core to the activities of the entrepreneur or organisation (Isaak 1998), the financial orientation of the entrepreneur (Linnanen 2002) and whether their motivation is social or commercial (Pastakia 2002) underpin typologies. Isaak (1998) makes a distinction between green businesses, which adopt an environmental orientation following establishment, and green-green businesses which are dominated by environmental goals at their inception. These green-green businesses aim for transformative environmental entrepreneurship, resulting in discontinuous innovation, and are driven by a green logic ethos which prioritises long-term sustainability through the conservation of resources (Isaak 1998). He cites well-known examples of green-green businesses, namely The Bodyshop and Ben and Jerry's - organisations characterised by their green and social values. Indeed, Isaak (1998) advocates that governments should earmark support, in the form of tax relief, subsidies and seed capital funding, for this type of green-green venture in order to incentivise this form of welfare-creating entrepreneurship. For Isaak (1998), the distinction is based on the extent to which a business is defined by its environmental goals. He implies that those that are green-green will have a more fundamental impact on sustainability performance.

Other authors frame this issue as the extent to which entrepreneurs are motivated by a desire to change the world relative to a desire for economic success (Linnanen 2002). Pastakia (1998) differentiates between social ecopreneurs, seeking to generate social value from their environmental innovations and commercial ecopreneurs, concerned by financial success. Holt (2011) presents ecopreneurship as firmly rooted in the creation of social value, with such activities intrinsically related to the pursuit of alternative lifestyles in the post-Brundtland atmosphere of the 1990s during which there was greater enthusiasm for responsible business behaviour.

These discussions leave open the question about whether the nature of motivation, in fact, affects the outcome of entrepreneurial activity. It could be that it is necessary to grow the business to a certain scale in order to acquire sufficient market share to effect substantial environmental change and environmental creative destruction (Schaltegger 2002). In this case, financial success would be paramount regardless of whether environmental motivations were dominant; even green-green businesses, such as Ben & Jerry's, Isaak (1998) would have to operate a commercially successful business to have the impact on consumption practices.

Walley's & Taylor's (2002) categorisation of environmental entrepreneurs consists of four different identities to build a nuanced picture of the characteristics of environmental entrepreneurs. Each type of environmental entrepreneur is categorised as being either environmentally or financially orientated and draws on different influences in their context, either soft or hard structural influences. They describe ad-hoc enviropreneurs and innovative opportunists as being financially-driven, but the former are influenced by personal networks whereas the latter are galvanised into action by factors such as legislation and government incentives. In contrast, their categories of visionary champion and ethical mavericks are motivated by their environmental values, but the former are concerned with overhauling unsustainable industrial structures (hard structural influences) whereas the latter group's activism stems from their interactions with others, namely family and friends. The implication of the Walley & Taylor (2002) framework is that favourable policies are likely to have the strongest impact on innovative opportunists, perceiving market opportunities through government action. For the other three types of entrepreneur, the link between structural influences and entrepreneurial action is likely to be more complex and raises interesting questions, such as whether it is possible to create ethical mavericks or visionary champions through, for example, educational interventions. This commitment to social change appears to differentiate entrepreneurs; for certain actors, social change is the overriding goal whereas, for others, it is a by-product of the pursuit of lucrative opportunities related to sustainable development.

The nature of this environmental commitment is discussed by Keogh & Polonsky (1998) who argue that the strength of an individual's environmental commitment determines how they will perceive and act upon opportunities for environmental entrepreneurship. Their collaborative forming model outlines three forms of environmental commitment – normative, continuance and affective commitment – and how these commitments influence individuals' intrinsic desire to protect the natural environment as well as how they affect the ways that individuals integrate external forces relevant to environmental opportunities. In essence, it is this affective commitment, characterised by an emotional and passionate understanding of the importance of the natural environment, which governs a more holistic view of opportunities for environmental entrepreneurship and the desire to pursue radical possibilities to achieve a positive impact (Keogh, Polonsky 1998). They contrast this high-level commitment with the other two levels of commitment which consider environmental opportunities largely in cost terms or as "obligations" which the organisation is duty bound to fulfil and lead to more limited activities in favour of environmental protection. Therefore, this deeper emotional attachment to the environment among members of an organisation is crucial to fostering environmental intrapreneurship.

This environmental commitment alone is not necessarily sufficient to bring about environmental entrepreneurship. Patzelt & Shepherd (2011) hypothesise that relevant prior sustainability knowledge combines with motivation and entrepreneurial knowledge to trigger the recognition of entrepreneurial opportunities relating to sustainability. Principally, they argue that individuals who pursue sustainable development opportunities are likely to be more attentive to the natural (earth, biodiversity etc.) and communal environments (state of communities in which people live) than those whose motivation is based primarily on economic gain. They posit that individuals' antecedent knowledge about these environments will determine whether they identify an opportunity for sustainability in the first place and which aspects of sustainability they target. As for motivation, sustaining the natural and communal environment can be perceived as an individuals' response to threats to their psychological well-being. In undermining individuals' reputation for taking care of the natural environment, environmental degradation is adverse to inter-generational and international relations. Future generations will suffer the consequences of current activity more severely than current generations. Likewise, certain parts of the world are more affected by the degradation of the natural environment than others. The depletion of the natural environment also restricts individuals' autonomy, as it deprives them of options in terms of eco-system services. Sustainable development offers a means of counteracting such threats and, thus, aids to restore psychological well-being. In addition, altruism - the extent to which individuals empathise and sympathise with others - can act as a major motivation to engage in sustainable entrepreneurship to alleviate the suffering of others due to their declining natural or communal environment (Shepherd, Patzelt 2011). A crucial contribution made by Patzelt & Shepherd (2011) is the understanding of the importance of entrepreneurial knowledge relating to the nature of markets and how to serve those markets and customer needs in transforming the other triggers (knowledge of communal and natural environments, motivation) into entrepreneurial action on sustainable development. In effect, this entrepreneurial knowledge identifies ways in which this prior experience of and desire to sustain both environments can be translated into implementable entrepreneurial opportunities. These independent variables concerning individuals' affective desires and their antecedent knowledge interact with each other to determine an individuals' propensity to environmental entrepreneurship. Entrepreneurial knowledge acts as a catalyst which helps to converts those antecedents into sustainable entrepreneurship.

Kuckertz & Wagner (2010) suggest that this environmental commitment and propensity to engage in entrepreneurship are linked. They find a positive relationship between sustainability orientation and entrepreneurial orientation in a survey of 712 students and alumni from the Technical University of Munich. It appears likely that environmental market failures are not the most lucrative to remove, as many of these particular types of market failures persist, such as climate change and the loss of biodiversity. In light of the lower financial rewards available, individuals with a sustainability orientation, as opposed to a purely economic orientation, should be more likely to undertake entrepreneurial action to address these types of market failures, with prior relevant knowledge and experience forming this orientation (Kuckertz, Wagner 2010). Interestingly, their results indicate that an individual's business experience weakens the link between this sustainability orientation and entrepreneurial intention. They attribute this result to the possibility that sustainable ventures suffer from low organisational legitimacy due to their highly innovative, and riskier, nature, with this legitimacy crucial in surmounting the liability of newness which such ventures confront. In terms of policy implications, it is critical to rectify this detrimental effect of business experience on the relationship between sustainability and entrepreneurial orientation. Kuckertz & Wagner (2010) stress the potential contribution of business education in redressing this – highlighting sustainability challenges and the opportunities for sustainable entrepreneurship whilst offering case studies of successful sustainable ventures throughout undergraduate, Master's and Executive management education would aid to counteract the effect of business experience on the perception of the viability of opportunities for sustainable development.

Whereas Kuckertz & Wagner (2010) claim that business experience weakens the likelihood of engaging in sustainable entrepreneurship, Lourenço, Jones et al. (2013) argue that business education, promulgating a "profit first mentality", is responsible for the relegation of social and environmental value as drivers of entrepreneurs. In analysing the attitudes of a sample of aspiring entrepreneurs, taking part in a business start-up programme, to an "entrepreneurial form of sustainability education", of the kind envisaged by Kuckertz & Wagner (2010), Lourenço, Jones et al. (2013) employ the theory of planned behaviour (Ajzen 1991) to analyse how the participants' evaluation of the sustainability education delivered to them impacts upon their intentions to pursue sustainable entrepreneurship. They find that the crucial factor underlying intentions to exploit learning from such education programmes is the perceived benefit derived from learning about sustainability entrepreneurship and although those with "for profit mentalities" perceive fewer benefits from this learning, they are, nevertheless, equally able to absorb it (Lourenço, Jones et al. 2013). The implications of this are that there could be significant benefit from offering sustainability courses within business education which highlight the merit of ecopreneurial opportunities, in terms of how they may bring competitive advantage and can be consistent with self-interest, as this would aid in overcoming the "institutional logic" (De Clercq, Voronov 2011) perceiving economic concerns as conflicting with sustainability among those with "profit first" mentalities (Lourenço, Jones et al. 2013). Integrating these two studies suggests that an emphasis on the business case for sustainability is most conducive to incentivising environmental entrepreneurship.

Creating courses dedicated to forming sustainable entrepreneurs might, however, be problematic. Currently, in Higher Education, entrepreneurship education and sustainability education are distinct (Lans, Blok et al. 2014). Whilst there are complementary competencies that overlap the domains of entrepreneurship and sustainable entrepreneurship, the self-interest associated with entrepreneurship inherently conflicts with the social and collective goals of sustainable development according to Lans, Blok et al. (2014). Lans, Blok et al. (2014) say that sustainability rests on a "normative competence to map, apply and reconcile sustainability values, principles and targets" (P.40) and that this normative competence entails greater "reflection and awareness" compared to the entrepreneurial competencies, characterised as being more orientated towards action. It could be that, given the normative complexity of this sustainability competence, that the integration of sustainability education and entrepreneurship education must be managed carefully.

In order to construct a viable business model to pursue opportunities for sustainable development, sustainable entrepreneurs, seeking to reconcile their own well-being with that of other humans and nature, must manage organisational tensions if their enterprise is to survive in a competitive environment (Parrish, Foxon 2009). In this context, entrepreneurs must have the skills to design an organisation consistent with the logic of "perpetual reasoning", according to which, humans and the natural resources are not simply assets employed to generate returns, but, rather, their conservation and development are outcomes in their own right (Parrish 2010b).

Parrish (2010b) proposes principles core to this "perpetual reasoning" centred on a holistic style of management. These principles consist of: making decisions based on the quality of outcomes as opposed to merely the quantitative results, greater equity among the distribution of "benefit streams" to stakeholders and maximising those streams at all points in activities, finding trade-offs among multiple competing objectives and enriching and conserving human and natural resources (Parrish 2010b). He implies that sustainable entrepreneurship is fundamentally different to conventional entrepreneurship and necessitates different forms of organisational behaviour in order to balance often conflicting objectives. It is possible that the very nature of opportunities for sustainable development means that sustainable enterprises must often adopt an entirely different approach to organisation, if they are to be legitimate and successful. Entrepreneurs must consider how to integrate social and environmental outcomes into their venture (Belz, Binder 2015).

According to Belz's & Binder's (2015) process model of sustainable entrepreneurship, such ventures concentrate on their double bottom line solution, combining economic with either social or environmental goals first. These ventures then progress to reconcile the environmental or social goal that was not addressed in the first phase to convert the double bottom line to a triple bottom line. They claim that this sequential process of constructing a sustainable enterprise helps to manage the complexity involved in reconciling the social and environmental outcomes and facilitates the establishment of priorities for development. Therefore, it is not merely about combining social and environmental aims with business objectives; the timing of this integration can be a crucial factor in sustainable entrepreneurship.

In addition to managing organisational tensions, green entrepreneurs may have to be particularly skilled at realising synergies among different actors in the supply chain to bring eco-innovation into fruition, given its complex nature. Larson (2000) presents a case study of an entrepreneur involved in the production of ecologically-superior kayaks, made out of recycled plastic, to demonstrate the potential of networks to Schumpeterian eco-innovation. Paul Farrow of Walden Paddlers established a “virtual network” corporation, bringing together the various actors (i.e. designers, scientists, suppliers) necessary to develop this challenging product, with this structure enabling the combination of expertise, typically found within a vertically-integrated corporation, with the ability to operate laterally, as within a start-up, for example. This indicates that environmental entrepreneurs face complex decisions in structuring their organisations.

The literature highlights contradictions that are inherent in sustainable entrepreneurship, principally between the business and sustainability dimensions. Poldner, Shrivastava et al. (2015) exhort researchers to appreciate the “rich and dynamic world of sustainable entrepreneurship” (P.2), warning against opposing a business logic against a sustainability logic. Sustainability entrepreneurs draw on multiple discourses, encompassing business logic, sustainability and aesthetics – especially, since it is ethical fashion entrepreneurs featured in their study – and Poldner, Shrivastava et al. (2015) suggest that if one discourse dominates, this is, ultimately, harmful to the pursuit of a successful business. Indeed, in the corpus of literature on sustainability entrepreneurship, there is a marked tendency to draw a dichotomy between those social and commercial discourses and, as the field advances, more nuanced discussions are likely to appear.

Indeed, sustainable entrepreneurs must draw on “discursive resources” relating both to business acumen and environmentalism to form a “coherent sense of self” (Phillips 2013). This can lead to conflicting “self-representations” and, at times, entrepreneurs will subordinate their environmentalist identity to their business acumen and vice versa according to the narrative they wish to present (Phillips 2013). This suggests that entrepreneurs seeking to have a successful sustainable venture must manage tensions between the social, environmental and commercial discourses. It is implicit in the above analysis that these goals are inherently contradictory. However, earlier in this section, economically-orientated entrepreneurs featured and this indicates that the commercial objectives are not always inimical to environmental goals and it is possible that the extent of tensions is dependent on the sector in which the entrepreneur is operating and the nature of what they do; producers of environmental technology may face fewer tensions among goals than in other sectors, for instance.

Understanding the nature of environmental entrepreneurs is fraught with the difficulty of determining whether and how much they differ from entrepreneurs not involved in environmental activities. The role of commitment to the natural environment in the pursuit of environmental entrepreneurship is central to this question and subject to debate in the literature presented above. It could be the case that its importance varies according to the sector and type of activity in which environmental entrepreneurs are involved; in certain sectors, the pecuniary motivation may be more influential whereas, in others, environmental values may be of greater importance.

2.2.3 Embedded nature of environmental entrepreneurship

Anderson (1998) argues that the social forces of environmentalism and entrepreneurship are not contradictory, but, rather, complementary in that entrepreneurial opportunities reflect society's values. Therefore, if society attaches greater value to the conservation of the natural environment, as manifested through the green consumer and corresponding green producer movements, opportunities for environmental entrepreneurship to exploit this value will emerge (Anderson 1998). Arguably, environmental entrepreneurship is embedded in society and contingent on the values of that society.

Anderson's (1998) conceptualisation of the embedded nature of environmental entrepreneurship is empirically supported by Meek, Pacheco et al. (2010) who investigate statistically the effect of societal norms on the incidence of solar energy firm start-ups across forty five US states. Since environmental ventures suffer from a “liability of newness” (Stinchcombe, March 1965), depriving them of legitimacy, they must overcome the institutionalised “rules of the game” which favour current unsustainable practices. Although centralised institutions which encompass regulations, policies and tax incentives, that are intended to promote or enforce positive environmental behaviours, are important in overcoming these institutional barriers to environmental entrepreneurship, Meek, Pacheco et al. (2010) examine the role played by decentralised institutions corresponding to social norms, defined as tacit codes of behaviour shared by members of the same group (Elster 1989) in environmental entrepreneurship. They establish positive statistical relationships between the incidence of environmental entrepreneurship and both environmental consumption norms that lead to preferences for ecologically-friendly goods and services and also family interdependence. Individuals concerned about their family's health and well-being, which is of course dependent on the state of the environment, are found to be more inclined to start up a business beneficial to the natural environment, with the pro-environmental nature of the venture reinforcing family approval (Meek, Pacheco et al. 2010).

Crucially, Meek, Pacheco et al. (2010) identify an interaction effect between social norms and centralised institutions. For example, they discover that low norms of conformity and a high rate of family interdependence in a society amplify the effect of state incentives on the incidence of environmental entrepreneurship. These results provide evidence of both the effect of social norms on environmental entrepreneurship, and the manner in which their presence amplifies the power of environmental policies, such as regulation and subsidies, in incentivising entrepreneurship. The implications of this are that policies are more likely to have a successful outcome in geographical areas in which particular social norms are prevalent and that environmental consumption norms should be fostered through awareness campaigns, for example.

In a German context, Shepherd, Dean et al. (2014) find that social norms are favourable to environmental entrepreneurs in the sense that entrepreneurs engaged in environmentally-friendly technology are judged less harshly by society in the case of business failure. In effect, their environmentally-friendly intentions act as a "pass for failure" (Shepherd, Patzelt 2014). If the stigma of failure is lower for environmental entrepreneurs thanks to more positive normative perception of their actions, then this may well lower the fear of entry for those inclined to pursue opportunities for sustainable development. This is indicative of a reasonably supportive German context for sustainable entrepreneurship and complements the work by Meek et al. (2010).

Eco-consumption norms on the part of the consumer are important; the pace of change in consumption habits in response to growing environmental threats is lamentable according to Linnanen (2002) who stresses the need for a “socialisation of environmental threats” by means of a public communication system to disseminate awareness of green issues among members of the public. It is not clear what this public communication system is, however, perhaps it corresponds to programmes such as social marketing aiming to alter buyer behaviour in favour of more ecologically-conscious consumption. Pastakia (1998) points out that consumer resistance is likely to be high if adopting an eco-innovation requires drastic changes to lifestyles. He argues that it is not only a case of selling the product, but also the concept in associating it with “cultural symbols” or “religious movements” in order to motivate drastic shifts in behaviour. Pastakia (1998) alludes to an Indian ecopreneur who marketed the concept of an organic composting technique, as an alternative to chemical fertiliser, by linking the natural quality of this innovation with the values of local spiritual culture. Likewise, Jansson (2011) describes certain eco-innovations as “high involvement products” (Jansson 2011) – in this instance, alternative-fuel-vehicles in Sweden. Alternative-fuel-vehicles involve more drastic changes in behaviour, so could reasonably be considered “high-involvement products”. Crucially, Jansson (2011) determines that early-adopters of such radical eco-innovations (i.e. the alternative-fuel vehicle) are more likely to possess green values and/or seek novelties when purchasing. Hence, it is worthwhile inculcating pro-environmental norms among consumers, as these trigger the purchasing of eco-innovations. Consumer resistance is a principal obstacle to the diffusion of green entrepreneurs’ innovations. It is perhaps the case that overcoming this resistance is not just a question of providing pecuniary incentives for consumers to adopt eco-innovations, but also of altering the internal values and preferences of the public in favour of environmentally-friendly consumption.

Garnsey, Dee et al. (2006) allude to the problem of market uncertainty in their study of 73 micro-enterprises operating in low carbon sectors. They found that the enterprises encountered difficulties persuading potential customers and partners of the value of the eco-innovation even following the introduction of new environmental regulations. It may, for example, be difficult to persuade potential customers of the ecological credentials of the innovation. In response to these obstacles, Garnsey, Dee et al. (2006) emphasise the role that government could play. They advocate public sector bodies purchasing from new eco-ventures to improve the credibility of their products among other potential customers and propose that regulators could even oblige market incumbents in regulated sectors to purchase from such smaller actors. In addition, the value of a trusted government-supported certification scheme in overcoming the problems posed by information asymmetries - whereby customers are not in a position to fully trust information regarding the environmental credentials of an eco-innovation – is emphasised. In this sense, the government would be engaging in a form of institutional entrepreneurship to reshape markets in favour of sustainability, as described later in this section.

Although highlighting the abundance of entrepreneurial opportunities to address environmental problems, Garnsey, Dee et al (2006) allude to the barriers new ventures confront in commercialising eco-innovation through their study of seventy three micro-enterprises operating in several different low carbon sectors. Although identifying a number of generic obstacles which would affect most new ventures, they also uncovered barriers specific to environmental ventures. The lack of knowledge among investors of the environmental sector posed a major impediment to accessing finance and this was compounded by a high degree of market uncertainty, in terms of persuading potential customers and partners of the value of the eco-innovation, even following the introduction of new environmental regulations. It may, for example, be difficult to persuade potential customers of the ecological credentials of the innovation.

Garnsey, Dee et al. (2006) emphasise ways in which the government could overcome these obstacles. They advocate public sector bodies purchasing from new eco-ventures to improve the credibility of their products among other potential customers and propose that regulators could even oblige market incumbents in regulated sectors to purchase from such smaller actors, echoing recommendations by Dean & McMullen (2007). In addition, the value of a trusted government-supported certification scheme in overcoming the problems posed by information asymmetries - whereby customers are not in a position to fully trust information regarding the environmental credentials of an eco-innovation - is emphasised by Garnsey, Dee et al. (2006).

As environmental entrepreneurship is embedded in its societal context, it will encounter different levels of support and resistance. Muñoz & Dimov (2011) distinguish between conformist and insurgent sustainability entrepreneurs. Entrepreneurial action emerges out of a supportive context in which there is a receptive market for sustainable innovations and greater clarity regarding returns and conformists thrive in this context. In contrast, in a an unsupportive societal context, entrepreneurs have to operate counter to social norms and institutions, and rewards are far less clear; these entrepreneurs are considered “change agents” and have an insurgent quality (Muñoz, Dimov 2011).

As “change agents”, sustainable entrepreneurs do not only introduce sustainable innovations to meet the needs of consumers, but also alter institutions to enable sustainable development (Schaltegger, Wagner 2011, Parrish, Foxon 2009, Machiba 2010). Schaltegger & Wagner (2011) modify their original matrix of ecopreneurship, featured in section 1.1, to include sustainable entrepreneurship. Their conception of sustainable entrepreneurship is broad and encompasses both social entrepreneurs, aiming to achieve social change through their ventures, and those who engage in “beyond market”, institutional entrepreneurship, aimed at changing the rules of the game for economic actors in favour of sustainable behaviour.

This institutional change may be necessary to improve the private benefits of sustainable innovation, so that they align with the collective social benefits of the enhanced environmental outcomes which result (Schaltegger, Wagner 2011). In other words, the benefits to the private consumer of adopting sustainable innovation must be increased through institutional change, so that they are more aligned with the collective benefits accruing to society from enhanced environmental performance and reduced environmental degradation. Policy intervention will frequently be required in cases where this private benefit is absent – Schaltegger & Wagner (2011) cite the feed-in tariffs for renewable energy in Germany are an example of such an intervention to change the institutional context for environmental entrepreneurship. Whilst the Schaltegger & Wagner (2011) reference to feed-in tariffs is a powerful example of institutional change in favour of sustainable entrepreneurs in the energy industry in Germany, the feed-in tariff law was an external policy intervention and it is not clear in what manner or how effectively entrepreneurs can act as change agents to transform the institutional context in favour of sustainability.

Parrish & Foxon (2009) claim that institutions, for example petroleum markets and energy distribution infrastructures, have led to the lock-in of both high carbon technology and high carbon modes of social organisation, the growth of which has, in turn, reinforced the existence of those enabling institutions. Therefore, sustainable entrepreneurs must create new institutions that encourage the adoption of technologies and modes of social organisation that are sustainable (Parrish, Foxon 2009). The authors cite the example of the founders of Native Energy, in the United States, who launched a new institutional innovation which enabled the marketing and selling of the long-term environmental attributes associated with renewable power generated on land belonging to Native Americans. This permitted the economic capturing of the positive environmental externalities arising from the generation of renewable electricity and the selling of these environmental benefits in the form of carbon off-setting certificates provided financing for renewable energy projects on Native American Land. This is an example of how environmental entrepreneurs can refashion the institutional context in their favour. However, in relation to this carbon-offsetting scheme, it is not clear that it radically alters the coercive pressure in the market in favour of adopting green energy in the way that regulation and state-imposed market incentives would.

This non-technological change, at the societal level is particularly crucial to the transition to sustainability and involves the overhauling of business models and entails changes to organisation, social structures and cultures, according to Machiba (2010). He illustrates this point using the example of sustainable manufacturing. As sustainable manufacturing moves from more incremental phases to more radical, holistic, phases, a greater scope of innovation targets and mechanisms is required. They suggest that this wider scope may encompass innovations such as new organisational arrangements – for instance, setting up markets to exchange waste resources for reuse in manufacturing processes. They refer to other examples - in the mobility industry, there is a contrast between efforts to make more fuel-efficient cars and other more radical approaches to sustainability, such as the bike-sharing Vélo-Lib scheme in Paris. In the steel industry, there has been more narrow cooperation with customers in the transport industry to develop lighter materials - this is an illustration of user-led integration in the development of sustainable innovation (Tidd, Pavitt et al. 2005). These approaches involve changes to institutions – car sharing challenges the dominant norm of owning one's own personal vehicle and the approach of the steel industry to developing ecologically-superior products entails overcoming major organisational and cultural obstacles in order to integrate consumers into the design process.

Sustainability entrepreneurs employ strategies to change institutions. Through conducting multiple case studies of entrepreneurs engaged in biomass in the Netherlands, Thompson, Herrmann et al. (2014) reveal how they might create favourable institutions despite being "resource and power scarce" (P.608). They identify strategies to bring about institutional change based around sustainability entrepreneurs increasing their legitimacy through creating new symbols and narratives to represent the need for their activities in light of current crises and "constructing new measures", such as social performance indicators to better illustrate the benefits resulting from their sustainable innovations. To increase their influence, sustainable entrepreneurs build both consensus, by attracting others to their cause, and new collaborations, entailing forming collective action groups, such as producers setting their own product standard, in order to bring about institutional change.

Using data from sixteen environmental entrepreneurs in the Dutch construction industry, Rosalinde & Woolthuis (2010) discuss how system-building entrepreneurs "co-create" their context to allow sustainable innovation to be successful. These entrepreneurs circumvent existing structures and institutions whilst forming networks of new actors out with the existing dominant players. Moreover, they exceed current environmental regulations, proactively developing new technologies and creating new demand for their sustainable innovation(s). In so doing, they challenge the dominant paradigm and are followed by system-following entrepreneurs, engaged in sustainable activities, but lacking the confidence to defy the existing system and market structure (Rosalinde, Woolthuis 2010). These system building entrepreneurs forge a pathway which leads to other actors

In their study of the Dutch Transition Management Programme, Loorbach, van Bakel et al. (2010) demonstrate how businesses can contribute to wider social change in favour of sustainability through taking a systems approach. Transition Management recognises that the roots of sustainability problems are entrenched in society and institutions; multi-level and multi-stage structural change processes are required to resolve these problems (Loorbach, van Bakel et al. 2010). They identify micro-, meso- and macro- levels of change, with firm-level innovations at the micro-level, industry structures, practices and behaviour patterns at the meso-level and wider societal trends existing at the macro-level.

This process of transition happens over four phases, from the challenging of incumbent structures at the earlier stages to the acceleration and settling of ecologically-superior structures at the later stages. Crucially, Loorbach, van Bakel et al. (2010) expand on the concept of co-evolution introduced by Parrish & Foxon (2009), through considering the complex and multi-faceted roles that sustainable businesses have in advancing transitions to a sustainable economy. In order to achieve successful transition, such businesses must establish dialogue with other leading performers in the sector to set out an overall vision for system-level change. However, they must also engage in tactical transition management, entailing the formation of alliances with external stakeholders, out with the sector, to change aspects of the institutional context which may hinder discontinuous sustainable innovations, and in operational transition management, namely experimenting with and testing sustainable innovations to enhance their rate of adoption (Loorbach, van Bakel et al. 2010). Transition management stresses that co-evolution is not an automatic process; firms engaged in sustainable entrepreneurship have to proactively contribute to the creation of a context conducive to the dissemination of their innovations. In addition to establishing and furthering a movement comprising various industrial actors which aim for sustainable development, sustainable ventures must attempt to confront and overturn wider institutional barriers to the success of discontinuous sustainable innovation.

Environmental entrepreneurs are unlikely to be entirely "conformist" or entirely "insurgent"; they, most probably, confront both favourable and unfavourable institutions in their context. They have limited power to refashion institutions in favour of their activities; policy makers must act to make institutions conducive to the pursuit of environmental entrepreneurship.

2.2.4 Environmental entrepreneurship and its economic context

A principal part of the formal institutional context, featured in the previous overview, is the economic system in which environmental entrepreneurs operate. The degree to which environmental value is integrated into economic decision making will be critical to the feasibility of pursuing opportunities for sustainable development. Dean & McMullen (2007) claim that "environmentally-relevant market failures" prevent entrepreneurial action to address environmental problems and it is the goal of entrepreneurs to tackle the causes of inefficient markets for environmental goods. Market failures weaken the incentive to adopt eco-innovation or distort markets through informational asymmetries, poor government intervention or, indeed, concentrating power in monopolistic actors averse to deploying eco-innovation (Dean, McMullen 2007).

The public nature of environmental goods and the existence of externalities weaken incentives to adopt eco-innovation and, therefore, constrain environmental entrepreneurship. Dean & McMullen (2007) describe environmental resources as public goods, as they are "non-excludable" which means that such resources can be consumed by any actor without payment for that consumption. Environmental goods are, thus, rivalrous, whereby one actor's consumption of the good adversely affects another's ability to consume the good; there is, thus, an incentive to consume the good as rapidly as possible as opposed to conserving the resource (Dean, McMullen 2007), reflecting a “tragedy of the commons” type situation (Hardin 1968). Dean & McMullen (2007) advocate the assignment of property rights to this public good - environmental well-being - to incentivise its conservation. Hardin (1968) illustrates this problem of public goods using the metaphor of a pasture shared by a group of herdsmen, each having the freedom to use that pasture as they so wish. According to his conception, in the pursuit of individual interest, each herdsman will add more cattle to the pasture despite the fact that this adversely affects the collective interests of the group, as the pasture has limited capacity to support cattle. Each herdsman will always seek to maximise individual gain, as the negative effects of his actions are shared by the collective whereas the individual utility gains accrue to him alone. It is this context of freedom to exploit the pasture which leads to such unsustainable behaviour, with Hardin (1968, P.1244) lamenting:

> *“Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons”*

Pacheco, Dean et al. (2010) also refer to this problem of public goods, employing a game theory framework. They describe entrepreneurs as operating within a green prison caused by the non-excludable nature of environmental goods which results in individual actors failing to engage in sustainable behaviour (defecting) even when this is against the collective interest. In the absence of economic rents from sustainable behaviour, entrepreneurs who cooperate will always be at a competitive disadvantage due to additional costs which other competitors do not bear (Pacheco, Dean et al. 2010) and environmental entrepreneurship will be suppressed. Revisiting Hardin’s (1968) analogy, the herdsmen all defect even though cooperation is necessary for the endurance of the pasture on which they all depend. In contemporary society, governed by individual freedom, economic actors all defect in the face of the dangers of climate change which threaten the well-being of the collective. This is partly because, in the absence of property rights, everyone benefits from an enhanced air or water quality, preserved biodiversity, regardless of whether they have borne the cost of engaging in sustainable development (Anderson 2009). This, in effect, encourages defection, as it is impossible to capture value from sustainable innovation. It is not practical to charge others for a better quality of air or water, for example. Environmental entrepreneurs do not receive adequate rewards for the outcomes of their entrepreneurial activity due to this "free-rider problem" and are not sufficiently incentivised to engage in this entrepreneurship (Anderson 2009).

Similarly, Kotchen (2009) describes eco-entrepreneurship as the creation of an "impure public good" (P.28), a private good, for which a market exists, which contains an inherent positive environmental externality. For example, green electricity has a private good element, namely the electricity, but has a positive environmental externality, in that it does not produce emissions compared to conventional power generation sources (Kotchen 2009). Drawing on micro-economic theory, he argues that eco-entrepreneurial activity will be "inefficiently low", since entrepreneurs cannot capture the value represented by the positive environmental externality, namely the enhanced environmental well-being that their innovation brings, as it is a public good.

Suggestions are made by Dean & McMullen (2007), Pacheco, Dean et al. (2010) and Kotchen (2009) as to how entrepreneurs can respond to this problem of non-excludability. The establishment of property rights for environmental goods attaches an economic value to their preservation them and, therefore, leads to greater opportunities for environmental entrepreneurship aimed at halting and reducing their degradation (Dean, McMullen 2007). In addition, Anderson & Leal (1997) consider that the allocation of property rights surrounding these environmental goods and contractual relationships, forces "free-riders" to pay for the benefits arising from an enhanced eco-system, and this generates rents from environmental entrepreneurship. Dean & McMullen (2007) refer to an analogy of light-house keepers who gained permission to charge ships using the harbour for services provided by the lighthouse. This allowed light-house keepers to convert a non-excludable public good – the safety resulting from the lighthouse services – into a non-excludable good, namely a good for which users that benefited (ships) had to pay. This attached an economic value to providing safety in the harbour and established a market incentive for light-house keepers to provide services for which they would be remunerated.

Pacheco, Dean et al. (2010) propose industry norms and legislation as a means of rewarding cooperation and penalising defection and, therefore, enabling environmental entrepreneurship beset by the public goods problem. Establishing internally-agreed norms promoting sustainability leads to a collective incentive for actors to cooperate, provided there is monitoring of norms and sanctions if they are violated. As industries grow in size, with a greater number of operators and the expansion of markets, internally-agreed norms may become difficult to monitor and implement consistently, and, in this case, government legislation becomes necessary to "formalise" sustainability norms and to induce changes to incentive structures to compel cooperation (Pacheco, Dean et al. 2010). For instance, this might be through regulations on waste or emissions. This portrays environmental entrepreneurs as subjective agents capable of interpreting and fashioning the context around them to generate opportunities for sustainable entrepreneurship.

Kotchen (2009) advocate governmental interventions as "demand drivers" for eco-entrepreneurs and this has been seen in the energy sector in certain parts of the United States in which emissions regulations, the introduction of renewable energy obligations, the establishment of carbon reduction plans and aversion towards the construction of large, centralised power plants has stimulated the demand for renewable energy, thus creating markets for this “impure public good” in the form of the incidence of eco-entrepreneurship.

A second form of market failure, discussed by Dean & McMullen (2007), that weakens the incentive to adopt eco-innovation is that of externalities, namely the social cost of economic activities which is not factored into private costs. Since the environmental costs of incumbent technologies, such as C02 emissions, are not fully (or at all) internalised by users, the private benefits (for these users) of switching to environmentally-superior technologies are low (Wüstenhagen, Hamschmidt et al. 2008) reducing the market prospects for green entrepreneurs.

It is difficult to internalise the environmental cost of economic activity, due to transaction costs. One can imagine the complexity in assigning responsibility of environmental damage to a particular actor and charging them for that damage. In order to address externalities, Dean & McMullen (2007) advocate the establishment of “economic institutions” by environmental entrepreneurs which can reduce these transaction costs. They illustrate this with the example of Richard Sandor who formed the Chicago Climate Exchange – a market place which permitted users with relatively low carbon emissions to exchange carbon emissions credits - allowances permitting the user to emit carbon - with users with relatively high carbon emissions. Effectively, this institutional entrepreneurship, through enabling the internalisation of the costs of high carbon technology for users and internalising the benefits of low-carbon technology for innovators stimulated both demand for eco-innovations and incentives to engage in green entrepreneurship. In doing this, environmental entrepreneurs are, in effect, acting as institutional entrepreneurs, as discussed in section 2.2.3.

Informational asymmetries, the power of monopolies and inappropriate government intervention also prevent the proper functioning of markets for environmental goods and services (Dean, McMullen 2007). Moreover, a lack of robust regulation concerning the eco-certification of products can undermine green entrepreneurship, since disreputable actors can make misleading claims about the environmental attributes of their products (Pastakia 1998) and this weakens the trust of consumers in green products and services. Entrepreneurs can engage in informational entrepreneurship, whereby they, for example, provide information to customers regarding the ecological attributes of a product or a technology and this empowers the consumer to make an environmentally-friendly choice, as they now have relevant information which they lacked before, thus overcoming the problem of informational asymmetries to the disadvantage of the consumer (Dean, McMullen 2007).

Breaking the power of monopolies in strategic sectors like energy is conducive to promoting environmental entrepreneurship, as monopolistic actors tend to be sclerotic and resistant to innovation (Dean, McMullen 2007). Dean & McMullen (2007) recommend that governments weaken these monopolies by, for example, compelling large-scale electricity operators to purchase a certain proportion of their power from small-scale providers, transferring greater market share to new, innovative green ventures which become "market appropriating entrepreneurs".

Likewise, political entrepreneurship, conducted at government level, is about rectifying inappropriate government intervention which is adverse to the interests of environmental entrepreneurs and involves lobbying to change the external political context (to the subsidy or tax regime for example), so that it is more favourable (Dean, McMullen 2007).

As opposed to viewing market imperfections as barriers which environmental entrepreneurs must overcome, Cohen & Winn (2007) consider that substantial opportunities are inherent to these imperfections for sustainable entrepreneurship. They claim that entrepreneurs can harness these imperfections and capture the economic rents available whilst also creating social and environmental value, thus realising a “win-win scenario” whereby economic development is not at the expense of social and environmental outcomes.

Entrepreneurs can convert these failures into opportunities for sustainable development. The dearth of environmental information about products leaves greater potential for entrepreneurs to seize opportunities to promote the environmentally-superior attributes of their innovations and the existence of negative environmental externalities present possibilities for entrepreneurs to develop alternative technologies and business models aimed at minimising these externalities (Cohen, Winn 2007). They describe inefficient firms, wasteful in their use of natural resources as giving rise to opportunities to promote recycling and reuse activities, fulfilling this circular economy concept. Intriguingly, they claim that the undervaluing of environmental resources in developed countries offers firms possibilities to gain experience in technologies in developing country markets which lack conventional fossil fuel infrastructure. Such firms would then commercialise these technologies in developed markets once demand for green technology had risen amid rising concern for the environment and higher fossil fuel prices, according to Cohen & Winn (2007). Whilst these market failures may constitute opportunities, the fact that they are under-exploited points to the difficulties in capturing economic value from tackling these opportunities, as described in the previous paragraphs by Dean & McMullen (2007) and Pacheco, Dean et al. (2010).

The status-quo economic system requires modification if environmental entrepreneurship is to fulfil its potential. This could either be through the initiatives of entrepreneurs, themselves, perhaps working in collaboration to establish property rights, for instance, or, as is perhaps far more plausible, through the intervention of policy makers in possession of the power to implement change, such as establishing institutions for carbon trading.

2.2.5 Policy and environmental entrepreneurship

Isaak (1998) distinguishes two philosophies of public environmentalism: free market environmentalism and social market environmentalism. Free market environmentalism emphasises the importance of defining and enforcing property rights and leaving market forces to address environmental problems efficiently, with entrepreneurs exploiting the opportunities created by these property rights. In contrast, under social market environmentalism, government uses regulation as a tool to induce pro-environmental market preferences in society and this motivates the entrepreneurs to establish sustainable businesses. Isaak (1998) alludes to the strict German environmental regulations (in the domain of recycling for example) which have led to greater environmental awareness in German society as an example of this social market environmentalism. He claims that this environmental value set has become embedded in the "social order" of Germany – a “green logic” has emerged.

There is a distinction between command and control policies, encompassing more traditional forms of regulation, and more advanced market mechanisms. In terms of external drivers, Demirel & Kesidou (2011) find that environmental regulation, in the form of command and control policies, are effective in stimulating both the adoption of incremental end-of-pipe technologies and investment in environmental R&D, the latter more likely to result in more radical process and product eco-innovation with correspondingly greater sustainability performance. They also find that environmental taxes do not have a significant effect on eco-innovation, however, they stress this could be down to the limited use of carbon taxes in the UK and their low level when implemented. Leitner, Wehrmeyer et al. (2010) describe command and control policies as “first generation regulation”, claiming that emissions trading, taxes and disclosure schemes are examples of more sophisticated, “smarter” regulation. Moreover, they argue that regulation is more important at radical stages of eco-innovation, as these stages entail greater investment and are associated with higher levels of complexity, uncertainty and investment. However, Horbach, Rammer et al. (2012) are more sceptical about the role of regulation, finding that it stimulates end-of-pipe initiatives, but that C02 reducing innovations are triggered by subsidies. There is dis-agreement about the relative role of regulation compared to other market-based instru-ments in the stimulation of eco-innovation.

More direct interventions, based on partnership, form part of this social market ap-proach. Drawing on the case of Victoria, British Columbia, Cohen (2006) discusses the roles that different public organisations, namely universities, government, capital services and professional support agencies have in stimulating sustainable entrepreneurship. These are the elements which comprise the sustainable entrepreneurial eco-system, defined by Cohen (2006). Particularly interesting examples of action by the government of Victoria include the foundation of the organisation Sustainable Development Technology Canada, a government firm dedicated to financing clean technologies and the undertaking of joint ventures with the private sector on energy-from-waste projects.

Other authors emphasise different elements of the ecosystem outlined by (Cohen 2006). Since environmental industries tend to be fragmented (Tagar, Cocklin 2010), this leads to a reduced potential for network externalities, with a lack of similar firms located in close proximity leading to a dearth of specialised labour and the absence of “knowledge spillovers” common among firms operating in a similar sector (Audretsch, Grilo et al.

2007). In addition, this fragmentation reduces the opportunities for firms to work together on joint innovation and sales/marketing initiatives, weakening market success (Tagar, Cocklin 2010). Tagar & Cocklin (2010) advocate the promotion of green clusters in which a number of environmental firms would be located within the same geographical space to strengthen the sector in face of this fragmentation. They argue that the formation of green clusters would lead to the emergence of greater collaboration among new eco-ventures in the form of pooled resources and the sharing of knowledge. On a macro-level, green clusters would lead to a “critical mass” of relevant firms which would have a greater presence, influence and, ultimately, aid a region to develop comparative advantage in this particular sector.

Lindhult (2011) considers the role of cleantech incubators, especially in the development of markets and institutions favourable to sustainable entrepreneurship. He suggests they could extend their remit to lobbying the government and to engaging in communication and education to shift the strategies of existing industries towards more sustainable practices. In addition, specialist advisers within incubators can help to inculcate sustainability principles in start-ups across all industries (Schick, Marxen et al. 2002), perhaps converting them from into green or, even better, green-green firms, introduced by Isaak (1998). Capturing the sustainability potential within start-ups could be a powerful policy tool (Schick, Marxen et al. 2002) which is unexploited presently.

This idea is reiterated by Hansen & Klewitz (2012) who advocate a role for “publicly-mediated inter-organisational networks” in promoting sustainability-orientated innovation within the wider SME community and this is a central feature of the sustainable entrepreneurial ecosystem, envisaged by Cohen (2006). Due to resource constraints, SMEs are generally ill-equipped to bear the risks associated with sustainability-orientated innovation, both in terms of the complex innovation process itself and the high risks of market failure to do with externality problem (Hansen, Klewitz 2012) - see section 2.2.4 for a more detailed discussion of this. The authors argue that a way of overcoming these constraints is for SMEs to engage in SME networks in which knowledge can be shared and the expense of innovatory activities can be distributed among the members. Third party “bridge builders”, including governments, universities, non-governmental organisations and Chambers of Commerce can enable the formation and operation of these SME networks. These target the potential for sustainability entrepreneurship within the wider population of SMEs that are not necessarily environmentally-orientated at their inception.

Hansen & Klewitz (2012) develop a framework outlining two different paths for this publicly intermediated innovation. Path A involves specific government intervention, either through environmental laws or regulation, which compel sustainable innovation, or through public-private partnerships, in which the government collaborates with SMEs directly through the setting up of clean production centres, specialised support services or joint initiatives (path B). It is implied in the article that the targeted SMEs are not those engaged in industries directly concerned with the natural environment; rather the broader group of SMEs which are often overlooked, yet could be a crucial source of sustainable innovation and entrepreneurship, given their sheer number in the European economy.

Whilst there is substantial interest in the possibility of developing ecosystems that could conducive to sustainable entrepreneurship, Meyskens & Carsrud (2013) do not find a relationship between partnership diversity and sustainable development and innovation within greentech ventures. Employing the resource-based view (Barney 1991), the authors measure the relationship between partnership diversity, in the form of the variety of partnerships between the greentech ventures and organisations in the public, not-for-profit, education and private sectors and the holistic success of the venture. This holistic success refers not only to the venture's commercial progress (called venture development), but to the advances in sustainable development and environmental innovation arising from its activities. It is claimed that, although partnership diversity is positively associated to both resource mobilisation and, thus, venture development, it does not significantly influence sustainable development or innovation (Meyskens, Carsrud 2013). The implication of this is that the existence of partnerships between greentech ventures and public, private and third-sector organisations may foster the birth and growth of these ventures, but not, ultimately, have an impact on levels of sustainability innovation within those ventures. This highlights the need to embed sustainability outcomes throughout this partnership network, within business support organisations, for example, to strengthen the relationship between partnerships and sustainability innovation.

More free-market approaches aimed at the generation of market demand and the facilitation of access to finance are possible. Notable examples include feed-in tariffs remunerating generators of renewable power with a guaranteed and fixed payment per kWh. Using public instruments to generate demand for eco-innovation counteracts the fact that the environmental costs of incumbent technologies are not internalised by users, as described in section 2.2.4. In the absence of market-enhancing interventions, environmental innovations are at a disadvantage to conventional, unsustainable technologies. Feed-in tariffs and carbon trading schemes are, in effect, a way of assigning value to green energy, in the former case, and to emissions cuts, in the latter case, as there is a financial advantage to avoiding emissions thanks to the existence of tradable permits. Once these property rights are established, economic actors, operating in a free market, will innovate to take advantage of the market opportunities resulting from these mechanisms (Isaak 1998).

These mechanisms are influential for financial stakeholders and policy makers must understand investors' perceptions of risks in connection with climate and energy policies if they are to mobilise private finance to diffuse renewable energy technologies (Bürer, Wüstenhagen 2009). As a market-pull policy, stimulating demand for green technologies, Bürer & Wüstenhagen (2009) finds that feed-in tariffs are by far the preferred policy instruments of investors in a survey of sixty six venture fund management firms in the US and the EU. They suggest that the feed-in tariff mechanism provides longer-term stability for investors and, ultimately, lower risks and this contrasts with quantity-based schemes like the Renewables Obligation. This, they say is because the latter are inherently more risky, as they are subject to greater price volatility and this is something that:

> *"only large, integrated energy companies tend to be able to overcome which points to a positive correlation between feed-in tariffs and entrepreneurship in the renewable energy sector" (P.4999)*

Their study shows that feed-in tariffs are the preferred policy of investors in relation to renewable energy. Intriguingly, Bürer & Wüstenhagen (2009) find that climate change is considered by respondents to be subordinate to energy security and competitive advantage as drivers for investment in renewable energy, with US investors mainly concerned with the price signals, notably the price of oil. This highlights the potential importance of factors out with sustainability concerns as triggers of investment interest in environmental entrepreneurship and the necessity of market incentives.

The financial crisis posed a major threat to the endurance of feed-in tariff schemes in European Union countries and this has profound implications for investors. Pointing to the paucity of research has been done on renewable energy since the financial crisis, Hofman & Huisman (2012) allude to cuts in feed-in tariffs that have been seen in countries, such as Germany and Spain, with Spanish tariffs having been revised retroactively – especially pernicious for investor confidence. Repeating the survey done previously by Bürer & Wüstenhagen (2009), they find support among investors for feed-in tariffs did not change following the financial crisis which indicates that in a climate of heightened perceptions of risk, the certainty offered by this instrument was still attractive, despite the fall in the cost of renewable energy technology. The remaining popularity of this instrument stands in contrast with policymakers' decisions to pare it back, especially since the certainty resulting from feed-in tariffs may be especially necessary to reassure investors in a climate of economic fragility.

This comes at a point in which environmental ventures have gained greater legitimacy among venture capitalists in recent years. This is demonstrated by the phenomenal growth in investment in the cleantech sector, concerned with the commercialisation of technologies based on upstream, preventive solutions as opposed to end-of-pipe technologies which are more incremental innovations (O'Rourke 2010). Despite these improvements in the availability of investment O'Rourke (2010) claim that green entrepreneurs still encounter problems in obtaining venture capital. They say that venture capitalists require substantial and early returns and this is not consistent with the complexity of eco-innovation. Furthermore, it remains hard for green entrepreneurs to secure investment if they are at an early stage of development and if they are in emerging technologies (O'Rourke 2010). To further increase green entrepreneurs' access to this form of financing, O'Rourke (2010) recommend that governments both require higher ecological and social standards in venture capital investments and also consider options including tax advantages, joint funding and guaranteeing investments, especially if the venture is at an embryonic stage.

There has been greater interest in alternative sources of entrepreneurial finance in recent years (Bruton, Khavul et al. 2015, Belleflamme, Lambert et al. 2014). Crowdfunding, whereby ventures finance projects through obtaining multiple small loans or donations from a large group of citizens often via an online platform (Mollick 2014), could hold potential for environmental ventures given the social nature of their activities which represent an attribute which may appeal to a public seeking to participate in crowdfunding. Hörisch (2015) discusses the crowdfunding of environmental ventures and, surprisingly, finds that there is no positive relationship between environmental orientation and crowdfunding success – this is at odds with findings by Belz & Binder (2015) that social and environmental attributes ease access to crowdfunded investment. He attributes this finding to the “non-excludable”, public nature of the goods provided by environmental ventures (Hörisch 2015). He argues that, generally, individuals are less willing to provide money if the benefits from their investment accrue to the collective rather than having a direct benefit to themselves and it is clear that an improved environment offers little in terms of individual reward and the outcome is not a “tangible” product, as often the case with crowdfunding projects. To fulfil the potential of crowdfunding, Hörisch (2015) recommends creating crowdfunding platforms that are dedicated to environmental causes and to consider the extent to which environmental protection could be presented as a charitable issue, as non-profit environmental projects were found to be more successful in attracting crowdfunded investment.

Social market and free market environmentalism are useful categories through which to analyse policies targeting environmental entrepreneurship. They are not, however, mutually exclusive and it is proposed that a mixture of the two policy branches will be combined to create a context that is most conducive to the pursuit of environmental entrepreneurship.

2.2.6 Conclusion: core themes within the field

This review aimed to conduct a systematic review of the environmental entrepreneurship literature in order to identify core narratives within the field. Previously, environmental entrepreneurship scholarship has been criticised as lacking rigorous empirical investigation (Lenox, York 2012, Hall, Daneke et al. 2010) and there has been call for more diverse theoretical approaches to the field (Shepherd, Patzelt 2011). Since environmental entrepreneurship remains an emerging field, it is not surprising that much of the work to date has concentrated on the generation of a "plethora of theory and propositions" (Lenox, York 2012) and has studied a small number of cases. More large scale, empirical studies are starting to appear (i.e. Muñoz, Dimov 2014, Kuckertz, Wagner 2010, Meek, Pacheco et al. 2010) and there is scope for large scale studies which address specific issues, such as those which Hall, Daneke et al. (2010) propose for investigation, including the role of policy in stimulating environmental entrepreneurship – the object of this PhD. From the five overviews featured in this section, several conclusions arise.

A contentious point in the field is the debate between new ventures and incumbent firms in the dissemination of environmental innovation. In other words, there is argument about whether it is new ventures or incumbent firms that are more likely to successfully diffuse radical environmental innovation. Whilst large incumbents have better capacities to disseminate environmental innovation on the mass-market, there are substantial doubts about their incentives to do this, especially if environmental innovation undermines their existing business model, based around fossil fuel infrastructure (York, Venkataraman 2010, Hockerts, Wüstenhagen 2010). They might engage in environmental innovation eventually, but, enter at a later stage, following the growth of Emerging Davids and the feedback that these new ventures provide (Hockerts, Wüstenhagen 2010). It is argued that the role of new ventures is pivotal in creating the disruptive force necessary to the sustainable transformation of the economy. This justifies the rationale for focusing on new ventures as the environmental entrepreneurs in this thesis without underestimating the ability of large firms to act as ecopreneurs at a particular stage in the transformation of an industry.

Entrepreneurship is a phenomenon which is embedded in society (Granovetter 1985) and the literature suggests that this applies to an even greater extent to environmental entrepreneurship. Its success is related to the internal motivations, values and experience of the entrepreneurs. Equally, it is contingent on the external societal structures, namely existing social, economic and political institutions.

Environmental entrepreneurs operate not only in a wider political and economic context; they exist within a social structure. In launching environmental innovations which challenge the dominant unsustainable paradigm, environmental entrepreneurs are deviating from entrenched social norms, a process described by Schumpeter (1934). A resistant social context corresponding to the undervaluing of environmental well-being in society, results in little impetus and support from individuals' personal networks to launch an environmental venture. Likewise, the unsupportive social context translates into weak eco-consumption norms and this restricts the rate of adoption of environmental innovations. Shifting social norms in favour of sustainable behaviour is important to environmental entrepreneurship.

The state of economic institutions appears highly relevant to the successful pursuit of environmental entrepreneurship. The degree to which the cost of environmental damage is not internalised by economic actors and the absence of property rights governing environmental resources will determine the extent to which ecologically-superior goods and services are undervalued. Economic incentive structures have to be changed in favour of adopting environmental innovation if environmental entrepreneurship is to be fully promoted. There is an inherent market failure undermining environmental entrepreneurs' activities and this is a core obstacle to their activities.

A major part of political interventions to promote environmental entrepreneurship consists of reshaping economic institutions in favour of sustainable development. This could be through social market approaches, based on environmental regulation and through more free-market approaches. Social market environmentalism envisages a stronger partnership between the public sector and environmental entrepreneurs as envisaged under Cohen's (2006) sustainable entrepreneurial ecosystem. It is argued that there could be a strong link between social institutions in environmental entrepreneurship and policy; both the adoption of environmental innovation among consumers and their support of pro-environmental policies are proposed as underlying issues.

To summarise, this review discusses theory about the role of new environmental ventures in the sustainable transformation of industries in addition to the possible nature and characteristics of environmental entrepreneurs. Having established this foundation, it has covered the debate on the social, economic and political context in which environmental entrepreneurship exists. In particular, it has shown that policies play a prominent role in environmental entrepreneurship. This literature base will inform the discussion of the perceptions of environmental entrepreneurs in the renewable energy sector of energy policies in Britain, France and Germany (see sections 5 and 6).

3 Methodology

Environmental entrepreneurs possess an awareness of the social, economic and political conditions, outlined in the previous section, and this influences how they evaluate the worthiness and feasibility of pursuing opportunities for sustainable development. Environmental and energy policies, to a degree, shape these social, economic and political conditions. It is the entrepreneurial perceptions of the impact of these policies which this study seeks to examine. After defining the research questions, this chapter will discuss the ontological and epistemological issues related to the nature of environmental entrepreneurs. Subsequently, the research design will outline how the perceptions of the entrepreneurs are to be captured and analysed in this PhD.

3.1 Research questions

The overarching research aims and objectives are given in section 1.2 and research questions arise from the literature review to accompany these aims and objectives. The first aim is to capture the entrepreneurial perceptions of environmental and energy policies which are common to all three countries. The following research questions are associated with this first aim which examines policies common to all three settings:

(i) How do environmental entrepreneurs perceive social market environmentalist policies, common to all three settings, conforming to environmental regulation and the creation of a sustainable entrepreneurial ecosystem?

(ii) How do environmental entrepreneurs' perceive free-market environmentalist mechanisms common to all three countries, aimed at defining property rights and enabling the functioning of markets for environmental goods and services?

The second aim, presented in section 1.2, is to capture entrepreneurs' perceptions of policies which are not universal across the three settings, but unique to one or two of the countries. The following questions result:

(iii) How do entrepreneurs perceive country-specific social market or free-market environmentalist policy approaches which do not exist in their own country?

(iv) How do entrepreneurs perceive policies in relation to the entrenched institutions which are unique to certain settings, such as existing energy infrastructure and the public mind-set.

In responding to these four research questions, the ultimate research question can be addressed, namely:

(v) What lessons can be drawn from the comparison of perceptions across the three countries to design better policies for the continued diffusion of renewables in Britain, France and Germany through entrepreneurship?

3.2 Ontological and epistemological premises

Frameworks used to examine social phenomena are usually "based on a set of meta-theoretical assumptions regarding ontology, epistemology, methodology, and the nature of the phenomenon under study" (Shrivastava 1987). In section 1.1, the subject of this thesis is stated as green entrepreneurship and certain criteria are given to isolate this phenomenon from other environmentally-relevant business activities. In operationalizing this phenomenon, environmental entrepreneurs' perceptions of environmental and energy policies are identified as the unit of analysis. This unit of analysis relies on certain epistemological and ontological assumptions, with ontology, concerning social objects' nature of being (Williams, May 1996) governing epistemology, relating to the legitimacy of knowledge about those social objects (Berger, Luckmann 1990).

Focussing on epistemology, Johnson & Duberley (2000) emphasise the way in which epistemological concerns underlie the conduct of management research, influencing the nature of the research questions, the methodologies chosen and the assessment of research outcomes. They argue that there is an increasing expectation that scholars show awareness of epistemological concerns in their approaches to empirical analysis. Although they admit that the pursuit of flawless epistemological standards is likely to be futile, they argue that greater awareness of epistemology aids the researcher to become more “reflexive” and critical of their own pre-conceptions and the potential ramifications of these preconceptions as to how we interpret the social world.

Traditionally, there has been great debate about whether the nature of social phenomena can be accessed and explained in the same manner as physical phenomena (Williams, May 1996), with the assumption that methods applied to natural sciences are directly transferable to the study of the social world (Knights 1992). In the area of management studies, there have been attempts to “define, conceptualise and study the nature of management knowledge” (Aram, Salipante 2003), contrasting general knowledge and contextual knowledge as two dominant forms. In establishing general knowledge, researchers seek to identify regularities characterising the social phenomena that are measureable, quantifiable and that can be generalized across the social world, thus form universal principles that predict the behaviour of social phenomena (Aram, Salipante 2003). They contrast this with contextual knowledge - knowledge that is dependent on both the context in which it is generated and the resulting interpretations of the social actors within that context. Thompson, Kiefer et al. (2011) frames this as a distinction between “structural realist logic", based on knowledge resulting from an "observable reality", and a "socially-constructed logic" nature of reality constructed in the minds of social actors. He suggests that techniques such as structural equation modelling may be more appropriate to structural realist logic whereas qualitative procedures may be more suitable to social constructivist logic.

Tsoukas (1994) outlines approaches to generating management knowledge that are orientated towards Thompson's (2011) structural realist logic and others that are orientated towards his social constructivist logic. *Formism*, involving the categorisation of phenomena according to the identification of systematic commonalities and differences among them, and *mechanism*, which assumes a "well-ordered", fixed, nature of the world, in predicting how social phenomena operate, both generate knowledge about the structure of the social world (Tsoukas 1994). This form of knowledge relates to abstract and generalizable principles about how, for instance, organisations function. He contrasts these ways of generating more structural management knowledge with contextualism, based on the "construction of narratives and stories for the interpretation of unique episodes. As opposed to pursuing universal, generalizable knowledge, contextualism is interested in understanding the dynamics present within particular settings and the valuable insights such settings may reveal and is based on a deep understanding of the subjective narratives of social actors within those settings. Tsoukas' (1994) remaining form of knowledge generation is organicism which advocates the building knowledge on the basis that organisations are like biological organisms and evolve in a similar manner according to the conditions in which they exist and this form of knowledge generation seems to have more in common with the contextualist mode of generation of management knowledge. This PhD project is rooted in the contextualist approach, as it seeks to generate knowledge about a management phenomenon - green entrepreneurship - that exists within and is contingent on the dynamics of country and industry contexts, in terms of political and market conditions.

Since these forms of knowledge creation are each associated with different sets of assumptions as regards the nature of the social world, they imply different methodological approaches. Formist and mechanistic knowledge adopt a rather positivist outlook. Under positivism, it is assumed that reality is external to social actors; it is not in their minds (Johnson, Duberley 2000) and this epistemology espouses the methods of the natural sciences to investigate the social world (Swingewood 2000) and is, therefore, biased towards more quantitative methods. A positivist stance limits the legitimacy of knowledge of the social world to phenomena which can be directly sensed empirically and, consequently, it is difficult to capture the deeper structures underpinning the social world and social entities (Scott 1995).

Contextualism is at odds with this notion that there is a reality external to social actors and claim that reality is, to a certain degree, constructed in the minds of social actors and is, therefore, more relative and its investigation is, therefore, suited to an interpretivist approach (Johnson, Duberley 2000). Crotty (1998, P.67) describes the emergence of interpretivism as a “contradistinction to positivism in attempts to understand and explain human and social reality”. Human beings possess an ego and are the objects of study (Benton, Craib 2011); they are, thus, ontologically different to physical phenomena. This view of reality as more subjective is concerned with the way social actors attach meaning to their actions and interpret the social context in which they operate (Benton, Craib 2011). Action is determined by a set of symbols in the milieu in which the social actor exists and the meanings attributed to these symbols are based on the interaction actors have with others (Joas, Knöbl et al. 2009). The goal is to understand how meaning is “imposed on the world" through dispensing with assumptions and received beliefs and identifying how social actors arrive at those beliefs/assumptions about their social context (Benton, Craib 2011). Environmental entrepreneurs are social actors with beliefs and values and they interpret their context in terms of how it affects their ability to pursue opportunities for sustainable development. Max Weber's *Verstehen* technique, involving the explanation of social actors' underlying motives and the meanings they attach to their actions (Parkin 2002) underlies the *interpretivist*.

Critical realism presents an alternative to the two poles of objectivism and social constructivism (Hodgkinson, Starkey 2012). According to critical realist ontology, a social world exists independently of our knowledge and interpretation of it and whilst critical realism recognises that our knowledge is framed through language, language does not, in itself, determine the nature of our world (Mutch 1999). Critical realism seeks to capture the generative mechanisms which underlie the workings of the social world and which may be beyond the consciousness of social actors and is heavily concerned with the interaction between agency and structure (Mutch 1999). Central to critical realism is retroductive reasoning, in which one, through the observation of occurrences and patterns at the surface, uncovers the underlying structures and mechanisms (Contu, Willmott 2005) of the social world. Critical realism aims to explain the social world using these structures and mechanisms whereas objectivist approaches focus on predicting behaviour and subjectivist approaches seek to deconstruct human behaviour (Reed 2005). In order to achieve this explanation of underlying mechanisms, critical realist approaches must take into account forces operating at different levels of analysis which form part of different structures and mechanisms acting to constrain human action and this entails "historical, structural and discursive" analysis (Reed 2005). This research project is predicated on the notion that it is, in fact, the entrepreneurs' interpretation of the structure, in the form of environmental and energy policies, which matters as opposed to the nature of the external structure itself. For this reason this study adopts an interpretivist as opposed to critical realist or positivist logic of discovery.

The primary aim of this research is to understand entrepreneurs' perceptions of their context, in terms of the policies relevant to their activities and although it is likely that there are commonalities and regularities among social actors' interpretations of these contexts, these perceptions are ultimately subjective. Given the contextual and subjective objects of knowledge generated, this research is more suited to an interpretivist approach, employing qualitative techniques which target the in-depth narrative of participants, to which Tsoukas (1994) refers.

3.3 Case study research design

Case studies lend themselves to the construction of "naturalistic" type generalizations, emerging from lived experience and "intuition" (Stake 1978). According to Lincoln (1985), a whole manner of different entities can constitute a case, including organisations, societies, cultures, incidents, government programmes and projects, with researchers engaging in the collection of facts, the interpretation of what is going on and perhaps the evaluation or analysis of policy or programmes.

Case studies observe a phenomenon "within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 2009, P.18). The importance of context in this study - its focus is the external context of green entrepreneurs who operate within the boundaries of a political and economic context - reinforces the rationale behind taking a case study strategy. In addition, the exploratory nature of this research, in that it is starting with preliminary constructs about the relationship between policy and green entrepreneurship, means that a case study approach, with its intense collection of rich data from several sources (Yin 2009, Eisenhardt 1989), is appropriate to firming up these initial constructs. The contextual nature of case study research is consistent with the generation of contextualised management knowledge, as discussed by Tsoukas (1994).

Initial theory guides the design of the case study, as “the simple goal is to have a sufficient blueprint for your study and this requires theoretical propositions” (Yin 2009, P.36). In relation to this PhD study, seminal theory was accumulated through the literature review and the collection of background information about energy and environmental policies, retrieved from French, German and UK government websites and documents. Multiple data sources are integral to the case method, in order to triangulate findings (Eisenhardt 1989), and, within this project, empirical data from semi-structured interviews are triangulated by field notes from practitioner energy conferences in all three of the settings.

A central feature of case study research is the existence of a “replication logic” in which findings in one case setting may or may not be replicated in the other case(s) (Yin 2009). If findings in one case are, indeed, found to exist in another case or in other cases, then this indicates greater validity of those findings, whereas, if they do not apply to the other case(s), then this offers opportunities for the development of theory as to why they do not apply (Eisenhardt 1989). In this research, in which three countries each represent a case, it is precisely the findings that are not replicated across the three settings that may present particularly interesting insights into theory regarding the impact and design of energy policies to further environmental entrepreneurship in the renewable energy sector. This “replication logic” enhances the potential for the development of theory, as the process of combining conflicting evidence and evidence across different cases and data sources forces the researcher to reflect and challenge received ideas about a particular subject (Eisenhardt 1989).

Although this approach has important qualities, there are still perceptions of the inferiority of case study research relative to other approaches in the social sciences and Yin (2003, P.xiii) claims that it is still beset with this reputation as “the weak sibling of social science methods”. Yin (2003) attributes this criticism of case studies to the fact that there is no defined methodology for this research approach which can lead to a lack of “rigour”. To minimise the risk of poor rigour, the research design and instruments used to implement this design are made explicit in this chapter. An inherent flaw of case studies is their “poor basis for generalization”, as they focus on relationships within one or a small number of settings (Stake 1978, P.7). Whilst his may be so, it is possible to argue that relationships found within a particular case can be reflective of what happens in a wider system at large (Gomm, Hammersley et al. 2000). Returning to the “replication logic” discussed above, in multiple case studies, findings that are replicated across cases could apply out with those cases to other similar settings. In relation to this study, findings that are confirmed across Britain, France and Germany could be argued as likely to hold true in other EU nations which may share similar economic and political characteristics, so there is potential for generalization beyond the immediate scope of this project.

In terms of the implementation of the research design, the cases - Britain, France and Germany - were selected on the basis of the potential theoretical insights they could produce (Glaser, Strauss 1967) and are, arguably, examples of extreme settings in which to study the phenomenon of environmental entrepreneurship. Britain, France and Germany are all advanced economies - each is a member of the G8 group of nations. As large and advanced economies, they make a substantial contribution to climate change – this is demonstrated by the fact that France was responsible for 2.8% of global industrialised countries' C02 emissions in 2011 and Britain and Germany were responsible for 4.2% and 5.7% respectively (United Nations Framework Convention on Climate Change 2011). Given their high contribution to global emissions, it is likely that there will be greater pressure in these countries to reduce emissions and, if they do reduce their emissions, this will, naturally, have a high impact on sustainability. The drastic emissions reduction targets undertaken by these countries, outlined in section 1.3, demonstrate that France, Germany and Britain are leading actors in sustainability, especially given their roles within the European Union.

The fact that the three countries diverge substantially, in terms of their energy policy context gives rise to potentially rich contrasts and comparisons and reinforces their status as extreme cases. Striking examples of contrasting policy contexts would be the massive French support of nuclear power (which for roughly 60% of total energy consumption in France - see Table 4) versus the recent German decision to abandon nuclear energy altogether. The different stance towards nuclear energy has implications for the deployment of renewables, as nuclear energy is a competing low-carbon energy source (Macalister 2009). The countries are also at different stages in the transformation of their energy sectors. Germany has been an early-mover in introducing support for renewables, whereas France and the UK have embarked on their transitions later and this has implications for the evolution of policies towards further expansion and integration of renewable energy sources in the settings. The contrasts inherent in these divergent cases lead to interesting theoretical insights about the role of policy in stimulating and supporting green entrepreneurship across the three settings.

3.4 Research instruments

Two primary research instruments were implemented to collect data from two primary sources, namely semi-structured interviews with entrepreneurs in addition to field notes from practitioner conferences. These were supplemented by background information on environmental and energy policies from government websites.

Lincoln & Guba (1985, P.268) describe the purpose of interviews as:

> *"obtaining here-and-now constructions of persons, events, activities, organizations, feelings, motivations, claims, concerns, and other activities, reconstructions of such entities as experienced in the past; projections of such entities as they are expected to be experienced in the future; verification, emendation, and extension of information (constructions, reconstructions, or projections) obtained from other sources human and non-human; and verification, emendation, and extension of constructions developed by the inquirer"*

Interviews essentially seek to capture the ways in which social phenomena are constructed across different (past, present and future) timeframes. The use of the interview technique is predicated on a belief in the importance of peoples' stories to understanding the context of human behaviour and the meaning attached to social action as accessible through language (Seidman 1998).

Lincoln & Guba (1985) identify two forms of interview; the more focused, structured interview and the more in-depth, unstructured interview. In a structured interview, the questions posed to respondents are guided by prior data (Corbin, Strauss 2008) and this is appropriate to the study, as it is necessary to have a degree of consistency in the questions, as the research instrument has to address specific aspects of the policy context in order to fulfil the research objectives in sections 1.2 and 3.1. Indeed, the questions posed emerged from existing research into the policies in existence in each country and the theoretical insights offered by the literature. In addition, consistency is essential to ensure there is comparability in the findings across the three cases.

Whilst interviews permit the researcher to access participants' rich accounts of personal experience, there are challenges associated with this instrument. Firstly, interviewing is labour intensive, given the need to establish contact with participants, conduct the interviews, perform transcription and analyse the large volume of data (Seidman 1998, P.5-6). Secondly, a standardised set of procedures for conducting interview-based research, both in terms of how to design the questions and in terms of how to analyse the resulting data, does not exist (Kvale, Brinkmann 2009). The latter challenge raises the importance of ensuring that steps are taken to guarantee the rigour of an interview study, with regard to sampling, the conduct of the interviews and the analysis of the data emerging out of those interviews.

In terms of the implementation of the interview strategy, each interview comprised two parts. In the first part of the interview, respondents were asked questions about the policy context in their own country. In the second part of the interview, respondents were given explanations of policy differences in the other two settings and asked for their reactions. The interview schedule for each country differed according to policy differences and each schedule is reproduced in appendices.

The second data source employed is field notes from practitioner energy conferences in all three countries. Field notes are observations of events made throughout field work and may contain some "conceptualization and analytic remarks" (Corbin, Strauss 2008, P.123-124). In attending presentations and workshops at energy conferences, it was possible to capture important insights from both a wider group of renewable energy entrepreneurs in addition to those of other stakeholders, including economists, an expert in environmental law and policy makers, such as the French Prime Minister, Manuel Valls. The field notes aid to enrich the findings presented in section 1 to develop an enhanced discussion in section 6 and permit triangulation of those very findings.

The following diagrams provide a breakdown of the empirical data collected to construct the three case studies. In Table 2, an overview of data collection points is given. In Germany, a number of mini semi-structured interviews were done with entrepreneurs at the two events attended. An overview of the field notes is provided in the appendix.

Table 2 Case study empirical data breakdown

CASE	SEMI-STRUCTURED INTERVIEWS	EVENTS FOR FIELD NOTES
United Kingdom	10 interviews with 10 respondents	3 events
France	9 interviews with 8 respondents	1 event
Germany	9 interviews with 9 respondents	2 events (including mini interviews)

In Table 3 details are given about the respondents in all three countries, principally the sector in which their firm is active and the length of time for which their firm has been established:

Table 3 Breakdown of semi-structured interviews

UK Respondents	Firm Details	France Respondents	Firm Details	German Respondents	Details
B1	Wave, 3-4 years established	**F1**	Solar, 4-5 years established	**G1**	Wind, 5-10 years established
B2	Wind, 5-10 years established	**F2**	Solar, 4-5 years established	**G2**	Wind, >15 years established
B3	Solar, 3-4 years established	**F3**	Solar, 1-2 years established	**G3**	Solar, 10-15 years established

B4	Wind, 5-10 years established	**F4**	Wind, solar, 10-15 years	**G4**	Biomass, 4-5 years established
B5	Marine, 4-5 years established	**F5**	Marine, 4-5 years	**G5**	Biomass, 4-5 years established
B6	Marine, 3-4 years established	**F6**	Solar, 5-10 years	**G6**	Solar, 4-5 years established
B7	Biomass, 2-3 years established	**F7**	Wind, 10-15 years	**G7**	Biomass, 5-10 years
B8	Solar, <1 year established	**F8**	Biomass, 10-15 years	**G8**	Wind, 10-15 years
B9	Wind, 3-4 years established			**G9**	Biomass, 3-4 years
B10	Wind, 4-5 years established			**G10 – G14**	Shorter interviews conducted at Lüneburg Energieforum, 2014

3.5 Rigour and legitimacy

There is an ongoing debate about the potential conflict between creativity and rigour in management research (Alvesson, Sandberg 2013, Bartunek, Rynes et al. 2006, Fincham, Clark 2009). Alvesson (2013) laments the paradoxical increase in the volume of “quality” published research that he perceives as not having been accompanied by a corresponding rise in innovative and interesting contributions to the field of management. Similarly, Bartunek et al (2006, P.9-10) stresses the wish to “move the AMJ toward being a more interesting journal” through becoming more open to the development of management theory, rather than being restricted to its testing, and embracing a wider range of empirical methods provided this does not compromise the “importance, rigor and validity” of submissions.

These debates may signal a change in mood about the acceptance of a wider variety of methodological approaches to generate novel and impactful contributions in management research. However, rigour remains crucial to the integrity of management research, in terms of the credibility, dependability and confirmability of findings. This is stated by Donaldson et al. (2013, P.154) who argues: “Rigour is necessary in the enterprise of organizational management research. It provides methods that help to separate fact from fiction" (P.154)

Although Donaldson et al (2013) are referring to positivistic approaches, based on quantitative analysis, this notion about the reliability and credibility of management research applies equally to the naturalistic paradigm and its associated methodological approaches. In a wider sense, qualitative research is said to be in a “triple crisis” of “representation, legitimation and praxis” (Denzin, Lincoln 2000, P.17). The most pertinent crisis in relation to this research is the “legitimation crisis” in which the “validity, generalizability and reliability” (Denzin, Lincoln 2000) of qualitative methods are questioned. This legitimation problem stems from the credibility issue facing qualitative research which has two principal aspects, namely the credibility of analysis and the credibility of the researcher (Patton 1999). Credibility of analysis relies on the extent to which that analysis is “analytically rigorous, mentally rigorous and explicitly systematic” (Patton 1999, P.1191) whereas the researcher’s credibility is determined by their training and background (Patton 1999). Essentially, the credibility of the analysis is dependent on the systematic way in which categories have been developed to analyse the interview text (Silverman 2015). Silverman (2015) also stresses the reliability of the interview schedules and careful transcription following interviews.

It is argued that the researcher's credibility is assured by his substantial training in research methods that he received as part of this Masters in Management Research which featured courses on qualitative research methods. Interview schedules for respondents in each country were prepared and are reproduced in appendices - this improved the consistency of the interviews. Careful and full transcription following the recorded interviews increased the accuracy of the data collected.

In terms of the credibility of analysis, a systematic procedure was followed to develop and refine codes which, ultimately, led to higher, more abstract themes. According to Flick (2009), a thematic structure will emerge out of qualitative data following a process of thick description, open and selective coding.

Codes are "labels that assign symbolic meaning to the descriptive inferential information compiled during the study"(Miles, Huberman et al. 2014, P.71). They serve to categorise the qualitative data collected during both the interviews and practitioner conferences. Codes emerged from the data in an inductive fashion, following in depth reading of the transcripts and field notes; this is preferable to deductive coding in which codes are imposed on the data (Miles, Huberman et al. 2014)

A process of first cycle coding was undertaken initially in which codes of a more descriptive and detailed nature (Saldaña 2013) were identified from the data. These first cycle codes led into a process of second cycle coding in which pattern codes were formed, amalgamating the first cycle codes into broader themes (Miles, Huberman et al. 2014). These broader themes were refined and permitted a higher level of analysis in addition to comparability across the three national cases. The coding structure is reproduced in appendices and shows the overall themes in which the first cycle codes are nested.

The detailing of this analytical procedure is necessary to reinforcing the credibility of the qualitative research method employed in this study. However, there remain three other issues related to credibility in qualitative research are, namely: transferability, dependability and confirmability” (Denzin, Lincoln 2000) which require attention.

Naturalistic inquiry does not strive for generalizability in the way that positivism does; it rather seeks to generate “working hypotheses that can be transferred to other contexts” (Guba 1981, P.81). This transferability will depend on the extent to which thick descriptive data is collected about the context(s) featured in the study, so that similarities can be identified between the context(s) of the study and another potential setting to which the findings of the study could apply (Guba 1981). In section 4, a detailed overview is provided of each case in order to fulfil this thick description and to enable readers to identify potential similarities, therefore, enhancing this transferability.

Dependability in qualitative research is analogous to reliability in quantitative research and is concerned with accounting for variance in the data (Lincoln, Guba 1985). Establishing an "audit trail" which details how data was collected and analysed is advised by (Guba 1981) to ensure dependability. In accordance with this, procedures for sampling, the recruitment of participants and data analysis are detailed, so that there is as much transparency as possible to explain any potential instability in data, as Lincoln (1985) proposes.

A final issue relates to confirmability which Guba (1981) says is the naturalist equivalent to objectivity in positivism and this, in parallel to reliability, is about the influence of subjective interpretation on the findings of the naturalistic inquiry. Guba (1981) recommends triangulation of data and researcher reflexivity to counteract the risks to confirmability. The fact that this study collects two sources of empirical data fulfils somewhat the need for triangulation. In terms of reflexivity, regular attendance at conferences such as

EURAM and BAM at which the researcher interacted with peers increased awareness of personal biases.

3.6 Sampling

Sampling in qualitative studies is a thorny issue, with little by way of guidance as to how to select participants to form the sample (Trost 1986). Whilst quantitative studies require a sample which is, to a certain degree, representative of the wider population, this is not true of qualitative studies in which a sample which exhibits variations is necessary (Trost 1986) – perhaps to reveal more interesting theoretical insights (Glaser, Strauss 1967).

Particularly difficult is deciding on the appropriate number of respondents in a qualitative study. There appears to be no consensus on how many interviews should feature in a qualitative study – indeed, this depends on the study being conducted (Becker, Bryman 2012).

Despite this ambiguity regarding the number of interviews, certain scholars offer rules of thumb for such studies; Adler & Adler (2012) suggest thirty respondents whereas Brannen (2012) argues for around forty. This approximate range seems to be what they deem as manageable for a PhD study. In this study, the number of extended interviews is twenty eight (ten British, nine French, nine German) with five additional shorter German interviews taken at the 2014 Lüneburg Energieforum. This number of interviews is consistent with the ball park figures given by Adler & Adler (2012) and Brannen (2012), although these are merely rules of thumb. The way in which the participants were selected is detailed below.

The phenomenon under investigation in this study is entrepreneurs' perceptions of environmental and energy policies and, to operationalise the research, there must be a unit of analysis. In this case, the entrepreneurial perceptions of policy, as represented through semi-structured interviews, are the primary unit of analysis. Additional insights are brought by field notes which complement those perceptions.

It is important to clarify the nature of the unit of analysis for the purposes of this study. "Entrepreneurial perceptions" do not necessarily come from the firm founders, but from members of the entrepreneurial team involved in the new venture. In the context of the energy sector, it is more appropriate to talk about entrepreneurial teams, as very few new ventures in renewable energy will consist of one entrepreneur acting alone.

These new ventures correspond to Hockerts' & Wüstenhagen's (2010) notion of Emerging Davids, mentioned in section 2.2.1, compared to Greening Goliaths, corresponding to large incumbent firms. These Emerging Davids are described by Hockerts & Wüstenhagen (2010, P.483) as:

> *"small firms that tend to be recently founded and have a relatively smaller market share."*

In the context of sustainability, we are particularly interested in those among the larger population of small firms that explicitly aim at providing not just economic value, but also social and environmental value."

The new ventures targeted in this study share the four characteristics outlined above. They tend to be recently founded (compared to the traditional energy utilities) and have a relatively smaller market share. As regards the environmental value part of the fourth criteria, since the new ventures are deploying renewable energy technology, they can be considered to create environmental value.

Qualitative research is driven by purposeful sampling which is based on finding information-rich cases

> *"from which one can learn a great deal about issues of central importance to the purpose of the research."* (Patton 1990, P.169)

In this study, a criterion sampling approach, according to which cases are selected which fulfil certain pre-established criteria (Patton 1990), is implemented, with the criteria corresponding to Hockerts' & Wüstenhagen's (2010) emerging David construct; this leads to cases that are most representative of green entrepreneurship in the energy sector. The research employed elements of the maximum variation approach, aimed at selecting cases which reflect as many of the specific facets of their context as possible (Lincoln, Guba 1985), in that attempts are made to select cases belonging to different energy technologies (i.e. wind, solar, biomass and marine), so as to represent the diversity in the renewable energy sector. Moreover, in 2014, since the German government introduced major reforms to the support mechanism for renewable energies, it was decided to target practitioners at the Leuphana Energieforum in 2014, as this would provide an opportunity to capture a specific change in circumstances in one of the settings, thus increasing the diversity of information about the policy context.

Under theoretical sampling, cases are selected on the basis of their ability to offer valuable theoretical insights, but, unlike purposive sampling, the strategy evolves as data collection continues (Strauss, Corbin 1990). In each country, new ventures operating in the main renewable energy technologies were sought. These new ventures displayed the following characteristics:

- Small in size: in terms of number of members

• Small market share

• Founded relatively recently

• High theoretical interest to the study

These new ventures were composed of a small team of individuals, and one member of that team was interviewed – since it is a small cohesive team, it is likely that any member interviewed would have substantial awareness of the policy-related issues affecting the venture.

In order to facilitate the process of recruiting research participants, a sampling frame was devised of firms in each country which met the above requirements. Evidently, no comprehensive list of new ventures engaged in each of the technologies discussed above exists, so it was necessary to develop lists of relevant new ventures in each country. This was done using directories of renewable energy industry associations in the three countries. Once new ventures were selected, members of the entrepreneurial team within them were solicited to participate in the research, using a letter (reproduced in appendices) which outlines the focus of the project and explains what is involved in participation in addition to reassurances about confidentiality and anonymity, detailed in section 3.7.

Twenty eight extended interviews were conducted with twenty seven respondents across the three countries, with five mini additional German interviews to take into account the particularity of the German setting in view of the reforms to support mechanisms for renewable energy technologies. Ideally, researchers should aim for theoretical saturation, the point at which “no additional data are being found whereby the sociologist can develop properties of the category” (Glaser, Strauss 1967, P.61). However, in practice, it is impractical not to have a rough notion of sample size given resource and time restrictions (Patton 1990). Patton (1990, P.186) recommends that qualitative studies establish:

> *"minimum samples based on expected reasonable coverage of the phenomenon given the purpose of the study and stakeholder interests."*

In light of the tentative guidelines, given previously, it was felt that approximately thirty respondents across the three countries would be sufficient to reconcile the breadth and depth (Patton 1999) necessary to provide a decent analysis of the three cases (France, Germany and the UK) and to satisfy the expectations of the funders, the ESRC. These were supplemented by field notes to ensure as full a coverage as possible.

3.7 Research ethics

The research for this doctoral project was carried out in line with the rules of both the University of Stirling and the Economic and Social Research Council, the funders of this project. The ESRC stipulates that:

> *"the principal ethics consideration should be to ensure the maximum benefit of the research whilst minimising the risk of actual or potential harm"* (ESRC 2015, P.2)

Its ethics framework proceeds to say that harm should be minimised for: research participants, researchers, research organisations and non-academic collaborative researchers. The ESRC (2015) expects six principles to be fulfilled to satisfy ethical requirements and these are reproduced in appendices. These principles apply to the protection of the participant in the research, namely that participation should be voluntary and that the participants' "rights, dignity and (when possible) autonomy" (P.4) should be respected – this extends to issues of respecting preferences regarding anonymity, for example. Moreover, the guidelines stress that all measures should be taken to minimise the risk of harm to researchers conducting the work. In order to reinforce the integrity of research, it is necessary to provide sufficient information about the purpose and value of the research and to ensure the research has integrity through being aware of any conflicts of interest and risks to the independence of the researcher (ESRC 2015).

Ethical approval of this project was granted by Stirling Management School's Ethics Review Committee - the review form is reproduced in appendices. Within Stirling Management School, "light touch" ethical review procedures apply to research that is "minimal risk", as determined if a project does not involve certain listed characteristics which would give rise to concerns - these are set out in the review form in appendices.

At the data collection stage, when recruiting participants an information sheet, reproduced in appendices and introductory email, reproduced in appendices, were prepared. These documents explicitly state that participation in the research project is voluntary and that the participants have the right to withdraw at any point – this reinforced "informed consent", stressed by the European Science Foundation (2011). In addition, it explains that all attempts will be made to ensure the anonymity of respondents and the firm to which they belong is respected. The purpose of the research and what participation involves are clearly stated in the information sheet, so that potentially participants are as aware as possible of the implications of participation in the project and the value of that participation. Procedures discussed above demonstrate how the ethical concerns of the ESRC were addressed in this project.

4 Cases and contexts: Britain, France and Germany

Although there have been greater attempts since the mid-1980s to create a more integrated European energy system (Tosun, Biesenbender et al. 2015), European energy markets remain very “national in scope” (Maltby 2013, P.439). There are substantial differences in terms of the energy mix (Gawel, Strunz et al. 2014) among different EU countries and this is, of course, partly down to different resource bases, but is also a result of different path dependencies which lock-in particular forms of energy (Wagner, Lutz 2012), alluded to in section 2.2. This different energy mix the three countries is displayed in Table 4 below:

Table 4 Breakdown of British, French and German energy consumption

Energy Source	**Share in Primary Energy Consumption in 2014 (UK)**	**Share in Primary Energy Consumption in 2014 (France)**	**Share in Primary Energy Consumption in 2014 (Germany)**
Natural Gas	51%	20%	32%
Coal	25%	6%	39%
Nuclear	12%	61%	11%
Renewables	12%	13%	18%

Source: BP (2015)

Whilst energy policies in all EU countries show a certain degree of convergence in order to meet the EU sustainability and renewable energy targets, there are differences in implementation of this overarching European policy framework. In this section, detailed contextual information about the three cases will be given.

4.1 Britain country context

4.1.1 British energy mix

As shown in Table 4 , the UK's energy mix is dominated by natural gas, followed by coal. This can be attributed to geographical factors, namely the discovery of substantial deposits of coal and natural gas in the latter part of the 20th Century, and the energy system has been orientated towards these two resources. Britain has been relatively laggard in the development of renewable power which accounted for 12% of final energy consumption in 2014 and only started supporting small-scale renewables in 2010 – later than both France and Germany. Whilst substantial progress was made between 2010 and 2015 in promoting the expansion of renewables, this has been undermined, somewhat, by recent decisions to pare back support for renewable energies in Britain.

4.1.2 British policy on climate change

Under British environmental policy, emissions targets are enshrined within law through the Climate Change Act and this law makes emissions targets legally-binding (UK Government 2008b). The Climate Change Act stipulates that Britain must realise an 80% cut in carbon emissions by 2050 compared to the 1990 baseline (UK Government 2008b). Five-year carbon budgets are the crucial instrument of this legislation (Townsend 2009), locking future governments into a trajectory for decarbonisation, with the government required to develop plans to meet the 5-yearly budgets to 2020 (Lockwood 2013). It must be noted that significant difficulty has been encountered in setting budgets beyond 2020 (Lockwood 2013)

As part of this commitment to curbing carbon emissions, the government introduced fiscal instruments in an attempt to shift incentives away from carbon-based energy. Firstly, a carbon price floor was introduced in April 2013, set at £40 per tonne, but later reduced to £18 per tonne up to 2019-2020 (HM Revenue & Customs 2014). This carbon price floor, affecting the electricity sector, aims to address the uncertainty posed by the fluctuating carbon price within the EU Emissions Trading Scheme, as it was recognised that the unstable European carbon price was problematic for investors in the low-carbon energy sector (Ares 2013). The counterpart to the Carbon Price Floor, paid for by electricity generators, is the Climate Change Levy paid by non-domestic users of electricity and gas which was introduced as a levy on the use of energy by businesses (Seely 2009). Originally, renewably sourced electricity was exempted from the climate change levy, but this exemption was lifted in 2015 (HM Treasury 2015).

4.1.3 **British policy on renewable energy**

A quantity-based system is employed for large-scale generation and feed-in tariffs remunerate smaller scale renewable generators. The Renewable Obligation Certificate scheme applies to large-scale generators, requiring them to source 15.4% of all their electricity from renewable sources in 2014-2015, up from 6.7% in 2006-2007 (Diaz-Rainey, Ashton 2008). Electricity utilities must obtain a certain number of certificates to cover the proportion of electricity that they are required to source from renewables.

Should electricity utilities fail to achieve the stipulated amount of generation from renewable sources, they must either pay into a buy-out fund, the proceeds of which are fed back to suppliers according to their contribution to the Renewables Obligation, or they must purchase Renewable Obligation Certificates (ROCs) from other suppliers, creating a value for each certificate (Woodman, Mitchell 2011). If a supplier has contributed 5% of the RO requirement, then it receives 5% of the buy-out fund (Woodman, Mitchell 2011). Inherent in the design of the Renewables Obligation is price and volume risk; if electricity suppliers do well in reaching the target, the value of renewable obligation certificates falls and, indeed, if the renewables obligation is exceeded, then the value of certificates falls to zero (Woodman, Mitchell 2011). This value instability is difficult for smaller generators to absorb (Bürer, Wüstenhagen 2009) and feed-in tariffs are used, therefore, to support smaller generation. Certain emerging technologies receive a proportionally greater number of certificates per MW hour generated compared to more traditional technologies, as they are considered to be in greater need of support given their developmental nature (Diaz-Rainey, Ashton 2008).

In April 2010, feed-in tariffs were introduced to support smaller generators of renewable electricity – below 5MW – and applied to PV, wind, hydro and biomass technologies (ofgem 2013). Essentially, actors that generate renewable power receive a payment for every kWh they generate and an additional payment for every kWh that they feed back to the national grid and this payment they receive is fixed for a period of twenty years (ofgem 2013). Degression, in which tariff rates for newly installed generation decline progressively, is a feature of the feed-in tariff scheme and incentivises faster development of technology (Mabee, Mannion et al. 2012). Such a degression model avoids investors waiting for cheaper technology and economies of scale to materialise before they invest in the deployment of technology (Mabee, Mannion et al. 2012).

A common criticism of FiTs is that they "socialise costs", as consumers finance feed-in tariffs through electricity bills and this means that those who can afford the capital cost of installing appliances benefit at the cost of those who cannot (Saunders, Gross et al. 2012). In addition, there are substantial doubts about the future of feed-in tariffs in the UK – recently, the British Government, concerned about the costs to the consumer of supporting renewables, cut feed-in tariffs for domestic PV by roughly two thirds, to come into force from Spring 2016 (Department of Energy and Climate Change 2015).

Similar to the feed-in tariff for electricity, the Renewable Heat Incentive pays householders a fixed payment per kWh of heat generated from renewables over a period of seven years as a “financial incentive aimed at encouraging the uptake of renewable heat technologies in the UK” (Abu-Bakar, Muhammad-Sukki et al. 2014, P.554).

Support for larger-scale renewable power generation will be changing in 2017 with the UK Government’s Electricity Market Reform; the RO scheme will be replaced by Contracts for Difference – a long-term feed-in tariff for renewable generation (Department of Energy and Climate Change 2012). Generators will sell electricity in the market and a contract for difference will pay the difference between the market price for electricity and the estimate of the long-term price required to accelerate investment in that technology – the strike price (Department of Energy and Climate Change 2012). The CfD will pay a top-up to the generator if the market price is lower than the strike price and, if the market price is higher than the strike price, the generator has to refund the difference to the government (Department of Energy and Climate Change 2012). Renewable feed-in tariff “contracts-for-difference” will be auctioned to generators. Projects will have to compete for a limited number of contracts. This has ominous precedents, as, when a similar scheme was previously implemented, many schemes were not implemented, partly due to bidders submitting unrealistically low bids (Toke 2011). Moreover, Toke (2011) warns of the transaction costs involved in contracts-for-difference, in which renewable operators will have to trade electricity on the market; small and medium-sized generators are likely to approach large suppliers for purchasing power agreements, as they lack the capacity to trade electricity themselves.

A particularly controversial feature of the Electricity Market Reform is the payment of a feed-in tariff to nuclear generators; the immense scale of nuclear plants could dominate the available funds for provision of feed-in tariffs and, given the finite nature of the funding mechanism out of which contracts-for-difference are resourced, smaller scale renewable providers could be squeezed out of the market for contracts-for-difference (Keay 2013). Unconventional gas may also complicate matters, as the UK Government has recently shown approval for the controversial technique of fracking to exploit Britain's shale gas reserves, through granting tax incentives to local authorities which award licenses to developers (Channel 4 News 2014).

Growth in the exploitation of UK shale gas could pose challenges to renewable energy producers, as electricity produced from natural gas is cleaner than electricity produced from coal (White, Fell et al. 2015). Moreover, in the US, shale gas has led to massive reductions in the price of natural gas and is compounding the potential competitive threat to renewable generators (Haddadian, Shahidehpour 2015).

Under the initial systems, namely the Renewables Obligation Certificate and the feed-in tariffs, smaller scale renewable generators enjoyed greater market certainty. The Electricity Market Reform entails greater complexity and risk, especially given the thorny issue of how this support for nuclear power will affect the energy market dynamics. The British Government's embracing of shale gas could exacerbate this uncertainty.

4.1.4 Other relevant British policies

Substantial infrastructural barriers in the form of connecting generation technologies to the national grid constrain the expansion of renewables in Britain - grid connection is a condition of receiving the feed-in tariff for the generation of renewable power. According to the House of Lords (2008), in order to increase electricity from renewable sources, additional grid capacity will have to be built, especially since renewable generation appliances are frequently located in areas where grid capacity is limited Moreover, there are bureaucratic hurdles involved in connecting renewable power installations to the grid, with renewable operators required to demonstrate that they are fully financed prior to being connected to the national grid (House of Lords European Union Committee 2008). Indeed, the UK's grid has been criticised as "antiquated", with OFGEM aware of the need for greater capacity in order to accommodate the growth in the decentralised generation of renewable power (Farrell 2015).

In terms of policies designed to create a sustainable entrepreneurial ecosystem, as described by Cohen (2006) in section 2.2.5, the UK Government does invest in R&D for renewables (International Energy Agency 2015). Although institutions, such as clusters and incubators exist in the UK, government support for this type of activity appears to have waned in recent years amid public spending cuts. For instance, the Regional Development Agencies which were charged with furthering economic development and regeneration in addition to contributing to sustainable development were abolished in 2012 (The National Archives 2015).

4.2 France country context

4.2.1 French energy mix

Table 4 highlights the hegemonic position of nuclear power in France's energy mix, accounting for over 60% of primary energy consumption in 2015. France has a long history of nuclear power and invested heavily in this form of energy to guarantee its energy security following the oil shock of 1973 according to Seely (2009) and Teräväinen, Lehtonen et al. (2011). They also highlight the limited opposition to nuclear power in France, with many French environmental activists supporting of this form of energy given its low-carbon status. Fossil fuel generation is more limited with natural gas as the main fossil fuel component in the energy generation portfolio. France performs slightly better than the UK in renewable power, but this is partly thanks to substantial use of hydropower.

4.2.2 French policy on climate change

As per its obligations under the EU's Climate and Energy Package, France has committed itself to achieving a 40% cut in carbon emissions by 2030 and an 80% cut by 2050 relative to the 1990 baseline and this will be accompanied by a 50% reduction in energy consumption by 2050 compared to 2012 (Ministère de l'Ecologie, du Développement Durable et de L'Energie 2015). A central part of this climate policy is the expansion of renewable power, with the Energy Transition Law stipulating that renewable power must make up 23% of the French energy generation portfolio by 2020 and 32% by 2030 (République Française 2015). This firmer law reinforced initial aims defined in the Grenelle de l'Environnement – a major conference on sustainable development held in France in 2007.

Similarly to the UK, the French Government introduced a carbon price in 2014, in the Finance Bill (El Beze 2014). Like the UK's carbon price floor, this carbon tax will be complementary to the carbon price resulting from the European Emissions Trading Scheme and operates cross-sector, aiming to reduce the consumption of diesel, natural gas and heating fuel (El Beze 2014). In contrast to the UK, this carbon tax is less relevant to the electricity sector which is less carbon-intensive because of the high proportion of zero-carbon nuclear power in the generation portfolio (Criqui 2009).

France is a pivotal actor in global climate change policy at the current time through its position as host of the COP21 Conference, held in Paris in December 2015. As both a powerful country and host of the conference, France has a unique opportunity to promote stronger responses to the challenge of climate change. France's pledge of $1 billion for the climate fund, dedicated to helping developing countries adapt to climate change (Goldenberg 2014), is testament to the leadership role which it took in the run up to the conference in December 2015.

4.2.3 French policy on renewable energy

France was a relative early-mover in supporting small scale generation, with feed-in tariffs in place since 2002 (Avril, Mansilla et al. 2012). The French feed-in tariff has had a somewhat troubled trajectory. Since its inception in 2002, it has undergone four major revisions to prevent a “speculative bubble” and this has seen increasing complexity built into the mechanism, such as differentiated tariffs depending on location, the kind of installation, magnitude of power etc., with the regular changes not “convenient for investors” (Avril, Mansilla et al. 2012, P.248). Of particular concern for investors is the degression mechanism was built into the last ordinance, following the temporary suspension of feed-in tariffs in 2010. This mechanism adjusts the tariff rate each quarter according to the number of new installations added to the grid to prevent too rapid deployment of renewable power (Avril, Mansilla et al. 2012).

As in Germany, there is a shift towards integrating renewables into the market and this is in the process of being implemented (in 2016). Solar PV installations greater than 100KW are now obliged to take part in auctions for contracts-for-difference, known as a *complément de rémunération* (Ministère de l’Ecologie, du Développement Durable et de l’Energie 2015). This new mechanism is aimed to better integrate renewable energy technologies into the market and avoid power price distortions caused by renewable generators feeding into the market at very low marginal costs when demand is low (Ministère de l’Ecologie, du Développement Durable et de l’Energie 2014). As with the contracts-for-difference mechanism in the British context, the *complément de remuneration* payment varies according to the market price of electricity. For larger-scale generation projects in specific technologies, France tenders out capacity to providers to reach the targeted generation in each technology, i.e. off-shore wind, marine solar, and these tenders are used for technologies which have certain characteristics (Ministère de l'Ecologie, du Développement Durable et de l'Energie 2015). These technologies may need strong direction as they give rise to conflicts of usage – biomass, for example, could lead to competition between energy generation and food security. Off-shore wind and marine power may struggle due to the scarcity of suitable locations. Technologies may be affected by information asymmetries relating to costs and may require substantial industrial development to become commercially viable. Such scenarios require more controlled support in the form of the tenders. The system has been criticised by renewable industry professionals, as previous tender calls failed to lead to the fulfilment of the targets for capacity in certain key technologies (Feurtey, Ilinca et al. 2015).

There are a variety of measures targeting renewable heat – the most prominent example is the availability of an "eco-loan", a zero-interest loan of up to €30,000 available to householders or landlords to conduct ecological renovations of their property (Ministère de l'Ecologie, du Développement Durable et de l'Energie 2014). Unlike the UK's Renewable Heat Incentive, this system tries to reduce the capital cost of the renovations, perhaps improving the immediate incentive to conduct renovations.

Renewable energy producers may benefit from the French Government's review of the country's reliance on nuclear power in energy provision. Growing concerns relating to the complexities of decommissioning nuclear plants (Petit 2013) and the overall safety of nuclear power in the wake of the Fukushima incident (Furois, T., Thomines, M., Lewis, F. 2013) has led the French Government to decide to reduce the proportion of electricity generated by nuclear power from 75% to 50% by 2025 (Furois, T., Thomines, M., Lewis, F. 2013). Whilst nuclear energy will remain a central part of energy provision in France, the reduced dependency on this type of power may lead to greater opportunities for the deployment of renewables.

France has prohibited technologies used to exploit shale gas (Boersma, Johnson 2012) which may assuage concerns among French renewable industry actors about the potential effect of unconventional gas on their market share.

4.2.4 Other relevant French policies

In France, there are now major delays in connecting renewable energy appliances to the national grid and this is especially acute for wind power (La Cour des Comptes 2013). Indeed, the integration of renewables into the energy generation portfolio will necessitate major investment in the French electricity grid (Derdevet 2013). Arguably, this highly centralised electricity infrastructure, centred on immense electricity production units (i.e. nuclear power plants) is not appropriate to the deployment of renewables which are better suited to a decentralised structure (La Cour des Comptes 2013). The French transmission system operator – RTE – aims to adapt the grid to the needs of the energy transition (Réseau de transport de l'électricité 2015).

France runs R&D programmes for renewable energy (International Energy Agency 2015). It has an extensive network of clusters, known as pôles de compétitivité, special structures which combine businesses, training centres, public and private research units in one geographical space and which have responsibility to foster innovation (Dussuc, Geindre 2012). According to (Dussuc, Geindre 2012), there were 71 of such structures distributed across France in 2012, across all sectors, including energy and substantial participation of SMEs in these pôles. This is a valuable part of France's sustainable entrepreneurial ecosystem (Cohen 2006).

4.3 Germany country context

4.3.1 German energy mix

German energy consumption patterns reflect those of the UK to a greater extent and the country is fairly reliant on fossil fuels - coal being the primary mode of generation, followed by natural gas. The prominent position of coal can partly be attributed to Germany's extensive coal reserves. Germany was a genuine early-mover in supporting renewable power – the coalition government formed of Social Democrats and Greens, coming to power in the late 1990s, launched the iconic *Renewable Energy Law* in 2000 which instituted support for small-scale renewables. Germany has made greater progress than the UK and France in increasing the share of renewables in its energy generation portfolio, as shown in Table 4 . Germany decided to abandon nuclear power by 2022, following the incident at the Japanese Fukushima plant which raised questions about the safety of nuclear power (von Dohmen, F. et al 2012). Therefore, the importance of nuclear will continue to decline towards the 2020s.

4.3.2 German policy on climate change

Germany has committed itself to cutting C02 emissions by 80-95% by 2050 compared to 1990 baseline levels (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit 2013). Its national renewable energy action plan stipulates a target of 19.6% of total energy consumption to be met from renewable sources by 2020 (Bundesrepublik Deutschland 2009), with this rising to 60% by 2050 (Bohl, Kaufmann et al. 2013). This position on carbon emissions in broadly in line with that of France and the UK and is, in fact, slightly more ambitious.

In terms of fiscal measures to respond to climate change, Germany has had limited success in implementing environmental taxes. In the late 1990s, there was pressure from the Green Party, then in coalition with the Social Democrats, to introduce stronger taxes for coal and lignite and for electricity, but this was met with opposition by the Social Democrats, who were mindful of the effects of such measures for energy-intensive industries (Onoda, Schlegelmilch 2015). Although taxes on electricity and natural gas were incrementally increased recently and a tax on nuclear fuel and airline tickets was introduced, the enthusiasm for such instruments appears to have waned, according to Onoda & Schlegemilch (2015, P.53) who state:

> *"the political will, even among the Greens to take further steps of an ecological tax reform had faded substantially…The protests in 2000 are still bad memories for many politicians"*

This refers to the disruptive petrol protests which took place in Germany and other countries in the year 2000.

4.3.3 **German policy on renewable energy**

The feed-in tariff mechanism for renewable energy was a core part of the EEG which came into force in 2000. The EEG is funded through energy bills, however there is a special equalisation scheme reducing cost burden on intensive energy users in particular sectors, but increasing the cost of contributing to the law's financing for the average consumer (Büsgen, Dürrschmidt 2009). The evolution of the German feed-in tariff has been volatile; there were strong tariff reductions of 10% in January 2010 and 15% in April for solar with a much higher degression rate applied with further reductions of 24% in 2011 and 9 to 15% to January 2012 (Avril, Mansilla et al. 2012).

The German support mechanism for renewables underwent major reforms in 2014 and. As described in section 4.2.3, France has recently introduced contracts-for-difference for PV volumes above 100KW and wind above 3MW and Britain has been operating contracts-for-difference mechanisms for generation volumes above 5MW to replace the *Renewables Obligation*. Essentially, the German reforms involve the greater integration of renewable generators into the electricity market, with generators in excess of 100KW responsible for selling the electricity themselves on the open market in return for a contract-for-difference which is dependent on the prevailing market price of electricity (Gawel, Purkus 2013). This will encourage these generators to better match generation with electricity demand (Gawel, Purkus 2013). In another respect, the German system resembles the British and French systems in that contracts-for-difference will be auctioned to generators (Bundesministerium für Wirtschaft und Energie 2014a) and, as in Britain, this implies a degree of risk compared to the feed-in tariffs which offer price and volume certainty. There are other costs associated with this new mechanism. For instance, at periods of low market prices, it is necessary to compensate producers in possession of a contract-for-difference; they must be paid the difference between the agreed price and the market price (BMWI 2014c). If the market price is very low, this can lead to high costs of compensation, as mentioned in section 5.3.1.2.

Controversially, a tax on decentralised PV was introduced in 2014 and compelled those who installed renewable appliances to contribute to the cost of financing the EEG, despite the fact that they produced their own energy (Bundesministerium für Wirtschaft und Energie 2014a). This is controversial given the fact that energy-intensive industries are given relief in terms of their contribution to funding the EEG.

In Germany, the EEWärmeG came into force on the 1st of January 2009 and stipulates that a proportion of the heating for new-builds and existing public building must come from renewable sources and will provide investment subsidies and low interest loans to help with the implementation of this (Bundesministerium für Wirtschaft und Energie 2011). This resembles the French approach in that it tackles the capital cost of undertaking renovations to install renewable heat in buildings as opposed to the British renewable heat incentive which pays feed-in tariffs for renewable heat.

In 2011, Germany made the decision that it would abandon nuclear power by 2022, following the Fukushima incident and in the face of long-standing opposition in the form of the anti-nuclear movement, formed in the 1970s and 1980s, closely associated with the Green Party (Buchan 2014). This means that Germany will be in the opposite position to the UK, where the role of nuclear power is going to be extended. Germany will also be in contrast to France, where in spite of reductions in its share of final energy consumption, nuclear power will remain very important. Whilst, the abandonment of nuclear energy may appear to be an opportunity for renewable operators, there are accusations of unintended consequences, namely that the phasing out of nuclear has led to a reversion towards coal (Dickel 2014).

Like the UK, Germany has permitted fracking to exploit its shale gas reserves, subject to certain strict regulations (Bundesministerium für Wirtschaft und Energie 2014b), however, it remains unclear what this may mean for renewable operators.

4.3.4 Other relevant German policies

Steinbach (2013) claims that the state of grid infrastructure in the member states of the EU presents a real “bottleneck” to the expansion of renewable energy and the German Parliament has stated the need for additional high voltage power lines and the modification/extension of existing power lines. Given the slow progress in building new power lines in Germany to date, the government has passed a law aimed at facilitating the planning and authorisation procedure with a view to accelerating the development of the grid (Steinbach 2013).

As far as the wider sustainable entrepreneurial ecosystem is concerned, Germany invests public money in renewable energy R&D (International Energy Agency 2015). Like France, Germany has been active in promoting industrial clusters with Kiese (2012, P.7) describing cluster strategies as a “firm part of innovation and economic development in all regions”. He claims that, in contrast to a more liberalised market approach to clusters, as taken in the USA, the German strategy is more coordinated and initiated by government. Since 2007, there have been three government-sponsored competitions for high-tech clusters in Germany, some of which are related to energy and environment, each endowed with €600 million, with the most recent competition organised in 2011 (Kiese 2012). This is testament of a fairly robust commitment to such institutions as a means of promoting innovation.

5 Entrepreneurial perceptions in Britain, France and Germany

As explained in sections 4.1, 4.2 and 4.3, a variety of policies regarding renewable energy sources have been implemented in Britain, France and Germany, targeting entrepreneurs. However, the success of these policies is contingent on how they are received by entrepreneurs and key members of entrepreneurial teams in the renewable energy industry, as they are a main group of change agents who will disseminate green energy technologies. These policies interact with other factors too, such as the public acceptance of renewable power and concerns about geopolitics. The perceptions these actors hold of energy policies and these other factors will be the subject of this chapter.

This chapter is divided into three sections to follow the logic of the three case studies, as outlined in section 3.3, with the perceptions of British respondents featured in section 5.1, those of French respondents in section 5.2 and those of German respondents in section 5.3. The first part of each section discusses perceptions relating to eight broader, overarching themes relating to the energy and environmental policy context in their own country that emerged from open and axial coding processes (Glaser, Strauss 1967, Miles, Huberman et al. 2014). The second part of each section features respondents' perceptions of policy differences in the other two settings – this helps to form the overarching narratives, integrating the three cases together in chapter 6.

5.1 Sample 1: Britain

Compared to the French and German samples, the UK sample was characterised by a substantial representation of emergent technologies, namely marine power in addition to more mature technologies. This gave the British data an interesting perspective from parts of the industry that were still largely in development which was enriching.

The interviews took place at a time when the British energy context was in the midst of a major overhaul, to do with the *Electricity Market Reform*, discussed in section 4.1.3, which implies changes to the way in which larger-scale generation is supported - this was of particular relevance to high growth firms and to marine power which is involves larger generation volumes. In addition, the feed-in tariffs had undergone substantial revision and, in the spring of 2016, after the interviews took place, the government implemented a 65% reduction in tariff rates, having already ended subsidies for on-shore wind early.

5.1.1 British respondents' perceptions of domestic energy policy

The following section features the attitudes of British respondents to policies in Britain relevant to their activities. Their reflections on the public perception and other drivers of innovative renewable energy technologies, such as geopolitics are also presented.

5.1.1.1 *Perceptions of the credibility of government action to accelerate the deployment of eco-innovation in the British energy sector*

Respondents expressed views about their confidence in the British Government's commitment both to reducing carbon emissions and to accelerating the expansion of renewable energy. As discussed in section 4.1.2, the Climate Change Act is Britain's flagship policy to address sustainability challenges (UK Government 2008a) and comments reflected that this legislation initially acted as a positive signal to entrepreneurs as to future market prospects, but that, in the intervening period, since the Act's inception in 2008, this confidence had waned:

> *"So, back in 2006, when…ehm…we started out the business, when we saw the Climate Change coming through, we saw it as a real opportunity to, you know, set up a busi-*

ness…within the renewable sector and the act certainly was a cornerstone of that credibility. I have to admit that's been worn down over the years slightly….There was a big launch, a feeling that we were going to have an industry in the sector…the small-medium renewable sector …, but, as time has gone on, and, we've seen what's happened with….we don't do solar PV, but, first of all, it was the solar PV cuts and, then, the drastic cuts to feed-in tariff rates within our banding, have again questioned the government's commitment to the feed-in tariff and the concern is that the feed-in tariff hasn't got long for this world" (B2)

"they've (the British Government) bit off more than they can chew. I think they underestimated investment in it and, fundamentally, due to the depression that started in 2008 and also because of the will of the people" (B7)

The Climate Change Act was viewed by respondent B2 as a catalyst for entrepreneurial activity, signalling the creation of new opportunities in a renewables sector that would soon, in their view, be populated by SMEs. However, this confidence has been eroded since the Act's inception, partly through the reduction in the feed-in tariff, one of the main instruments to implement the overall goals of the Act. The allusion to the recession of 2008 by respondent B2, just as the Climate Change Act was ratified, is intriguing and implies a feeling that policymakers' priorities have been diverted away from environmental concerns due to the economic situation and that this has undermined the respondent's confidence as to the investment of the UK Government in sustainable development and as to public support for action to decarbonise the economy.

Other comments, from respondents B2 and B9, suggested that the Act now offered very little by way of certainty to entrepreneurs in the sector and that it did not have a bearing on firms' strategy. Respondent B10 suggested that the shorter-term political cycle was of primary importance than overarching policies like the *Climate Change Act*:

"In terms of what's going to happen on the ground, how much subsidy people are going to get….how stable the investment climate is etc…….is more driven by shorter-term government in place…after every election……In the end, the lifecycle…these kind of investments, at least

> *in wind,…is very short-term right…It takes a couple of years to develop a project, but then to decide do we want to build it out? (B10)*

Given the short-term nature of much of the renewables business, more immediate issues, such as the level of subsidies and specific political party policy (stances towards the expansion of on-shore wind) may be of greater concern to certain entrepreneurs as opposed to the overarching, long-term direction of climate policy with its associated vicissitudes.

Respondents B1 and B3 lamented the mistakes they believed the UK Government had made in this area of policy. Comments reflected a belief that the approach was often politically expedient. For example, there was reference to Labour Party leader Ed Miliband's "Energy Price Freeze" policy, whereby energy prices would remain static for twenty months should the Labour Party win the 2015 General Election:

> *"we are voting blind and interventions like Ed Miliband's there….are even less helpful, because they are….misleading people and encouraging people not to get an understanding of what the issues are and to take a very short-term view that price is the only thing they need to understand"* (B1)

> *"It's almost like it's (The Climate Change Act) got blown off course….with, you know, more immediate priorities….and, obviously, all this stuff about energy prices as well…and opportunist moves by people on both sides of the house"(B3)*

A feeling is expressed above that the long-term sustainability of the energy sector has given way to short-term concerns to do with, in particular, energy costs. This undermines the need to engage the public and consumers in relation to the immense challenges the sector faces in replacing existing capacity with low-carbon alternatives whilst ensuring energy security. Energy prices may have to rise to accommodate the need for greater investment in the future energy infrastructure, of which renewables are a principal component, to meet the goals of the Climate Change Act and a political focus on costs undermine this. Negative intervention on the part of the government in wind energy was seen as having a pernicious effect on investor confidence, ultimately raising the cost of finance for wind projects due to increased perceptions of risk among financiers:

> *"I think the real concern people are starting to have is that the government is more and more negative towards wind and more willing to intervene….in .the power price projections and put them down which means we are less sure about the revenue we are going to get…… and all of this is kind of negative for the business….It's not good for investor confidence…..People want to make higher returns, capital is more expensive…The government itself is making it all more expensive to build these kind of assets, I don't think that's very helpful….it is more the perception from people that they see the government actively trying to suppress this industry and that is causing greater uncertainty and that is not good for the investment climate…" (B10)*

The remark above by respondent B10 indicates the impact that adverse government policy can have on the investment climate in the wind energy sector. Financial stakeholder perceptions of government policy are relevant, as entrepreneurs are reliant, to a certain extent, on their investment of capital and they will be sensitive to government policy when making investment decisions (Bürer, Wüstenhagen 2009b). Reducing the power price projections, for example, leads to greater uncertainty regarding revenue likely to be received via the contracts-for-difference mechanism.

In addition, concerns about the flaws in the implementation of the instruments used to support the transition to a low carbon energy sector were expressed:

> *"I have heard other comments…people saying that DECC and Treasury have got completely different views on what is covered in the levy control framework…whether it should be covering nuclear even or not….and it's out of control." (B3)*

> *"There is a systematic problem between DECC and OFGEM of registering appropriate quantities of hydro….It is wrong…it is a cock up…..they still haven't agreed the formula by which this would be given out…So, that creates uncertainty…So, nobody is willing to invest. So, the government insists on introducing these things half-baked." (B6)*

Responses above claim that the government departments responsible for administering the schemes are not working in a coordinated manner and that this, ultimately, has led to uncertainty among entrepreneurs as to how support will be allocated among the applicable generation technologies through the levy control framework, the mechanism which allocates funding to support the technologies.

Credibility of British energy policy among participants has suffered from short-termism and mistakes in the implementation of the support mechanisms.

5.1.1.2 *Attitudes towards the support mechanisms for renewables in the British energy sector*

British participants in the study were affected by the feed-in tariff and by support mechanisms used in connection with larger-scale generation (ROCs, CfDs), described in section described in section 4.1.3.

In general, for the participants, the feed-in tariff mechanism has been crucial in establishing a market for renewable generation technologies in Britain. Indeed, the feed-in tariff was frequently cited as the reason for the founding of their business. Responses reflected that the availability of such tariffs has offered the consumer, seeking to install micro-generation technologies like PV panels, a sufficient return-on-investment on the appliances to incentivise a greater number to adopt renewables, with the financial motivation seen as the primary driver for uptake of sustainable energy rather than concern for the natural environment. This tariff was seen as crucial to the growth of decentralised renewable generation technologies, in the absence of which, there would not be sufficient awareness about renewables among the public for the expansion of this technology to be sustained. A selection of remarks relating to the effect of the feed-in tariff is presented below:

> *"It (feed-in tariff) attracted people to the market..It's created businesses and it's drawn capital into the market" (B3)*

> *"90% of my customers are not thinking of this from a green point of view. What they are worried about is making extra money and the feed-in tariff needs to incentivise these people….it's been so important to get the renewables industry off the ground…..The difficulty is now…if the feed-in tariff starts to dwindle away, are renewable energies in the public mind set enough for it to survive?" (B8)*

> *"The fixed guarantee for fifteen years is very important….For the newer windfarms, there is some…value base depending on where the prices are..for the years after year 15 to 25, but…eh…..the majority of the value of the assets is determined by the first fifteen years…..FiT period." (B10)*

B8 raises doubt about whether there is sufficient awareness among the public about renewables for these technologies to be self-sustaining without the incentive. Likewise, B10 highlights that the value of a renewable energy generation asset is driven by the period covered by the feed-in tariff, with the period thereafter less influential, due to the dependence on less predictable market prices beyond the fifteen year feed-in tariff period. This reinforces the power of the fixed returns, guaranteed by the feed-in tariff, in motivating both uptake and investor confidence in renewables.

In addition to giving rise to a renewables industry, the feed-in tariff has enabled the market preparation of eco-innovation in the energy sector, according to the respondents. This has been partly through economies of scale at the manufacturing stage, with greater market dissemination driving improvements in production processes that, ultimately, lower the costs of technology, such as solar panels. One respondent described:

> *"it's only when you've got optimisation work and then volume to bring the cost down…that you can bring prices down .that was what the feed-in tariff was designed to do" (B1)*

Another respondent concurred that economies of scale, involving mass production and incremental price reduction, was crucial to the future expansion of eco-innovation in the energy sector. Indeed, this entrepreneur drew an analogy with the automotive industry, viewing similarities between the economies of scale in the solar industry and those of the automotive industry characterised by continual falls in prices and the effective squeezing of margins.

> *"The technology, the efficiency is improving all the time….that….I mean…the goal…obviously…if you've got an industry that's almost hooked on subsidies, you've really got to get to this sort of grid parity point as soon as possible…..The whole thing is about scale…It's much more on the industrialised basis" (B3)*

In the above quote, the importance of reducing the cost of renewable technologies through achieving economies of scale is emphasised, with the implication that the current reliance of renewables on subsidies is not sustainable in the long-term. It is essential, in the view of this entrepreneur, that "grid-parity" is achieved whereby renewable energy competes at the same level of cost as conventional fossil-fuel derived energy sources and economies of scale can lead to the necessary cost reductions for grid-parity. Feed-in tariffs help the development of the industry to the point at which economies of scale can be realised.

For financial stakeholders, support mechanisms act as a crucial incentive to invest, as, at current rates, the market price of renewable power is still too low. Respondent B10 argues that investors are agnostic as to where they place their money, both in terms of industry and country, and, to entice them to invest in green energy, mechanisms which minimise uncertainty are essential:

> *"The ROCs, they're…key right....without those kind of support levels, our capital would not be invested in the UK to build out wind farms. Unfortunately, the cost and that kind of thing…for these kind of assets, on-shore….is too high to do them from the power you get the market……without subsidy, you don't get the returns which are required…This asset class com-*

> *petes with bonds, equities, infrastructure projects in different geographies…and that's something people sometimes forget, it's not a local thing…this money flows around and invests anywhere…and it will invest in other places if the risk-return trade-off is much better…Yeah…People want to know that if they put money into businesses that invest over five to ten year windows, that when they put money to work and..money at risk, that they get a return from it.. The more uncertainty there is, the bigger return people want to get from it….because it's perceived as more risk"(B10)*

This comment raises questions about the effect of paring back these support mechanisms on the availability of investor finance for renewables in the UK, as they could change the risk profile of renewable energy investments. This is crucial, as capital does not respect environmental needs; it is concerned with gaining the highest return for the lowest risk.

Respondents expressed views about the reforms undertaken by the British Government to the support mechanisms, namely the changes to the feed-in tariff since 2012, in the form of degression, outlined in section 4.1.3, and the proposed Electricity Market Reform under which contracts-for-difference will replace Renewable Obligation Certificates for larger scale generation. The Electricity Market Reform is discussed in more detail in section 4.1.3. There was speculation about possible reasons behind the reforms, with a view emerging that the prevailing economic circumstances in Britain had caused the British Government to reform the feed-in tariff to reduce energy costs for consumers and industry. Contributions related to the effects of the recession in 2008 which were believed to be constraining the availability of funds for the expansion of renewables until the economy had recovered to a point where it could withstand higher energy prices. A slightly different perspective was offered in which the UK Government was apprehensive about the impact of higher energy costs, due to subsidies like the feed-in tariff, on the country's competitiveness. This was seen as especially problematic given the mobility of international capital, with industries seen as able to move to geographical locations with lower energy costs.

> *"If we make our cost base artificially higher than other countries, capital will move." (B1)*

> *"I am sure their focus is that if we've got a strong, healthy economy, we can do it, but, at the moment, we can't. I think their focus is on building a strong economy, so, then, they can implement more of these things" (B7)*

It is difficult for developed countries like Britain to take action for the collective good on climate change, if other countries do not follow suit, as they will lose competitive advantage in energy-intensive industries compared to countries that have lower energy costs, as they have not adopted measures to decarbonise the power sector. This difficulty is expressed as the "free-rider problem" (McMillan 1979), with countries profiting from the enhanced environmental well-being resulting from others' actions to reduce emissions without having participated and borne the necessary costs themselves.

Specifically in relation to the feed-in tariff reforms, several participants were concerned both about degression and the way that it is implemented. There was reference to the emergence of a "boom-bust", "feast-or-famine" situation, particularly in the solar PV sector:

> *"A whole lot of capital started to rush towards solar PV and then that was capped and that was quite messily handled ……the whole supply chain and manufacturers in that sector is boom and bust…..They're under pressure artificially by a certain date and then, as soon as that date's passed, there's nothing for them to do…….Smoothing that demand through proper degression is not happening at the moment."(B1)*

> *"with the degression…it's feast or famine. So, if you're in that side of the business, you need to have other stuff going on" (B3)*

According to the remarks above, the degression mechanism has not been managed well by the government, and leads to instability in the industry, with abrupt drop-offs in activity as the tariff for generation declines. This has led to market conditions characterised by sharp fluctuations in demand for installations which is difficult for actors in the sector to absorb, hence the need to diversify into other areas, to which respondent B3 alludes.

Participating entrepreneurs were keen to highlight the indirect effect on stakeholders of the reforms to the feed-in tariff:

> *"They're reducing the incentive and are creating more uncertainty for investors to put their money into the development of renewable technologies…It (the feed-in tariff) indicated to investors and to companies that there was a market for higher cost renewable energy until costs could be brought down and eh….it, then, made finance available, but it is now much harder to raise that kind of finance." (B1)*

> *"…because of the uncertainty over the feed-in tariff, and…investors….a lot of the manufacturers are now questioning whether it's worthwhile putting the R&D into developing a turbine more suited to the UK market, because they're not sure about the longevity of that market… Investors, still at that level, are seeing the government's mixed messages and saying: 'Why, on earth, would we want to invest in the sector; the government are obviously not supporting it."(B2)*

These quotes reveal the pernicious effect of the reforms on the confidence of investors in the British renewables market, due to doubts about the durability of the market. Investors have to be sure that technology will receive public support, as it is relatively more expensive than conventional technology. However, the opinions presented suggest that the British Government's ambivalent approach towards the evolution of the feed-in tariff has undermined the confidence that such technology will be supported sufficiently and this has made it harder for entrepreneurs to obtain finance. This uncertainty has impacts further upstream in the supply chain – manufacturers, according to respondent B2, have been dissuaded from conducting R&D on technology tailored for the UK market.

Respondents were also affected by the reforms to the support mechanisms for large-scale generation. Several participants associate enhanced levels of risk with the reforms which consist principally of the introduction of *contracts-for-difference* for renewable producers of over 5MW whilst others view it as neutral and as having beneficial aspects. An example of a more positive remark, in relation to the reforms, discussed the greater certainty over price under the contracts-for-difference scheme compared to the ROC:

> *"It makes quite a lot of sense that you have got some certainty that you will get…you know….a fixed price for your electricity which….again, with the renewable obligation…because it's a tradable thing…that's another area where you think well you can go through and you can get accepted for ROCs, but actually how much will you get from then in practice? It seems hard to actually pin down." (B3)*

The value of the Renewable Obligation Certificates are dependent on the extent to which energy utilities undershoot their targets for the generation of renewable energy – the more they undershoot, the more certificates they need to buy from renewable generators to cover their shortfall. As the number of certificates needed rises, their value rises and the renewable generators earn more for each certificate they trade. Of course, this means that the actual revenue that a renewables generator is going to receive can be difficult to predict. Contracts-for-difference guarantee the renewables producer a fixed price and, therefore, remove this variability and this is seen by respondent B3 as a positive change. On the other hand, there is the risk of being unsuccessful in the CfD auction.

However, several respondents were concerned about the inherent risks involved in the scheme, primarily to do with being unsuccessful in securing a contract-for-difference in the capacity auctions:

> *"Whereas, for contracts for difference, because it depends on the capacity allocation for each technology, you could always have projects operating, but miss out on getting the subsidies and I think that's a really big uncertainty" (B9)*

Given that there are irrecoverable sunk costs involved in developing a project for the CfD auction, such as grid connections, administrative work and deposits, being unsuccessful in the process could result in severe financial difficulties for a firm. This risk of not obtaining a CfD is compounded by uncertainties as to how the process of awarding the CfDs will operate. Respondent B6 expressed concern about the manner in which the funding for subsidies would be distributed, especially given the fact that there are several different technologies competing for CfDs:

> *"You are not actually guaranteed to get the level of price which the contracts-for-difference purports to guarantee. Understandably it says: 'there is a total pot of money'….and they still haven't agreed the formula by which this would be given out…So, that creates uncertainty…So, nobody is willing to invest. So, the government insists on introducing these things half-baked……We have no idea how much of that will be given to nuclear, wind, on-shore, off-shore" (B6)*

Competition with these other technologies casts doubt about the amount of funding remaining for the branch of renewable energy in which a new venture is involved, especially if technologies which require particularly substantial support, like nuclear, are included in the subsidy scheme.

Respondent B10 discusses the implications of the Electricity Market Reform for investor confidence in the renewables sector:

> *"I think the bigger impact which we've seen lately….which was introduced also through EMR was the competition element.....because that creates a lot of uncertainty about investment decisions….a lot of people need to work out….do we want to….put money as risk…..whilst we're not even sure if there is a …project at the end of the day…It creates more binary risk which is not great for investors…….and that will drive up the capital cost again… If you make it more a*

> *bidding, competition and auction element, you change the whole risk picture for putting these kind of investments in place" (B10)*

From an investor's perspective, the competitive element changes the nature of risk – it is now "binary", all-or-nothing, depending on whether the project receives a CfD or not, and this type of risk is more serious for potential investors. The respondent warns that this higher risk, associated with the *Electricity Market Reform*, may undermine investor confidence and make it more expensive for firms to obtain capital. This binary risk compares with less severe risk to do with the value of renewable obligation certificates. This type of all-or-nothing situation may exacerbate perceptions of investor risk, driving up the cost of capital, as investors seek compensation for this higher risk.

It is important to note that the support mechanisms are not only relevant to the new ventures, but affect financial stakeholders that provide finance for renewable energy projects. Whilst the support mechanisms, namely the feed-in tariff and Renewables Obligation scheme, are perceived positively by the respondents, the reforms to the feed-in tariff and the *Electricity Market Reform* are, generally, cause for concern.

5.1.1.3 ***Role of wider industrial policy***

Wider industrial policy did not feature heavily in the British interviews. One interviewee claimed that Britain was seen as a place that was more favourable, in the EU, both to conduct R&D and to deploy renewable energy technologies:

> *"the UK is the better place both to do R&D and develop through to commercialisation and to deploy the technologies… the skill bases that are generally in the UK that's attractive as well, because it's been a very heavily maritime nation" (B5)*

This was in contrast to a contribution from another interviewee who said that the UK had no real industrial base for developing renewable energy technologies and served as a venue in which foreign companies had the opportunity to deploy their technology:

> *"Well, the game has played out. There is no question that the UK does not have a renewable energy industry……what we have is an opportunity for the French, the Germans and the Chinese, Japanese to use their technology to build in our markets. If you take tidal energy, it belongs to Siemens, Alstom, DCMS, Awosaki…… the fact of the matter is that there is no UK tidal energy industry…it's being given away to the French and the Germans So, all we have is the site where everybody else can put their turbines in. No, we've given it away."(B6)*

It seems fair to infer from this comment that Britain has missed opportunities to establish a renewables industry in which it would have ownership of the technology and reap benefits from this. However, Britain does, as B5 claims above, enjoy the advantages of foreign companies undertaking research and deploying technology in its economy, but the lack of domestic engagement in this could be a worry, as implied by B6, contrasting the views of B5. B6 attributes this lack of a British renewables industry to the different characteristics of the British economy, highlighting the lack of large-scale engineering industry and the bias towards other sectors, for example finance. However, finance is identified, by respondent B10 as important to the emergence of environmentally-relevant entrepreneurial activity in the renewable energy sector. B10 suggests that the UK has greater focus on the financing and commercialisation of these energy technologies, as this is where its comparative advantage lies:

> *I think they can do more to make sure that these businesses can grow to become big businesses….not being sold to US companies…There's a different approach to supporting R&D…basically…I think the UK….are doing well….from a technological side…..to be honest, we cannot all be the best guys in everything…I mean France…..and Germany……have historically had a very strong engineering focus….In the UK, it's more the finance and technological….support…..cleantech and energy…….it has found its own niche…(B10)*

Although its niche is finance, like B6, participant B10 suggests the UK could do more to nurture domestic renewable energy businesses and to retain those businesses, referring to the need to support firms' growth in addition to their founding.

The financing constraints affecting environmental entrepreneurs, identified by O'Rourke (2010), Randjelovic & O'Rourke (2003) and Outsios & Kittler (2014) are reflected in this study too, with respondent B1 commenting:

> *I think they (investors) are looking for things that are more market-ready and they will be an enabler once technologies have reached a scale where they are ready to be industrialised, but they don't necessarily at this stage seem to be providing risk project finance which is what's needed for some of the early scale-ups of technologies (B1)*

In this participant's view, public finance is more available when technologies are at a more mature stage and ready to be integrated into the market. However, for more nascent technologies, characterised by a higher risk of failure, there is a need for public investment which is not being addressed. Given the often disruptive and radical nature of eco-innovation and the technical risks with which it is associated (Randjelovic, O'Rourke et al. 2003), it seems likely that the availability of "risk-project" finance, as the respondent describes it, would have greater importance for entrepreneurs.

Beyond this comment about seed finance, another participant implied that the UK government had to set an example to other potential investors and the best way of doing this was to invest itself:

> *The thing is as well, they can't be hypocritical in the sense that they're paying a feed-in tariff to the farmer and customer, but they need to invest themselves. (B8)*

One respondent alluded to public R&D expenditure and perceived that the Government was tending towards carbon capture and storage (incidentally, the carbon capture and storage fund has been subsequently scrapped) – this raises issues about the government's research priorities that might not be favourable towards renewables:

> *"They seem to be heavily siding towards carbon capture and storage, I think £250 million they are putting into that….." (B7)*

Industrial clusters were viewed as a positive idea in principle. One participant remarked that such structures enabled collaboration among firms – exactly what they are designed to do (Freimann, Marxen et al. 2010). They highlighted that, in the absence of such a structure, collaborations can be difficult to arrange, as investors are apprehensive about protecting intellectual property – the cluster arrangement appears to be an environment in which concerns like this can be overcome, in the view of the respondent. In this sense, clusters represent institutions; they establish a context in which there are rules and norms facilitating collaboration and knowledge exchange among actors in the renewables industry. Organising and financing clusters are a way in which the state can foster innovation without leading the innovation process itself – an area in which the state would have the right competencies:

> *I think that that approach (clusters) represents a very good way of doing it. The difficulty you will always face is trying to raise money and any new venture….it's the difficulty getting to collaborate at the same time as investors putting money in and, then, wanting to lock up IP to get a return on it. (B1)*

Interviewee B5 praised the participation of international actors in Scottish renewable energy clusters. The fact that the clusters are open to international participation is considered an advantage and has enhanced the base in the North of Scotland and contrasts with the more protectionist French clusters, discussed in section 5.2.1.3. This remark is slightly in conflict with the previous comments by respondents B6 and B10 regarding the efforts to ensure the emergence of a British renewables sector. It is suggested that an innovation policy for the renewables sector must reconcile the importance of nurturing a domestic renewables industry with encouraging and supporting valuable international collaborations which may be crucial to the development of technology.

There are weaknesses identified in Britain's industrial strategy towards renewables, addressed by respondents, in relation to both the availability of finance and the wider support structures for new ventures in the sector.

5.1.1.4 ***Policies towards incumbent technologies***

In Britain, nuclear and shale gas are the main competing technologies for renewable energy as a result of the UK Government's positions regarding these generation methods (see section 4.1.4).

Common among the UK respondents was a feeling that renewables and nuclear power did not compete on a "level playing field", as the costs of nuclear power were underestimated:

> *I don't mind the competition as long as it's a level playing field and as long as the subsidies are transparent, as long as the full cost of nuclear, in terms of not just setting up, but what happens afterwards, how do you get rid of all the waste? (B2)*
>
> *I think there is an element in government of a lack of transparency when they look at what the total costs of nuclear are. Two thirds of DECC's annual budget is actually nuclear decommissioning of plants that are already in place. We pay part of the price of our energy, but we are also paying through taxation for a large part of the energy bill…the overall energy bill (B1)*
>
> *Of course, nuclear comes with other problems, the decommissioning being the biggest, but guess what, that's forty years away, we don't need to worry about that. (B7)*

In the minds of the above respondents, the hidden costs include present subsidies, decommissioning at the end of a nuclear plant's life and the treatment of nuclear waste from the plants. Indeed B1 highlights that the UK taxpayer is paying a large portion of the costs of nuclear power indirectly and that this serves to conceal the true cost from energy bills. This lack of transparency about the true costs cause nuclear power to appear artificially competitive relative to renewables and this is perceived as unfair by the above respondents who want to compete on equal terms with nuclear power. B7 comments on the way that future costs are discounted. This is a financial norm that is advantageous to nuclear power, characterised by high capital costs, cheap running costs, and substantial treatment and decommissioning costs at the end of service.

Only one British respondent mentioned the risk of nuclear accidents and this was only to highlight that they believed such a danger did not figure highly in the public's consciousness:

> *….the risks that are involved…ehm….You know…It's one of these things: nobody really worries about anything until something happens. (B8)*

Respondents B3 and B10 did not view nuclear as a major competitive concern for renewable firms. B3 considers that, by the time new nuclear infrastructure comes on line, renewables will have gained in efficiency and grown to become a principal source of energy and will be in a much stronger position to compete, especially due to ongoing shadows over nuclear, such as the EU investigations over state aid – for instance, the *Hinkley Point C* plant project could encounter difficulties because of the loan guarantees which the British Government must provide to reassure investors (Guardian Newspaper 2015). This view is supported by participant B10, claiming that nuclear power is on a longer time horizon so is not, at least, an immediate threat to the renewables industry:

> *It operates on different timelines…I think it will create……I mean…it gives negative pressure on pricing…because it produces…pretty cheaply when it sells into the market, but, in essence, it's so far away…it still needs to happen, so this is a longer term thing (B10)*

It is especially interesting that the respondent B3 proceeds to discuss emerging markets, such as Africa and South America and believes that these are potential future areas of growth for firms such as theirs and could compensate for any potential loss of market share through the addition of nuclear generation to the UK's energy infrastructure. This is an example of entrepreneurs looking beyond the domestic market and even the European market for future expansion – perhaps after the technology reaches maturity. Whereas Cohen & Winn (2007) suggest, in section 2.2.4, that new ventures could gain experience and learn through developing renewable technologies in emerging markets in expectation that fossil fuel prices will rise in the developed world, this remark raises the possibility that the process could work the other way round. New ventures could develop renewables in the British market and when nuclear plants start to constrain market growth in Britain, these new ventures could target emerging markets, lacking infrastructure and in need of new energy technologies, to satisfy growing demand for electricity.

Another incumbent alternative to renewables is natural gas and this source of power has gained momentum since the exploitation of shale gas was accelerated, as discussed in section 4.1.3. Participant B9 viewed nuclear as preferable to shale gas, stating:

> *In terms of actually reducing their carbon emissions, I think that's a stance which seems a lot more acceptable than what's going on in the UK, especially with shale gas (B9)*

This is a reference to the fact that generating power from nuclear does not release any C02 emissions and, therefore, is a better option than shale gas for the decarbonisation of Britain's energy sector. In the shorter term, nuclear was perceived by this respondent as a greener alternative to shale gas – notwithstanding the possibility of an accident.

In terms of shale gas, respondents had mixed reactions to the UK Government's backing of fracking, mentioned in section 4.1.3. There was suggestion that shale gas had distracted attention away from renewables:

> *I think that their (the government's) eyes have been diverted on to shale gas. I think the government has taken their eye off renewables and they're looking to going back to supplying gas cheaply…(B2)*

> *For us, the government having been quite a public stance about how their supporting nuclear and even shale definitely influences us because it is clear what sort of signals they're giving.....In terms of nuclear, shale, renewables, it's quite hard to decide which one the government's clearly backing.(B9)*

The above comments are linked with opinions expressed in sections 5.1.1.1 and 5.1.1.2 questioning the British government's long-term commitment to renewable power and sustainability, more generally, and that this could be compounded by the allure of shale gas.

Other respondents were more sceptical about the potential threat of shale gas to renewables, emphasising the limitations of this form of energy, with shale gas wells exhibiting diminishing returns after the first couple of years and Britain's interconnection into the EU gas market limiting the negative pressure British shale gas would have on gas prices in Britain (as shale gas extracted in Britain would be sold on the EU gas market, diluting the effect on gas prices in Britain) (B3). In addition, gas power plants, fuelled by shale gas, would need carbon capture and storage technology (which reduces emissions through capturing and storing emitted carbon) and this would reduce the economic competitiveness of shale gas compared to renewables (B6). Moreover, the risk of natural disasters with which fracking is associated was mentioned, with this risk seen as strengthening public opposition to fracking (B7 and B8). This view is supported by recent *YouGov* public opinion surveys which revealed growing public opposition to fracking in Britain, especially if this were to be done in a nearby area or town (Jordan 2015). It would be difficult for the government to exploit shale gas in the face of strong opposition from the electorate and from communities in which exploration sites were to be located.

There were also neutral and positive reactions to the exploitation of shale gas, with B5 commenting that shale gas was a reasonable policy provided it was done in moderation and B7 believing that shale gas could act as a transitional source of power in the short to medium-term whilst low-carbon generation is extended, acknowledging the potential gap in power capacity due to the removal of coal power plants.

Common among British interviewees, was the perception that nuclear and shale gas formed part of a balanced future energy portfolio for the country. This was partly due to what they saw as the inherent constraints of renewables as a technology:

> *I suppose, unless you can get the energy storage piece worked out, then the renewables clearly, on their own, they need something to balance it (B3)*

> *There is an element, if you build up a basket of renewable technologies, as some islands have done, you can cover baseload, but for the central, or for the cities, that baseload issue needs to be comprehensively addressed, because if there's no wind and the cities all want electricity, then you have a problem, so nuclear probably does have its place (B1)*

> *We need a…..sort of mix of energy solutions…and…ehm…you know, whether renewables can do it all by themselves or whether nuclear needs to play a part is a bit of a hot potato (B2)*

Since renewables are beset by problems of intermittency (referred to in B1), and, given the current difficulties in storing energy (alluded to in B3), there is a feeling that renewables potential to fulfil Britain's energy needs will always be limited and that, consequently, there will always be a need for a mix of energy solutions, as advocated by respondent B2, supported by B8's reflections on the limits of current technologies. B8 goes on to describe renewables as supplementing nuclear power and that this would not necessarily undermine their business model:

> *As long as they support the nuclear with renewables…then you know…it would be fine….our business would still be viable (B8)*

These comments are indicative of a perception that renewables will co-exist with other forms of energy and form part of Britain's future energy mix and that this can be consistent with a viable business model. Such a vision contrasts with the more sceptical and critical attitudes of German respondents towards Britain's envisaged energy mix, discussed in section 5.3.2.1. This reinforces the idea that, in the British data, there was not so much emphasis on incumbent technologies as a threat but, rather, a desire that there should be fair competition between those technologies and renewables.

5.1.1.5 *Reflections on the wider energy system*

Strbac (2002) identifies challenges for the British electricity grid arising from the intermittency of many renewable power sources, the location of renewable power and the high concentration of smaller scale generation. Several respondents' contributions echoed these concerns about the unsuitability of current grid infrastructures to the expansion of renewable power output:

> *I think it is needed urgently this upgrade, especially at our level, we see the restrictions on the grid as really preventing people putting in the products that they want to (B2)*

> *So, we're coming against that, so the longer that we're in the industry, the more PV that goes on roofs, the more strain there is on the overhead cable network, so, for us to continue in the way we're going, there will have to be a change and a big, big investment in upgrade work to…ehm…the local DNOs and that again stems from the government, because, effectively, at some point in the future, the cables are going to burn. (B8)*

Entrepreneurs operating in more remote areas had particularly acute problems due to the nature of the electricity grid. In the north of Scotland, given the increase in on-shore wind, off-shore wind and marine renewables, thanks to the abundance of natural energy resources in this region, there is substantial export of power from the north to the central belt region of Scotland according to the Electricity Networks Strategy Group (2012). The Group refers to a "severe strain" (P.9) on north to south and east to west power corridors in Scotland and, in addition, highlights that the power circuits linking Scotland and England are at their "maximum capability" (P.10). Respondents affected by this specific problem to do with the electricity grid remarked:

> *We are right at the end of the grid here on x…to get a connection for our 330KW windturbine…it took us two years to finally get an agreement to get a firm connection. There is no capacity led on the x grid because we're at the end of the transmission grid. It was a nightmare, it was one of the hardest parts of our project (B4)*

> *The only thing that's slightly annoyed me was we were going to take a site up in x to do our first demonstration, but they couldn't guarantee what we could get for electricity generated, because x's electrical connection to the mainland is only about 3MW capacity ……..it puts up the cost of doing the demonstration significantly, because you have to, essentially, dump the power you are generating, because you can't do anything with it and this is because the UK policy on improving grid is so woefully slow that we're being left with the problems that you can't get the power back that people can actually demonstrate. (B5)*

Renewable technologies, like wind and marine power, tend to be located in remote areas in which the natural resources are present. In these areas, entrepreneurs depend on enhanced grid connectivity to remote areas in order for their business to be viable – otherwise, their project is slowed down significantly, as in the case of B4, or no longer viable – as with B5, who would end up with wasted power, thus loss of revenue, in the absence of a grid connection. The UK's policy of grid upgrades has to be substantially accelerated according to B5. B5 claims that the infrastructural problems of the grid are due to a lack of thought about how to integrate innovative technologies into the market, after the initial support. In other words, there is a failure to properly consider the system costs of integrating renewables into the wider electricity market and how to pursue the further expansion of renewable technologies.

Upgrading and extending electricity grid would help to alleviate a major constraint on the expansion of renewables in Britain, especially in view of the north-south power flow on the island which is likely to intensify with the expansion of renewables, since these resources are concentrated in the north.

Onerous administrative barriers were identified by British entrepreneurs as a constraint to their activities, hampering growth and, in certain cases, threatening business viability. The comments related to the planning process:

> *It's (the planning permission process) very subjective, it's very arbitrary, there are no guarantees, it drives our investors and customers mad that a simple process, even where someone….where a planning officer has said yes, you should get consent for this turbine. Even at that stage, it gets turned down (B2)*

> *I mean the feed-in tariff...there's quite a lot of companies…I mean, we've come across quite a few…and also quite a few who are now disappearing or are in trouble because, actually, and we've found it's been significantly harder to get the planning permissions.(B3)*

The planning permission process is a source of considerable uncertainty for projects, as it is unpredictable and B2 describes this as pernicious for both customers and investors, with B3 claiming that it can threaten the survival of businesses. If costs have been incurred to develop a renewable energy project and it is then impossible to obtain planning permission to implement this project, then forecasted revenue is foregone in addition to upstream sunk costs. Such a scenario is clearly detrimental to the stability of a business model in the sector.

Respondent B9 reiterated concerns about the fairness of the planning process, claiming that the system was more favourable to fracking than renewables despite the existence of greater public opposition to fracking. Any perceived discrepancy between the planning procedure for renewables and other technologies, such as shale gas exploration, should give rise to concern, as it is further indication of suspicions, raised in sections 5.1.1.1 and 5.1.1.2, about the British Government's commitment to the long-term future of the renewables industry. Respondents desire a fair, transparent and reliable planning procedure – this is critical to their business model. This issue to do with planning permission was not prominent in the French and German data and seems to be a British problem. Regulations may be inappropriate given the need to accelerate deployment of green energy; regulation aimed at protecting the landscape may, in fact, conflict with other goals to do with reducing carbon emissions.

Intriguing comments were offered by respondent B1 about whether society needs to rethink how it organises itself in face of the new energy challenge:

> *Well, you know, if you've got good wind and wave energy and tidal energy in Orkney, is it more sensible to put in conductors to take that electricity to the Central Belt, or is it actually better to build some factories closer to where those major sources of power are. Balancing where raw materials are, where people are and where the energy is…is quite an interesting dynamic in the future, in my opinion (B1)*

According to the respondent's thinking, civilisation in Scotland is concentrated in the central belt, as this is where the large-scale deposits of coal were discovered and heavy industry built up in this area around this energy source. In a context of the transition to renewables, bearing in mind the discussion about grid infrastructures in section 5.1.1.5, locating settlements and energy consumption close to where it is produced is an alternative or additional policy option to adapting the grid to better transport energy to its points of consumption. This is an interesting reconceptualization of the problem and is a stimulating thought for policy makers and, perhaps even, human geographers.

5.1.1.6 *Perception of the public*

As discussed in section 2.2.3, environmental entrepreneurship is an interactive process in which the public are stakeholders. They are not only consumers who adopt environmental innovation; they form the electorate, therefore, their consent to energy policies favourable to renewable energy is necessary for these policies to endure.

Respondent B7 describes the slow pace of change in the behaviour of the "average consumer" in terms of adopting renewable heat technologies, highlighting the need to disseminate eco-innovative energy technologies beyond niche markets to which they may currently be confined:

> *What they've done at the moment is they're dangling carrot with incentives, but no one is hungry. What they've got to do is start hitting people with the stick and, then, people will thank government for having these incentives……It's all fair, but, until they are blinding obvious with their message to the average consumer, it will never change. (B7)*

Disseminating these technologies among the average consumer, beyond Rogers' (1995) innovator and early adopter categories, is important if renewable energy technologies are going to lead to a dramatic improvement in sustainability. As stated in section 2.2.1, eco-innovation must be diffused on the mass-market if it is to have a sufficiently high sustainability impact. B7 suggests that simply the incentives on their own are inadequate to induce change on the, otherwise, apathetic "average consumer" and that penalties were necessary to force a shift in consumer behaviour.

Contributions regarding consumer behaviour extended beyond the adoption of eco-innovation and alluded to the role of the consumer in facilitating the transition to a low-carbon energy system through reducing demand:

> *I think the thing you can agree on is that actually we need to be reducing the amount of energy we use…But, people don't seem to be very good at making the connection between issues So, I just don't see the behaviours matching up to all this stuff. It's easy to moan about energy prices and, but actually, do you care enough to do something about it? (B3)*

> *Let's have a look at the amount of energy we waste on a daily basis whether that be in the home or in the office or….I don't know…like a huge great building like a hospital or school (B8)*

There are issues about the cost burden on the consumer of supporting renewables. However, this problem could be alleviated if the consumer invested in better energy efficiency and was, thus, in a position to reduce energy usage. It seems that energy efficiency, operating on the demand side, is a counterpart to the expansion of renewables – indeed, energy efficiency is one of the three pillars of the EU's 2020 and 2030 Climate & Energy Packages (European Commission 2015b, European Commission 2015a). To make progress on this front, the above responses suggest that consumer engagement will be paramount in addressing the demand side.

Participants B3 and B7 perceive a short-term attitude on the part of the British public compared to the French and German public.

> *Compared to the Germans and the French, people seem very short-term here and actually not interested. I remember somebody saying: 'Your average German is saving for next year's holiday. The average Brit is saving for beer at the end of the week. (B3)*

> *People in other European countries are so, so much more aware of renewable technologies and the benefits and I actually think the attitude of, especially, Germans are….they do…they think thirty, forty years ahead. When they buy a house, they think that house is going to be with them for life. (B7)*

The perceived short-termism of the British public is perceived as not being conducive to the longer term nature of the investments in domestic renewable electricity and heat.

B3 also referred to a preoccupation with short-term energy prices which diverted focus away from the long-term challenges of the energy transition and this is echoed by respondent B5 who alludes to the public backlash to rising bills due to the costs of supporting renewables:

> *People are now getting a bit upset when they see their electricity bills going up significantly, because of subsidies for like wind turbines and so on….and it was not clear at the time how that was going to be done... (B5)*

In the above comment, B5 suggests that there is a lack of willingness-to-pay for renewable power among the British public, implying that they do not appreciate the rationale of subsidising renewables for the long-term stability of the energy system. B1 supported this view, arguing that the public, in fact, did not understand the gravity of energy issues and that this would only change in response to a major shock to the energy supply:

> *The majority of the population's understanding of the issues involved is next to nothing…The public perception will change overnight when the first powercut hits (B1)*

This major shock would result from the failure to sufficiently develop alternative power sources to replace decommissioned coal plants. It is worrying that B1 views that it would require such a crisis to mobilise public opinion – perhaps raising awareness before such a crisis hits would be preferable.

The perception of the British public appears to be particularly challenging for energy entrepreneurship. Within the data, there is criticism of the lethargic rate of adoption of renewable energy technologies on the part of the British consumer and this is compounded by perceptions of a general short-termism and low willingness-to-pay of the public at large in Britain.

5.1.1.7 *Geopolitics as a driver of the adoption of renewable energy*

A recurrent theme within the UK interviews was the existence of other drivers for eco-innovation in the energy sector. Essentially, these drivers are not related to the dominant logic of sustainability, but rather concern energy security and independence, especially in light of geopolitical issues.

B6 predicted that concerns about energy security would begin to eclipse environmental issues:

> *What we'll see now is a very sudden switch of emphasis on energy security as the leading concern…….with environmental concerns taking second place. You know, the next few years…that will be the driver of policy. (B6)*

According to B7, this narrative around energy security and independence could be an attractive way of promoting the uptake of renewables to consumers, as it may offer them greater price certainty against potential energy price volatility:

> *I think we'd to have a better uptake of renewable technologies if they actually talked more about the energy crisis than the climate change crisis. I think more customers are turning to renewable energies because of the cost of energy, having a bit of independence, mitigating future energy rises. (B7)*

Whilst these two respondents emphasise the power of arguments to do with geopolitics and energy security, section 5.1.1.6 suggests that the public are not sufficiently aware of the discourse around the energy crisis or, if they are, it has not had much of an impact on their attitudes towards energy policy.

In the B2B market segment, energy security and geopolitics may be a far greater incentive for adoption of renewable power as a means of managing risk. B2 talks about clients in the business sector who are increasingly interested in decentralised energy as protecting them against unpredictable energy costs; electricity could form a large part of such organisations' operating costs:

> *So, I think businesses are setting themselves up now and, in a way, even after the feed-in tariff, or whatever happens…businesses are…have maybe been a bit slow to wake up to this at the small, medium renewables level, but they are seeing how renewables can play a very important part in providing that security for the long-term stability of their business. (B2)*

B2 implies that long-term energy independence for businesses could form a new business model for renewable energy firms in a post feed-in tariff scenario. It is interesting to note that the respondents are thinking beyond the feed-in tariff and reflecting on other arguments to market the adoption of renewables to the consumer and businesses; energy security could make a promising business case for renewables in these market segments.

There were several references to the geopolitical situation in Russia, at the time of the annexation of the Crimea by Russia, given its importance for Europe's gas supply:

> *We've got to have energy security…we can't let the Russians dominate what we do and hold us to ransom. Do we really, really trust Russia? It is clear to me that the strategy for the European Union would be to try very hard to reduce dependency on Russian gas…You screw us…we'll screw you…just, it'll take us a bit longer to screw them than it'll take them to screw us (B6)*

Price instability of natural gas, resulting from a potential reduction or interruption in gas supply from Russia, could lead to enhanced profitability for renewable operators if the wholesale price of electricity increases, as a result. More importantly, B6 argues that the crisis in Ukraine could lead the European Union to take steps to reduce its reliance on Russian gas in order to weaken its political vulnerability and this could act in the favour of renewables. Whilst such a move may be advantageous to renewables, it may also be of benefit to nuclear power. Alternatively, it could cause the government's energy policy to shift focus from decarbonisation to energy security, resulting in greater use of alternatives to natural gas, like coal. Respondent B5 is more direct about the way that the crisis could change the government's approach to less mature technologies which are more expensive to support:

> *It's (situation in Russia and Ukraine) actually, they say relatively good news for the marine renewables, because it increases the chance that support from the government will continue to ensure it becomes a viable additional source of energy, because it then reduces dependence on imported coal and gas. ...So, I think it's, ultimately, relatively good to help ensure that another area that could provide 10 to 15% of the UK's energy demand isn't sort of lost. (B5)*

In the presence of concerns about energy security, the British government may be more willing to continue support to emergent technologies, such as marine power, that have high potential in order to diversify the energy portfolio and hedge against risk of energy price volatility – a strategy described by De Vries & Tabner (2015).

Energy security is one of the three points of the energy policy triangle, as outlined in the British government's *Electricity Market Reform* alongside decarbonisation and competitiveness (Department of Energy and Climate Change 2012). Therefore, policy around energy security is argued to be highly relevant to new ventures in the British power sector and energy security has potential to be an important motivator for the adoption of renewable energy technologies, but this is contingent on how the British government will integrate this energy security dimension into the evolution of its energy policy.

5.1.2 **British entrepreneurs' perceptions of foreign energy policy**

In this section, the reactions of British participants to policy differences in France and Germany are examined. As stated in section 3.4, this data was gathered in the second part of the interviews in which policy differences were explained to respondents who then gave their reactions to those differences. In terms of British reactions to French policy, these focused around certain core characteristics, principally French nuclear policy and the French approach to supporting the emergence of new industries. Reactions to German policy were more extensive, given the starker contrasts between British and German energy policy.

5.1.2.1 ***Perceptions of French energy policy***

In general, French policy was not particularly controversial for British entrepreneurs. It is possible that this is because of the convergence of British and French energy policy – these issues are discussed in sections 4.1.3 and 4.1.4.

There was criticism, from a British perspective, of the extent to which nuclear power dominated the French electricity market, with respondent B5 highlighting the opportunity costs inherent in the French energy mix:

> *As far as their dependence on nuclear, personally, I think it was far too dependent on it and France is a country that could quite easily make a lot more use of solar or even geothermal energy. They've got quite a lot of energy that could be suitable to that which they don't seem to have done much about. (B5)*

In the participant's view, French reliance on nuclear power has crowded out other viable sources that could have easily been exploited, especially considering the geographical features of the country. B1 is partly critical of the hegemony of nuclear in the French energy mix:

> *It (nuclear) shouldn't be the only mix and you're going to talk to me about France and France really is using nuclear as its main source of power, so there's an element of certainty, but I'm pretty sure that the French are paying part of their energy, but they're paying a lot of it through their tax......but if you've got 70% coming from nuclear, you don't really need to be*

> *looking at high-cost alternatives. If energy prices are going to rise, as they will, those higher cost resources could be brought on top when those energy costs are higher, so that you don't end up then with too much of a penalty. (B1)*

The respondent suspects that nuclear power is being partly funded by the taxpayer in France and, therefore, its full cost is not represented in market prices – indeed the French public are paying for this element of certainty that nuclear provides. The participant makes the point that the high reliance on nuclear power also protects France from energy price volatility; base load power is assured through nuclear, so there is little need to resort to additional higher cost forms of power. Implicit in the comment is that this could be advantageous to France in a context of energy price volatility. However, this also means that there is less of an incentive to develop renewable power that is lower down the merit-order, due to its higher marginal cost. This may make it difficult for renewable entrepreneurs to penetrate the French market; in Britain, in which there is currently less nuclear, there has been perhaps been greater scope for higher cost renewable sources to gain ground.

The existence of a powerful nuclear "lobby" in France was perceived as a direct threat by B2, perceiving this lobby as very powerful:

> *I find that frightening, first of all, being so close to them, but we work with ehm….x who are a French manufacturer and they say that the nuclear lobby there is…is really strong, it's very difficult to say anything against the nuclear industry at all, but, also, the nuclear industry are, very much, ehm….what's the word?....campaigning against renewables and they're putting a lot of money behind questioning renewables and I don't see that so much in the UK, but, certainly, they're saying in France, it's becoming an issue, it's becoming a bit of "us" and "them" and, obviously, the nuclear industry has a lot more money and they're concerned about the myths and the economies of scale that the nuclear industry are…are…ehm..are…..throwing at…ehm….bringing down renewables (B2)*

This idea of a "lobby" has connotations of the nuclear industry exerting influence to shape the institutional context in favour of their own interests, through for example propagating ideas about the disadvantages of renewable power. Given the leading market position that nuclear operators enjoy in the French power industry, it is likely that they are keen to defend this position against new entrants, namely renewable firms. They do this by promoting the narratives cited by the respondent, relating to economies of scale, for example. This respondent reflects on the greater resources that the nuclear industry has to dedicate to corporate political activity and the upper hand that it may possess because of this position.

Whilst respondent B8 called for greater diversity in the French energy mix, other British participants, in fact, praised the French reliance on nuclear power, with B6 emphasising the importance of nuclear power to energy security. B9 argued that, as far as decarbonising the energy sector was concerned, the French policy of using nuclear was the best strategy, despite concerns about the technology and, certainly, far superior to Britain's approach of exploiting shale gas in a bid to lower emissions.

There was evidence of envy of the French Government's more interventionist approach in nurturing a renewables industry, with B3 lamenting the perceived inability of Britain to support the expansion of an industry and to capitalise on early success to foster long-term development:

> *It seems like we've got some leading edge companies in this country doing stuff, but, I suppose it's the typical thing that seems to happen is that we lack the follow-through in actually being able to expand and do this stuff….and that, unless these companies can get in and, effectively, get funded by the Germans and whatever to do stuff, but the Germans and the French will obviously want to protect their own stuff…It just…We always seem on the wrong page somehow…It's lack of understanding and commitment…(B3)*

What is interesting in the above quote is this notion of "follow-through" and expansion. Having mechanisms in place destined at start-ups is not sufficient for the development of a vibrant renewables industry. It is also necessary to help those start-ups to up-scale and grow into "High Growth David" firms and this is where the British approach may be inadequate.

France was considered by B6 to be patriotic in its industrial policy towards the renewables sector, using inducements to encourage firms to be loyal to France:

> *What the French are doing is…their feed-in tariff for tidal energy is quite low…What they do is they subsidise the investment by French companies to build in France. So, you have a French industry (B6)*

This has been conducive to the creation of an indigenous industry in France, including higher value-added work existing in the "up-stream" manufacturing part of the value chain.

This patriotic approach was viewed as protectionist by respondent B5:

> *"The only downside of what they're doing is that it is very heavily biased to French companies. In fact, even (inaudible) the German company that is involved with us, have been in France just recently at a big conference out there and they said: "Basically, unless you set yourself up as a French company, you won't get anywhere. You've got to have a French partner at the absolute minimum". So, it is a very protectionist cluster. (B5)*

This is very different to the position in the Britain, outlined in section 5.1.1.3, in which companies from all over the world participate in the clusters - this may, indeed, be the best way of creating a world-class cluster, benefiting from the best technology available internationally, but could be less effective at delivering a domestic renewables industry that retains value in the local market.

As opposed to stark contrasts, British participants' reactions targeted nuances in French policy. From a British perspective, nuclear was not strongly controversial; it was considered as an effective way to ensure energy security. It was, rather, the extent of the reliance on nuclear power and the (potentially) undue influence the industry might have over the governance of the energy system in France. Whilst the French approach to industrial development was positively perceived, there remains this debate between nurturing a domestic industry and attracting global talent.

5.1.2.2 ***Perceptions of German energy policy***

Attitudes of British respondents towards the German *Energiewende* policy, described in section 4.3.3 were divided. There were positive reactions to the commitment towards renewables but, equally, there was substantial scepticism about the achievability and rationale of the goals expressed within the policy, especially the phase out of nuclear.

Statements in admiration of the *Energiewende* policy, described how it provided a long-term framework for the German renewables sector:

> *Anyone in the renewables industry envies Germany…They're leading the way…and they will…and, in ten years' time, they will be the envy of everyone, because they're going to be self-reliant on what they have produced and they'll become richer and more powerful because of it. What they'll then do is produce more than they need and start exporting it. They've made that commitment and they've got the people behind them who understand it and can see the benefit of it, because they've got a long-term attitude that we just haven't got. We're a buy now, pay later country. (B7)*

Respondent B7 implies that the *Energiewende* is an industrial strategy in addition to increasing Germany's geopolitical power, especially if it becomes a greater exporter of electricity; it is already an exporter of technology. The contribution reiterates the theme relating to cultural values, as featured in section 5.1.1.6, contrasting a perceived longer-term attitude in Germany with Britain's myopic approach, neglecting long-term energy strategy. Participant B9 concurs with this view about the industrial advantage that could result from the *Energiewende*:

> *I do think the German and UK governments stances differ and how it affects business, is because there is a much clearer signal in Germany about renewables and how they're committed to it. It helps the supply chain…make it more efficient, so people are much more willing to invest in turbine manufacturing facilities which drives domestic costs down a lot more, so I think, in Germany, on-shore wind, for example, I'm not exactly sure, but, just because the facilities are there, you're reducing your transport costs and so on, so there is much more scope for them to drive down the costs, whereas, here, we still have to import our turbines and all of that adds on to the cost. (B9)*

B9 claims that the unequivocal market signal, given by the *Energiewende*, would foster the establishment of a strong industrial base in Germany for renewables, as there is greater confidence in the existence of a strong domestic market and this, in turn, furthers the development of a local supply chain which can reduce costs in the domestic market.

Criticism of the German approach targeted the way in which the *Energiewende* policy had been implemented, identifying the overheating of the renewable power market as an issue:

> *I think the Germans seem to have a lot problems with the amount of solar that's been taken up, the level of feed-in tariff that was put in place to subsidise it…In terms of the feed-in tariff, they are having problems with that, it is creating a very high cost base for their energy and they're busily trying to renegotiate some of that without appearing to disincentivise people" (B1)*

This overheating presents the German government with a dilemma in terms of how they contain costs of supporting renewables without stifling the growth in decentralised energy. The allusion to PV is interesting, as this form of power was originally given a highly preferential feed-in tariff, many times higher than that allocated other forms of renewable power, as it showed potential for the greatest cost reductions (Wirth 2015). Over time, the costs of PV technology have declined substantially and its feed-in tariff rate is now below that of off-shore wind, although it continues to account for 55% of the cost renewable support in 2014 whilst contributing only 25% of renewable power (Wirth 2015).

It is possible that this early preferential treatment for solar PV is partly responsible for the cost level of the support mechanisms that is currently seen as unacceptable.

Respondent B3 referred to difficulties caused by the intermittency of renewables which they saw as particularly acute in Germany, given the higher share of renewables on the German energy market:

> *There was one day in Germany – last June – just the amount of sun and wind that people producing and renewables get priority access to the grid, so people with coal stations…people like RWE, they were actually having to pay to put their electricity on the grid…there was negative pricing, so that's obviously ruffled a number of feathers for people and you need to have the sort of balanced system (B3)*

Producers receive fixed feed-in tariffs for the power they put on the grid regardless of demand and this can lead to surplus power and negative electricity prices at times of high production of renewables since coal power, the main backup, is inflexible and cannot be ramped up or down easily (Gawel, Purkus 2013). The above respondent describes the incidence of negative pricing as a result of surpluses as detrimental to having a "balanced system", with this view reflective of British perceptions, featured in section 5.1.1, that renewables will form part of a diversified energy portfolio alongside more inflexible conventional technologies, namely coal and natural gas. Such a goal involves integrating renewables into the power market, making production more demand-orientated (Gawel, Purkus 2013) and this motivates the current reform to the *Renewable Energy Law* in Germany in addition to the *Electricity Market Reform* in Britain.

Respondent B10 describes the German policy as one of extremes in which there has been this rapid expansion of renewables whilst there has been little regard to the problems of integration, such as balancing supply with demand on the grid, and this has been compounded by the decision to abandon nuclear power:

> *I think it's a bit…funny right…..They've gone a bit too far in two extremes…one, too much subsidy in place….which caused massive boom in renewables and, now, they are actually shutting down nuke plants….whilst they still need to cope with balancing the grid …you only have to look at how E.On, RWE etc…are doing to see that….the picture is not working for them… I don't think it's a very stable long-term energy plan….I mean that….I think….that is the biggest observation in that market….(B10)*

The extremes are difficult for the large utilities to absorb and, for this reason, the respondent doubts the long-term credibility of the energy policy. In essence, respondent B10 recognises that an energy policy that accommodates both the incumbent utilities and new ventures is necessary for the successful long-term transition to a low-carbon economy.

Criticism of Germany's decision to abandon nuclear power focused on the perverse effects of the decision:

> *I think, given this negative pricing they had on electricity last year, the fact that C02 emissions have gone up, because they're burning the dirtiest of coal…It (the abandonment of nuclear power) does seem pretty crazy and I have seen that there is big opposition to building these new transmission lines and so on. So, I think…I used to think it was all rosy in Germany. I actually think it's not – they have quite a lot of issues there (B3)*

Other respondents echoed this concern, arguing that abandoning nuclear was an imprudent decision on the part of the German government, with respondent B5 also referring to the recourse to coal in order to compensate for the loss of nuclear power, with very deleterious ramifications on Germany's environmental performance. The respondent claims that Germany has struck the wrong balance in terms of its energy mix and that it would have been preferable to use nuclear to provide base load power and to use natural gas, a far more flexible and relatively cleaner fossil fuel, to compensate for intermittent renewables. This latter suggestion is reflective of a British perception, featured in section 5.1.1.4 that renewables will operate in tandem with conventional energy sources, namely nuclear, gas and coal and that this is a realistic long-term policy towards reaching an energy mix likely to meet the three priorities of climate, energy security and economic competitiveness. Implicit in the above comments is that the abandonment of nuclear power has destabilised somewhat the German energy market.

Germany's nuclear exit was perceived by participants B1 and B6 as heightening the country's vulnerability to geopolitical events:

> *The solar bit, we've covered already, they seem to have a resource that is, actually, out of balance and they've ended up with about 33 to 35% of their energy covered by gas coming in from Russia which has led to the situation that Putin can do what he wants and Germany was going to be able to say absolutely nothing, because they are in no position to say: We are going to stop buying gas from them'. So, Europe is not in a state, politically, where it can extract any political leverage until it can replace or remove that energy dependence….In those terms, if it was in the public consciousness, that the reason that Putin got away with what he did in Ukraine, is because Germany is buying all the gas to get lower prices or consistency when they haven't got the nuclear power stations in place, individual people might have different attitudes to the higher costs of renewable energy, because renewable energy, generally, it is resource that is available and tending to be used locally. (B1)*

Respondent B1 argues that Germany's energy dependence on Russia has undermined their foreign policy in the most recent crisis in Ukraine. In their view, if the public were aware of the role of energy independence in Germany's foreign policy, then this might influence willingness to support higher cost renewable energy technologies which foster energy security, as they are produced locally, therefore reduce the need to import power. This indicates the power that arguments about energy security could hold in bolstering the case for renewable power.

B6 suggested that this vulnerability would serve to undermine the nuclear phase out in Germany:

> *I think you'll probably find that that the nuclear exit policy changes pretty rapidly with Mr. Putin's latest adventures…Here they are in Germany thinking: 'Do we really want to be domi-*

> *nated by Russia?'….by a madman such as Putin…I don't think so…Personally, I think they're bonkers…They should have lots and lots of nuclear (B6)*

Reinforcing remarks made by other British respondents about having a diversified energy mix to which renewables contribute, B6 advocates having lots of nuclear in the generation portfolio; with this being especially important in the light of geopolitical risks posed by Russia.

In terms of other relevant contributions in relation to the British perspective on the German context, B3 praised the support for energy storage in the German context in the form of subsidies. Storage is important in facilitating the integration of renewables into the energy market and this is a policy that would be beneficial in Britain – this is discussed in greater depth in section 6.1.7.

Although there is evidence of envy among British participants of Germany's vision for the expansion of renewables, there is substantial scepticism about the abandonment of nuclear power. This is viewed as an extreme policy move, given the difficulties in integrating renewables into the power market and the concerns about energy security arising from the situation in Ukraine.

5.2 Sample 2: France

Path dependency has led to the dominance of nuclear power in the French energy mix. Although France has, in the past ten years, begun to promote renewable power, the hegemonic position of nuclear is an indirect entry barrier for new ventures.

5.2.1 French entrepreneurs' perceptions of domestic energy policy

The following section features the attitudes of French participants to domestic French energy policy. It discusses respondents' perceptions of policies aimed at the expansion of renewable power in France in addition to their perceptions of policies towards incumbent technologies, principally nuclear. As in the UK context, the public perception, energy infrastructure and geopolitical issues will also be explored in order to engage in a holistic debate.

5.2.1.1 *Perceptions of the credibility of government action to accelerate deployment of eco-innovation in the French energy sector*

Following initial targets established in the *Grenelle de l'Environnement* of 2007, mentioned in section 4.2.2. The *Energy Transition Law*, ratified in 2015, set the main long-term targets for sustainable development – this law was especially important since France was going to be hosting the COP21 climate negotiations in December 2015.

Participant F2 emphasised that the Energy Transition Law had set a clear direction for the expansion of renewables:

> *For the first time in France, we had medium- and long-term objectives….something to say: 'this is where we want to go', in terms of energy production, in terms of the environment, in terms of renewables, C02….and that's very important. The "Grenelle" set these objectives and they are now strengthened by the Energy Transition….This does not change the objectives, but it gives some form of continuity for 2025, 2030…..now, that's important (F2)*

The *Energy Transition Law* offers a sense of stability for respondents like F2, as it sets milestones for the transformation of the French energy sector which reassures environmentally-orientated new ventures in relation to the continued expansion of renewable power in the French market.

Whilst there was praise for the principle behind this overarching French environmental policy, respondents showed considerable scepticism about its feasibility, with participants F1 and F5 arguing that the financial crisis, starting in 2008, had undermined the French Government's ability to support the expansion of renewables:

> *It's a question of financial support to develop the sector. The Grenelle de l'Environnement in its initial form…..had wanted to initiate the development of renewable energies, like PV and wind, with lots of subsidies from the state….so that they would really take off. These subsidies were very generous at the start…and….the market took off quickly……and….as the financial crisis came to Europe….and affected France, the government decided to reduce the financial support. (F5)*

The difficulty lies in the implementation of the objectives set out in the *Grenelle* and reinforced in the *Energy Transition Law* - participant F1 also suggests that it is the implementation of the objectives that counts rather than the objectives themselves which remain abstract ambitions. In order to develop renewable power, market support in the form of feed-in tariffs and, in the French case, tenders for large-scale renewable generation is necessary and, in strained economic circumstances, it has become more difficult to justify the cost of this support. This is reflective of views expressed by British participants, in section 5.1.1.1, who alluded to the economic crisis as having harmed the deployment of renewables in Britain. In Britain and France, there is a perception that sustainability is popular in times of economic prosperity, but that, in times of hardship, it becomes a secondary priority. This is discussed in greater depth in section 6.1.2.

Other French respondents reflected that the French government's plan had little credibility (F3), that the government was "scared to implement it" (F8), potentially due to the reasons described above, or, due to resistance by the nuclear industry and pointed to instances of instability with regard to previous green policies – for instance, the reversal of the carbon tax in 2010 (F3 and F8) (although a new carbon tax was subsequently introduced in 2014). This volatility in policies may undermine confidence in the integrity of long-term objectives on decarbonisation. Indeed, respondent F5 complained about instability of the institutional context, with a perception that the "rules of the game" were continually changing.

The Energy Transition Law which followed the *Grenelle* has set a framework for the transformation of the energy sector in France and this is a strong signal for new ventures. However, it is the implementation of the long-term objectives that is most significant.

5.2.1.2 *Attitudes towards the support mechanisms for renewables in the French energy sector*

As said in section 4.2.3, the feed-in tariff has been a principal instrument used to accelerate the deployment of micro-generation technologies in France. Respondents commented on how the feed-in tariff had stimulated the growth of renewables in the French power market and fostered the emergence of a renewables industry:

> *The level of the feed-in tariff…in France…in 2006, 2007 was set at levels which allowed the emergence of an industrial branch in wind power, in PV and in biogas…..For me, as an investor, this mechanism is a very good one….means that we can get on top of our business plan….the business and investment models are secured. It enables investment.(F6)*

> *The feed-in tariffs……for us….they were important…. They allowed us to make progress in innovation….The tariffs were lucrative….we made some money….which we could reinvest in development…when we started in 2007, the panels were three times more expensive then….compared to now….with the tariffs decreasing regularly, solar energy has become competitive with fossil fuels. (F8)*

The revenue certainty provided by the feed-in tariffs allowed new ventures to form robust and credible business models which attracted investors, as it offered reassurance in relation to market risk. Moreover, the lucrative nature of the feed-in tariffs permitted investment in innovation and development, according to F8, and incremental cost reductions to the extent that green energy is increasingly competitive with conventional energy sources. This comment supports Leete, Xu et al. (2013), who claim that the producer surplus from tariffs will lead to greater innovation in renewables and, ultimately, lead to lower costs and better quality. Although this is an advantage of the feed-in tariff mechanism, it has given rise to the problem of an overheated market as described by participant F1:

> *For the PV sector in France, it is a huge.....it's slowly dying…but it has been a huge factor in developing the PV industry. I am sure you know that there was this huge boom in France in 2008 to 2010.(F1)*

Whilst F1 describes the feed-in tariff as contributing massively to the development of a PV industry, the "boom" between 2008 and 2010, indicates a possible delayed response in adjusting the feed-in tariff rate to reflect cost reductions in PV technology. This is compounded by the economic crisis post-2008 which led to an increase in feed-in tariff costs at a time of financial stress in France as in other EU countries. Linked to this "boom" idea, F4 claimed that the feed-in tariffs had a distortionary effect on the market, giving rise to a large-scale PV industry that did not correspond to the real level of market demand and resulted in the wasteful production of solar panels. Implicit within both responses is this idea that the feed-in tariff is an instrument that is not sensitive enough to market conditions. This can be both economically unsustainable and, as F4 argues, lead to unintentional adverse outcomes for the environment.

F5 alluded to the pernicious effects of the changes to the principal support mechanism in France, namely the reduction and moratorium of the feed-in tariff, outlined in section 4.2.3. The participant is particularly critical of retrospective changes to feed-in tariffs, introduced at the time of the suspension of the feed-in tariffs in response to the overheated development of solar PV. Retrospective changes to conditions can undermine the confidence of financial investors, as it introduces unpredictability regarding the profitability of energy projects. Respondent F5 implies that these reforms to support mechanisms are, in fact, in danger of undermining the leadership that Europe has demonstrated in tackling this environmental problem for fear of damaging its economic competiveness. This resonates with other views in the UK section and is reflective of a wider conflict between economic competitiveness and supporting environmental innovation in the energy sector.

Since there is greater doubt over the endurance of the feed-in tariff mechanism, French respondents discussed alternative post feed-in tariff business models:

> *Until about now, we've sold about 30 installations, so we're still on a kind of early development phase and the majority of them have been with the feed-in tariff…selling the electricity back to the …reinjecting it and selling it back to EDF, but, obviously, it's a big question right now that a lot of people are asking in the PV sector in France. The feed-in tariff continues to go down, I think it's about 28 cents now…which is much lower than the 60 cents it once was….at the highest point. So, there's this big push now for what we now call….auto-consommation. In English, I think it's "self-consumption. (F1)*

Self-consumption, in which households consume the solar power themselves, without feeding back to the grid, may become the dominant business model for PV deployment in France as the feed-in tariff continues to decline. This model could be expanded to communities generating their own electricity using micro-grids, although this remains limited hitherto. A model based on self-sufficiency is dependent on renewables being competitive with conventional energy sources, otherwise it would not be financially beneficial for a household to produce and consume their own energy. The reductions in the price of PV, discussed by F8, aid the viability of a business model based on self-sufficiency. These comments indicate that new ventures are planning for a post feed-in tariff scenario and considering alternative business models.

In France, the feed-in tariff has had a catalytic effect in helping a renewables industry to develop, but the way in which this instrument has been managed has been criticised by respondents. Increasingly, new ventures in France are exploring alternative business models in preparation for the withdrawal of feed-in tariffs.

5.2.1.3 ***Role of wider industrial policy***

In section 2.2.5, the role of clean tech clusters in stimulating and growing environmentally-relevant entrepreneurial activity is discussed. In the French interviews, green clusters and R&D schemes featured more heavily than in the British data.

Respondents F1 and F8 point to the value of the clusters for the nurturing of the upstream part of the industry, referring to the facilitation of research and development alongside knowledge exchange:

> *The cluster.....I think it's a good mechanism, in terms of more the development side.....of the process (F1)*

> *They (the clusters) enable good exchanges among actors in the sector.....They put in place support...to foster research (F8)*

F8's contribution about the facilitation of exchanges reflects ideas in section 2.2.5 describing clustering as a means of favouring knowledge sharing and collaboration among actors operating in the clean tech sector.

F5 places greater emphasis on the role that clusters could play in public relations, crafting a good image for the sector and promoting renewable energy to the public. Given the importance of the public perception to the renewables industry and the perceived power of the nuclear lobby (alluded to in section 5.2.1.4), this PR role could be instrumental in improving the prospects of green ventures. Schaltegger & Wagner (2011) suggest that a role for such organisations could be to try to lobby to change the rules of the game in favour of green industries.

Participant F3 warned of the danger of these clusters exceeding their defined competencies:

> *"The idea (of the clusters) is good, in terms of invigorating research, but there is also this problem of setting the boundaries of what these clusters do....they should stick to their role which is to create a network and not to intervene in every area….These clusters, they are starting to annoy me…you know…..they're all anyone ever talks about…They don't do anything….It's the businesses that take action, yet the clusters are the story….and the businesses feel a little upstaged (F3)*

There is a distinction between the clusters acting as a means of supporting entrepreneurs in the sector on the one hand, through serving as a platform to connect different actors in the industry, and the clusters infringing on the autonomy of the entrepreneurs, if they are intervening in areas out with their specified role, as implied by F3. This is an interesting remark about the clusters and emphasises the potential need to carefully consider the scope and role of the clusters.

R&D support in France comes under a scheme called AMI (Appel à manifestations d'intérêt) which runs tenders for publicly funded research projects, many of which are in clean tech and energy. Respondents F1, F2 and F4 had had personal experience of this R&D support scheme, with funding from this scheme instrumental in the development of their products which have now been commercialised:

> *….a big part of our development of the first version of our product that we're commercialising now….was largely financed by these public…opportunities (F1)*

> *We exist thanks to this support from the state to kick start this new industrial and energy branch….in marine renewables (F2)*

F2, operating in a more nascent area of technology- marine renewables- credits the AMI scheme with the establishment of the firm and these remarks indicate the potential of such publicly-backed initiatives to nurture the up-stream part of an industry. The state has, in effect, entered a vacuum and created opportunities for firms to exploit. For respondent F4, although the AMI scheme has been central to the development of the firm's technology, they argue that the procedure for participating in the scheme is onerous:

> *In relation to the AMI,.....it's that the process of applying for funds….is more suited to large companies than SMEs…..it involves complex proposals….It's quite intense. However, it's thanks to it that we could develop our technology….It's (the AMI) is an important source of finance….for an SME….which helped us a lot…..However, we find it unsuitable for SMEs…..it's quite hard going. (F4)*

The respondent claims that the mechanism that is well-designed for SMEs, due to the administrative burden required to participate in the programme. Respondent F5 adds that smaller firms do not have the resources necessary to commit to the projects:

> *It's more the large companies…that can afford it….You need to be able to afford to spend a long time on the project…with a return on investment which is rather long-term (F5)*

This is indicative of a potential bias towards larger firms inherent to such schemes and this may be a barrier to participation for innovative new ventures.

A serendipitous finding in the French context related to efforts by the French Government to facilitate crowdfunding, envisaging this as playing a part in the French Energy Transition. In October 2014, the French Government passed legislation to enable citizens for the first time to lend money directly to businesses which they had previously been unable to do. The legislation created new structures in the form of institutions which could act as financial intermediaries between citizens and the businesses to which these citizens are lending money as an investment (République Française 2014). Respondent F8 has employed crowdfunding to part finance several of their firm's renewable energy projects, with crowdfunding accounting for approximately 8% of total finance raised for a typical project. As discussed in section 2.2.5, crowdfunding is an alternative source of finance to traditional financial institutions. What is interesting in France is the development of equity crowdfunding whereby investors (crowdfunders) lend to a renewable energy project and receive returns on that investment and the initial capital as if it were, in fact, a bond. This is important, considering Hörisch's (2015) conclusion, in section 2.2.5, that an environmental or social orientation does not make it easier for a venture to raise funds through crowdfunding, attributing this to the collective rather than individual benefits brought by environmental goods. This may indicate the weakness of donation based crowdfunding as a means of raising finance for renewable energy projects and the better prospects offered by equity-based crowdfunding, whereby crowdfunders receive a share of the profits from a project (Belleflamme, Lambert et al. 2014). In France, thanks to the legislation on crowdfunding, intermediaries have been established which specialise in equity-based crowdfunding in the renewable energy sector. These intermediaries link crowdfunders with projects and manage crowdfunding campaigns on behalf of project developers (F8). Crowdfunding not only offers an additional finance option that may be easier to access than traditional routes, but it also allows greater engagement of the public in renewable energy projects. For instance, if citizens from the local community participate financially in a wind farm project, then this can strengthen community support for that project. Crowdfunding, therefore, may have two roles; it may act as an additional finance source for green entrepreneurs and it may also be a means of building public consent to renewable energy projects which can be contentious, especially in the case of wind power.

France appears to have a relatively well developed infrastructure of green energy clusters as well as a relatively coherent R&D policy. However, there is criticism, among French respondents of the suitability of these schemes for new ventures. The French legal framework for crowdfunding is very intriguing and is something that would, arguably, be worth emulating in Britain and Germany.

5.2.1.4 ***Policies towards incumbent technologies***

There is one main incumbent technology in the French power market: nuclear power. Undoubtedly, as far as fulfilling the "golden triangle" of energy security, decarbonisation and competitiveness (European Commission 2015a, European Commission 2015b), it is a promising technology - in generating power, no carbon is released, the fuel supply is relatively secure and, ostensibly, electricity prices in France are far lower than in Britain and Germany, as illustrated in Table 5:

Table 5 EU domestic electricity prices

Country	**Domestic Electricity Price (€ per kWh) in 2015**
United Kingdom	0.21
France	0.16
Germany	0.29
Italy	0.25
Spain	0.23
Netherlands	0.19
Belgium	0.21

Source: Eurostat (2015)

In France, with its nuclear-focused energy mix, electricity prices in 2015 were 44% lower than in Germany which is committed to phasing out nuclear power, reinforcing the relationship between nuclear power and a lower cost of electricity.

The position of nuclear power in the French energy market and the advantages with which it is associated poses a challenge for new ventures in the French renewables sector. Respondents F1 and F3 made reference to the advantage of nuclear power in decarbonising the power sector:

There's no silver bullet you know…..I don't think that we should be dependent on nuclear, but it is a pretty impressive technology that it can be so powerful without emitting C02, so, ehm…I think there is…ehm….there is a positive side to it as well, I would not automatically say it is terrible. I think…I think having a mix of different options is the best. (F1)

This has brought another debate which is very topical in France…which is the debate between renewables and nuclear……of course, nuclear is carbon free….as much as renewables……the supporters of nuclear in France….don't want us to talk just about renewable energy, but about low carbon energy and that encompasses renewables and nuclear. (F3)

Similarly to contributions in the British data (section 5.1.1.4), F1 argues there needs to be a diversified energy portfolio and that nuclear power is attractive in that it is carbon-free in addition to being an efficient and stable way of generating large volumes of power, being, by implication, indispensable in a low-carbon energy system in which renewable power plays a substantial role. F3 suggests that nuclear power frames the climate change debate in France; influencing the discourse to ensure that it is not disadvantaged - "low carbon energy" being ambiguous, encompassing both nuclear and renewables.

There was reference to the way in which the widespread use of nuclear power had depressed electricity prices in France making it harder for renewables to capture market share, according to respondents F1, F5 and F7, with F5 drawing an insightful comparison with Germany to illustrate this:

Renewables are much more attractive and profitable in Germany….because the market prices are very high .Our market price is very low…due to nuclear….that makes the production of renewables more expensive (F5)

In France, we have a price per kWh that is extremely low, one of the lowest in Europe. The fact that prices are rising…per kWh allows renewables to approach parity…Wind turbines..I sell at e0.08 kWh…I can sell PV at e0.1kWh…Nuclear is around e0.05kWh or 0.06 kWh…we are approaching the price of nuclear (F7)

Since renewables have traditionally been uncompetitive due to the low French electricity price, they have needed greater financial support and their development has been constrained, with F7 highlighting the difference in price between renewables and nuclear in France although the gap shows signs of being closed. This is also clear from Table 5 introduced previously. In order for renewables to expand, the impression above is that a higher wholesale price of electricity in France is necessary. For instance, F5 claims that Germany's higher electricity price has made renewables far more appealing and financially viable on the German energy market. There is a structural disadvantage for renewables in the French power market due to the price distortion.

The hegemony of nuclear power in France was considered to have serious implications for the expansion of renewables:

> *Due, mainly, to the 'nuclear rent'.....electricity is relatively cheap……for the time being….and it has developed enormously beyond nuclear and related industries…..it has developed everything to do with the electricity industry…..,notably, everything to do with network…distribution….etc. (F4)*

> *The position (of the French Government towards nuclear) is clearly important, because the choice to continue with this policy of all-nuclear…or to reduce the share of nuclear in France….is going to influence the policies regarding the development of renewable energies…If we want to keep the current rate of nuclear….we will not need to invest much in renewables, because with the nuclear power stations….we meet our current production needs" (F6)*

F4 refers to a "nuclear rent" to describe how the nuclear industry is entrenched in the French energy market, with "rent" implying a protected and insurmountable role for nuclear power, with the growth of associated industries having reinforced the way in which nuclear is embedded in the French energy market. For instance, the accompanying infrastructure has been designed to suit the large-scale, centralised and stable production of nuclear electricity and is, consequently, less suitable to the more intermittent and decentralised production of renewable electricity. According to F6, the scope for the expansion of renewable power in France will be dependent on the government's decisions towards nuclear power. Under the Energy Transition Law, the government aims to reduce the share of nuclear in final electricity consumption from 75% to 50% by 2050, so this should, in theory, enhance prospects for renewables. However, this is a long-term goal and vulnerable to questions surrounding the credibility of policy ambitions.

The implementation of this goal to create a more balanced energy mix is also vulnerable to the powerful French nuclear lobby - a theme which emerged at various points in the French interviews:

> *To get citizens to see that nuclear energy is not cheaper….is not safer….It is just marketing, you know? The media is manipulated….to say these things….It is intellectual manipulation…(F8)*
>
> *What annoys SMEs like us the most, is the lobbying in favour of nuclear…which at times discredits renewables…. (F7)*
>
> *There is this big lobby….. people who will slow it down….who will highlight technical problems: the electricity network is not capable of accommodating renewables (F5)*

The pro-nuclear lobby was viewed by the participants F5 and F7 as trying to discredit and hamper the development of renewables, advancing, in the view of F5, spurious reasons why renewables cannot expand, such as the capacity of the grid. Since nuclear enjoys such a central position in France, an expansion of renewables threatens to erode its market share. F3 described nuclear and renewables as being engaged in a "game of opposing sides". On one side, the nuclear lobby suggests that there is a minimal risk of incidents like Chernobyl and Fukushima occurring in France and that, given nuclear is C02-free, the case for investing in renewables is invalid. On the other side of the debate, there are those who advocate that there are real risks associated with nuclear power and, consequently, the share of nuclear power in the energy mix must be reduced in order to guarantee French energy security. SMEs engaged in renewables require the second argument to prevail if they are to achieve substantial success, but this is dependent on the ability to influence public and political opinion; Respondent F8 describes the capacity of the nuclear industry in public relations, with the renewables industry being comparatively weaker in this respect, as discussed in section 6.1.2.

In parallel to contributions in the British data, in section 5.1.1.4, there was reference by French entrepreneurs to the indirect costs of nuclear power that are not necessarily represented in market prices. F8 commented:

> *They want to continue with nuclear because…for them…it's a less expensive form of energy…but, in reality, that's not true at all….because all the real costs of nuclear, like research, decommissioning……there are so many indirect costs that are not currently taken into account….The problem which emerges….is what is the real price of nuclear….and many experts say that French nuclear energy is paid for indirectly…and that it is probably wrong that it costs 50 euros per MWh………..EDF says it costs 80 euros per MWh….but we don't know if the problems of insurance, waste, decommissioning are included…..it is still a bit vague what the real price of nuclear is (F8)*

F8 doubts that substantial indirect costs are reflected in the market price of nuclear and, as a result, nuclear is artificially cheap. This view supports B1's suspicion, in section 5.1.2.1, that the French public paid for a large part of their nuclear energy through taxation. Hidden costs were seen by F8 as weakening the credibility of the claim that nuclear was a cheap source of energy. Establishing a level playing field between nuclear and renewables may be aided by greater transparency over the true costs - this has not been achieved, according to F8. It is possible that if policy makers took these indirect costs into account, then this would change the nature of the debate between the nuclear advocates and the renewables industry.

A quote that was particularly striking and perhaps emblematic of the policy dilemma confronting the French Government came from F3:

Do we put C02 before safety? Or do we put safety before C02? (F3)

For France, nuclear is hugely attractive in reducing carbon emissions but comes at a considerable potential safety risk, according to F3, and it can be inferred that this issue on nuclear safety is a principal argument which interacts with the need for decarbonisation in the debate on the expansion of renewables.

As regards shale gas, F5 and F8 doubted the credibility of the government's prohibition of shale gas exploration. F6 even claimed that opting not to pursue fracking constituted a missed opportunity for the country. This point reverts back to the economic argument and suggests that France will be at a competitive disadvantage if it does not develop shale like other countries and will suffer from the opportunity cost of not nurturing an industrial base in this area. Moreover, there is this notion about energy security, with France potentially being dependent on other countries for its supply of natural gas, although its substantial nuclear fleet mitigates this concern somewhat.

Perceptions regarding nuclear and shale gas are connected to this issue about the future of the French energy portfolio and whether a balanced mix of technologies should be promoted or whether the transition should be far more renewables-focused:

I think…I think having a mix of different options is the best (F1)

Nuclear is at the heart of our energy strategy…..and if we reduce this share of nuclear in our energy mix, we need to find alternative, low-carbon sources…..renewable energies are a perfect example of that" (F6)

> *Do we prioritise renewables over everything else? There is no answer….it depends on the country…..We are probable best to diversify our energy sources. (F3)*

> *In Great Britain, in Germany, or in France…I think that it will be a complete mix…and I think that this mix has to be increasingly at a European level… (F3)*

> *It's a mixed energy policy…nuclear, likewise conventional energy sources and renewable energy…What we have more and more today…is an energy mix. (F7)*

It is envisaged by the respondents above that renewables will form part of an overall mixed energy portfolio that includes nuclear and conventional energy sources. This view about renewables as part of a wider mix resembles those of several British respondents and suggests more guarded expectations about the Energy Transition, with renewables as additional to nuclear and conventional generation as opposed to acting as the core future energy source for France. It is important to stress that the perceptions are not necessarily that renewables should become the dominant energy source in France; rather, as in Britain, there should be fairer competition between nuclear and renewables, so that a more diverse energy mix can be reached. F3 advocates an energy mix at a "European level" – this is consistent with the increasing efforts to develop an EU energy policy that has, so far, largely been driven by concerns over energy security and economic competitiveness (Maltby 2013). Indeed, establishing an Energy Union is a priority for the European Commission which regards this as a way of ensuring that Europe has "secure, affordable and climate-friendly energy" (European Commission 2015c).

5.2.1.5 *Reflections on the wider energy system*

Reflective of British perceptions, French respondents were critical of aspects of the existing energy system in France to do with bureaucracy both in the administration of feed-in tariffs and in the support for large-scale generation which may be applicable to those involved in marine renewables. As in Britain, French participants described the need to adapt the electricity grid to accommodate an expansion in renewable generation:

> *We have a problem with the networks because…to sell the electricity on the market….the grid has to be able to absorb it……and there is a problem with the electricity grid in certain regions, especially in the west and in Marseille. We need to find the mechanism to sell electricity on the market in France… (F5)*

> *You have to be able to connect renewable energies to the grid. This grid has been built to distribute electricity, not to accommodate the production of renewable energy. It was designed in a top-down manner…from producer to consumer….to the end-user…..The problem is the management of the grid….we are stuck with this problem of how to integrate renewable energies. We have to invest to integrate these new sources, in investing more in the grid, so that the new production points can be accommodated (F6)*

The difficulties described above relate to the integration of renewables into a system that has been designed for large-scale, centralised generation that is stable as opposed to intermittent generation. As a result, the electricity grid has difficulty absorbing the growth in intermittent, decentralised output from renewables (F5). F5 and F6 both refer to system costs associated with the rise of renewable generation and argue that there is a need to better integrate renewables into the market. F5 says that a mechanism to sell electricity on the market must be established; this would lead to demand-orientated production and mean that the grid would not become overloaded when weather conditions were favourable to the production of renewables. This would assist the integration of renewables, discussed by F6, however, this should be accompanied by greater investment in upgrading the electricity grid, so that it can absorb the growth of new forms of generation. This issue around system costs is discussed in greater depth in the discussion chapter, in section 6.1.7. F2 claims that the fact that electricity consumption is well dispersed across the "four corners" of France means that there is good grid coverage across the whole territory, meaning that there are fewer areas where grid coverage is very poor – this contrast with Britain, in which there are remote areas in which grid coverage is very sparse (section 5.1.1.5).

An emergent theme is energy storage which would enable the integration of renewable power into the wider energy market through facilitating demand-orientated production of renewables – excess power would be stored and fed into the grid when required:

> *I think that if we managed to find solutions to energy storage at reasonable costs and at the right scale…we would be able to manage renewable energies much more effectively. Renewables are, you know…intermittent. (F6)*
>
> *Today, truly, especially with wind turbines and PV, the worry is that there is no storage. We are on the grid all the time and that causes problems (F7)*

Storage would be part of the solution to finding an effective mechanism to trade renewable electricity on the market. It would, essentially, permit demand-orientated production.

A desire for better governance of the carbon mitigation process was expressed by F5 and F7, with F5 describing the inefficiency of current systems involving the exchange of carbon permits:

> *What actually happened is that they (incumbent firms) bought certificates…on carbon markets etc…so, the effect was that there was a development of a carbon certificate exchange market, but no impact on renewables. Rather than install renewables, businesses prefer to buy permits…(F5)*

The scheme provided an insufficient incentive for large firms to increase their engagement with renewables, according to F5. This is attributable, perhaps, to the collapse of carbon prices due to over-allocation of permits exacerbated by the effect of the economic recession starting in 2008 (Laing, Sato et al. 2013). This could be influential for new ventures, as it leads to a weaker demand for environmental technology in the wider market. F3 raises the idea of a European Energy Market – an idea that has gained traction in recent years:

> *We have difficulty implementing it (European energy market)….it involves rules of the game which are coherent among countries, grids between countries……this mix must be at a European level, and it will be France who fulfils Europe's nuclear needs. (F3)*

There has been substantial discussion that an Energy Union would lead to a more efficient energy system across Europe that would be more resilient to supply shocks (Maltby 2013). F3 envisages that this system would be based on the comparative advantage of each country; France would provide Europe's nuclear power, for example, as it has particular competencies in this area.

Whilst a European Energy Union and better functioning European carbon market is arguably beyond the scope of this PhD, the French Government would do well to investigate possibilities for promoting storage technologies, as this would overcome a principal obstacle to the expansion of renewable power. Moreover, it could work with partners in the EU to forge a more effective carbon exchange mechanism.

In light of the continued decline of the feed-in tariff, there was evidence of respondents thinking about new business models based on self-consumption of energy:

> *What interests us, in particular, are local energy networks….local consumption…typically…not connected to the national grid…. we try to produce energy where it is consumed…..and to avoid transporting combustibles…..to have local resources…. (F2)*

> *We are going to get to the Energy Transition between 2014 and 2015….we will emerge from a trough…and go towards a new business model in 2016, 2017, based on self-sufficiency…..This second business model, based on self-sufficiency, is here because the government cannot afford to finance the development [of renewables] (F5)*

> *Recently, we were in contact with a big retailer….and they gave the impression of seeing the need for self-sufficiency….self-production….self-consumption…not only for security of energy supply, but also for purely economic reasons… (F4)*

Two factors underlie this move towards self-consumption as a business model. Firstly, the decline in government support, partly due to restricted public finances (F5), which have seen renewable operators in hard times (going through a "trough"), will force renewable energy business models on to this self-consumption path. Secondly, self-sufficiency in renewables is increasingly becoming an attractive way of securing energy supply and, increasingly, makes economic sense, initially for groups such as isolated communities (F2). Self-sufficiency may be attractive for large retailers, with high energy costs, as this offers a way of easily reducing a large part of their cost base (F4). However, it is possible that, as the energy transition advances, this new model of self-sufficiency, bypassing the grid, becomes more widespread. This idea, raised by F2 of producing energy where it is consumed is somewhat similar to the suggestion made by respondent B1, in section 5.1.1.5, about locating energy production and consumption in the same geographical location. This self-sufficiency model is possibly what a post-support context would resemble for new ventures.

The Emerging David versus Greening Goliath (Hockerts, Wüstenhagen 2010) theme is also present, with F5 claiming that the utilities are playing a double game, restricting the market whilst investing in the technology themselves. They are, effectively, waiting for a turning point to come in the French energy market and will reap the benefits then:

> *They (the utilities) put up obstacles to prevent some people from entering. At the same time, EDF is a big actor in PV. They are closing the market off,… they want to control the market. The day when we are all convinced in France that we need to switch, we will switch massively towards renewables because we will be forced to….EDF will be ready, because they are investing. They are playing a double game… (F5)*

This could be detrimental to the speed of dissemination of renewables – Foxon & Pearson (2007) claim that if the expansion of renewables is solely undertaken by incumbent firms, this expansion will be slowed down, as renewables will remain a niche for these actors until a late phase in the transformation of the energy market. This could pose great risks for society.

Actions, such as the enhancement of the electricity grid are relevant to the further dissemination of renewables in the short- to medium-term. However, perceptions indicate that, in the longer term, post-support mechanism, self-sufficiency will be an important business model for renewables in France and this entails a different logic towards the energy system.

5.2.1.6 *Perception of the public*

In contrast to Britain, the public perception did not feature substantially in the French interviews other than the rather indirect link to lobbying, covered in section 5.2.1.4. However, participants F2 and F8 made interesting remarks about the conflict between economics and environmentalism:

> *In fact, when there is a pessimistic mood…there is a tendency to stick with what we have and not develop new sources of energy – people will just try to buy the cheapest energy possible and that can be hard since that forces us to sell at a loss relative to cost. Conversely, in periods of economic prosperity, where people want to green their image….they will buy renewables and green energy and this increases the price relative to supply…..an increase in demand relative to supply…..that will, as a result, improve the profitability of projects….(F2)*

> *Today, the problem is that the economy comes before the environment…..However, if we destroy the planet, there are no aids (i.e. fiscal stimulus packages), it is irreparable what we are doing…..natural disasters….climate change…. (F8)*

The EU has been through difficult economic times since the financial crisis which broke out in 2008 and the implication here is that demand for green energy among consumers is higher at times of economic plenty. When the economic situation deteriorates, sustainability is relegated to a secondary priority; this is potentially to do with the long-term uncertainty regarding the rewards for engaging in sustainable development, as discussed by York & Venkataraman (2010) in section 2.2.1. This need not only be about the economic situation – German field notes, covered in section 6.1, discuss the way in which current issues, such as the refugee crisis and the Greek bailout can deflect the public's attention away from the environment, perhaps as it is perceived as an issue which does not have urgent implications.

5.2.1.7 *Geopolitics as a driver of the adoption of renewable energy*

As discussed in section 4.2, energy security has, historically, directed French energy policy. The large-scale roll-out of nuclear power aimed to secure France's energy independence following World War II during which energy supply had been a core strategic issue. This historical background means that whilst energy security is of relevance, the debate is largely focused on nuclear power and this was reflected in contributions. In F1's view, the general public and average consumer were not sufficiently aware of issues around energy security and geopolitics for this to have an impact on the market for their business:

> *Again…sort of, on the operational basis, we're working on the smaller scale and we're working with homeowners who I don't think are completely…I mean in France…completely sensitised to these much bigger macro issues (F1)*

These issues are rather abstract according to the respondent, and are too vague and complex to influence the behaviour of the average consumer.

As in the British data and German data, F8 raised the possibility of the Russians using their control of the gas market as a "weapon" and, so, this indicates that, in the French context, there is awareness among participants of the strategic implications for renewables of geopolitics:

> *The price of gas is high and will continue to rise. What's more, the Russians will use it as a weapon (F8)*

Other contributions from F5 and F7 suggested that nuclear power would provide energy security and that concerns about geopolitics were an argument for retaining nuclear power and being reticent in reducing the share of nuclear in energy consumption too rapidly (F7). Whilst geopolitical concerns are, arguably, of significance in the French energy market, respondents do not necessarily perceive these issues as having direct implications for their market prospects. Moreover, energy security acting as a driver for consumers to adopt renewables will depend on greater awareness of these issues among the general public – as argued by UK participants (section 5.1.1.7).

Geopolitical issues were not as strong in the French data as in the British or German data and this could be to do with the unique nature of the French energy mix, principally the stable supply from nuclear power.

5.2.2 **French entrepreneurs' perceptions of foreign energy policy**

In this section, the reactions of French participants to policy differences in Britain and Germany are examined. As stated in section 3.4, this data was gathered in the second part of the interviews in which policy differences were explained to respondents who, then, reacted to those differences. In terms of French reactions to British policy, these centred on the British government's decision to increase the role of nuclear power in future energy provision and to approve the exploitation of shale gas.

5.2.2.1 ***Perceptions on British policy***

French respondents were briefed on certain key differences in UK energy policies and were asked their reactions. In the coming years, the Britain's energy policy context will come to bear greater resemblance to that of France, due to the recent decision to expand nuclear power. French participants are accustomed to a context with substantial nuclear power and this may indicate why their views on UK policy were not particularly stark. As for Britain's support of shale gas, reactions were rather limited, despite the fact that fracking has been prohibited in France where it faces greater opposition.

French participants, who reacted less favourably to British policies, discussed the competitive threat that nuclear and shale would pose to renewables in the British market:

> *The problem with.....especially with shale gas, is that the development will maybe slow down the development of renewables. I think that nuclear is a little different, because it's got such heavy costs and everything....it's not a direct competitor, whereas shale gas, I feel that a lot of people are going gung-ho into that, because there's a huge opportunity, because it's so cheap, that it will deter, slow-down the development of renewables, so yeah..... F1)*

> *…there is a desire in the UK to develop renewable energies, especially PV. It is...at the moment....the most interesting market in terms of development...However, we think to ourselves that it won't last long, because we know that nuclear plants and shale gas are coming. There is a window of opportunity which will last one or two years. There are subsidies, conditions favourable to sustainable development in the short term in the UK....and the only fear is that shale gas and nuclear are not far behind and that it won't last....it will just be there to take off….to have a certain number of installations….and, afterwards, there is the risk of a slow-down. (F5)*

Shale gas was perceived by F1 as a greater threat to the expansion of renewables than nuclear, since it can be exploited in a far shorter time horizon and does not entail such substantial and long-term costs as nuclear. Respondent F5 reacts from the position of an entrepreneur interested the British market for solar PV and claims that the decisions relating to nuclear and shale gas dampen the long-term prospects of the British market for renewable energy. There is a window of opportunity in the short term for renewables in Britain before the market cedes to shale and nuclear, promoted by the government. This insight about the competitive threat posed by the growth of nuclear and shale is powerful, since this firm has actually had commercial interest in the British market.

Other more neutral and positive perceptions towards the UK policy were:

> *If they (the British) have decided to build nuclear power stations, that is going to reduce their C02 emissions....now...they will have to manage the radioactive waste...and it's a political choice....What do you prioritise in a country? (F6)*

> *You must not only see it from a negative point of view......when there is this desire, on the UK's part, to reduce carbon emissions and, unfortunately, people think that greenhouse gas emissions can only be reduced through renewables, but they can be reduced likewise through nuclear. You can't envisage for a country the size of the UK and France an energy independence, based on 100% renewables....in the short term.......you need to aim for an energy mix.... (F2)*

The above remarks demonstrate greater sympathy with the idea of a mixed energy portfolio, consisting of renewables alongside other sources like nuclear and shale gas. F6 implies that opting for greater nuclear power is a trade-off between carbon emissions and the problem of nuclear waste for the UK, implying that nuclear is indispensable in the decarbonisation of the energy sector which could prevent catastrophic climate change. Indeed, F2 praises nuclear energy as a sensible means of reducing emissions, claiming that a complete transition to renewables is, in fact, unrealistic. Interestingly, F4 hinted that the UK's nuclear policy may be of benefit to French industry and this appears likely, given France's expertise in the construction of nuclear plants. This point refers back to the idea about the wider industrial ramifications of energy policy decisions and that there may be opportunity costs of investing in nuclear power compared to renewables, in terms of possibilities for domestic industries and employment.

There is a view, expressed above, that British policy will ultimately be detrimental to renewables. However, there is also an underlying acceptance of the role of shale gas and nuclear to the decarbonisation of the UK's energy sector. It is perhaps a question of how one envisages the Energy Transition. In support of Britain's policy, it is perhaps envisaged that renewables will supplement base load electricity, supplied by nuclear and shale. A more critical and radical viewpoint may envisage the Energy Transition being directed by renewables and consider nuclear and shale gas as removing market share from renewable energy.

5.2.2.2 *Perceptions on German policy*

German energy policy is fundamentally different to that pursued by France. The principal difference lies in the position of nuclear – it is the main source of electricity in France whereas in Germany it is going to be phased out. Different nuclear policies have led to dramatically different market prices for electricity in both countries and this has clear implications for renewable energy entrepreneurs. Perceptions of French entrepreneurs towards German policy largely concentrate on this nuclear exit. However, there are other recurrent themes to do with a different mentality towards the environment and different approach to energy in Germany compared to France. French participants in the study believed that, in Germany, renewables had a natural advantage. A higher market price for energy, Germany's status as a first mover in clean energy and its perceived economic strength were advanced as being beneficial for renewables:

> *….the French definitely have a lot of issues trying to move support for the development of renewables, in particular solar, as opposed to Germany…(F1)*

> *The French and German markets are very different. Renewable energy is lucrative and profitable in Germany, because the market prices are very high (F5)*

> *They can afford to indulge in an energy policy that is more focused on renewables, as they are in a better position economically than other countries." (F8)*

> *…..energy in Germany is sold to the customer at a far higher price than in France, so, the market price is fundamentally much higher….and people are used to the self-consumption scenario (F3)*

A higher market price for electricity in Germany was seen as instrumental to the perceived greater success of renewables in Germany. In a context marked by higher market electricity prices, German consumers had become more accustomed to producing their own electricity, under this “self-consumption model”, namely producing one’s own power through micro-generative technologies in return for a feed-in tariff and were, therefore, more prepared for the large-scale transition to renewable power. Given the higher market price of electricity in Germany compared to France, French respondents considered that there were greater incentives to become self-sufficient in Germany, even at a time when feed-in tariffs are being reduced and withdrawn. The fact that electricity was relatively cheap in France, largely due to the nuclear rent, was considered the main obstacle to greater profitability that renewables were believed to enjoy in Germany (F3 and F5). An interesting insight was offered by respondent F8 who claimed that Germany’s relative economic strength meant that it was in a position to pursue a strategy with greater focus on renewables than in France in which the Government perhaps lacked the economic strength to commit fully to the cost of reducing nuclear power’s share in the French energy mix whilst expanding renewable power. This link between economic prosperity and green strategies appears at various points in the contributions of respondents and is an important theme in the Energy Transition.

F5 argues that Germany’s energy system is less monopolistic than the French system and that this means that it is more agile and better able to adapt its infrastructure to the expansion of renewables:

> *We, we are one country…..we have one company - EDF (Electricité de France) at a national level…..We have local distribution companies…., but we have a national operator, EDF. In Germany, it is about operators, operators in the plural,…who are independent, who have tariffs, conditions, who can invest…..who can construct transmission lines….etc. If we wanted to strengthen the electricity transmission lines to accommodate a new solar plant, that goes*

> *through government, requires national investment…it goes to the national level. In Germany, that can be done at a regional level, so it does not have a national impact (F5)*

This relates back to Dean's & McMullen's (2007) point about monopoly power causing environmental market failures. If the transmission grid is run by one monopolistic provider, as in France, this could cause sclerosis in upgrading the infrastructure necessary for the expansion of renewables.

French entrepreneurs, quoted above, perceived these fundamental characteristics as making Germany a more receptive market for renewable energy than France. However, despite the feelings above that the lower cost of energy had constrained the development of renewables in France compared to Germany, views about the German decision to abandon nuclear power were, on the whole, negative. Respondents highlighted the perverse effects of the decision on Germany's climate targets:

> *It's a bit galling that a country that is really advanced in renewable energies……..has seen its record on C02 get worse because it has made the choice of shutting down nuclear. These are political choices…(F6)*

> *Yes, but, you know….they finished with nuclear overnight…….but, you know, maybe….what they've done…….They've reverted back to producing electricity from coal…and that…..it's almost worse than nuclear…. The time it takes to put wind farms and solar in place….There are possible problems…(F8)*

> *… as we have seen in Germany…They closed down the plants….but…..at the same time…they are having to tap energy from all their neighbours…., so it's not all that positive…..What we can see….is that, in very cold weather, Germany is asking neighbouring countries for more energy than previously,……as they are experiencing a shortage of energy. (F2)*

> *I would criticise the Germans for having abandoned nuclear so quickly because this was a purely political decision…(F7)*

It was seen as a contradiction that Germany, a country performing so well in terms of diffusing green energy, had reverted back to using coal-based electricity for part of its needs and, in so doing, undermined its efforts on climate change. There was a general perception that the move to abandon nuclear power had been made hastily and was having unforeseen consequences. For instance, F2 describes the implications for German energy security; Germany has become more dependent on energy imports from neighbouring countries at times of shortages, with this restricting France's ability to import power from Germany when needed. Therefore, Germany's nuclear exit leads to consequences for French energy security too – an issue analysed by Bruninx, Madzharov et al. (2013). The nuclear phase out was not, in general, seen as having a positive influence on the renewables industry; indeed, respondents emphasised the reversion to coal and the destabilising effects of the decision on the electricity market. The abandonment of nuclear power was perceived as being politically motivated and not based on rational, evidence-based policy making. Indeed, F8 discusses the time involved in the large scale deployment of renewables, reinforcing the idea that the decision to abandonment of nuclear is not a judicious one – this sense of realism about the limitations of renewables in relation to the debate on nuclear is similar to comments by British participants in section 5.1.1.4.

The only explicitly positive comment about the policy was expressed by F4 who argued that leaving nuclear would strengthen the domestic market for renewables and, ultimately, confirm Germany's status as a world-leader in renewables and enable it to export its expertise on foreign markets:

> *It's killing two birds with one stone….because…..on the one hand…the abandonment of nuclear power….and the Energy Transition Policy….effectively……boost the domestic market…..for businesses…….this boost for the internal market will enable German companies to export….and to sell what they develop abroad…..It is a move…which may have a big impact……..it seems like a quite a shrewd policy…(F4)*

This comment reiterates the way in which decisions about energy policy have potential ramifications for the industry of a country and F4 believes that leaving nuclear power will lead to an industrial advantage for Germany in renewables, as this will reinforce the domestic market for renewables.

Germany is at a more advanced stage than France of reforming its support mechanism – these are discussed in section 4.3.3. Market-orientated reforms to the support mechanisms are a reality in France as in Britain and Germany – feed-in tariffs will be abolished for generation volumes above 100KW for PV as per the German reforms. There was understanding of the need for reform as renewable energy technologies became more mature, with F4 describing the German support mechanism reforms as more suitable to demand-orientated production of renewable energies:

> *" I don't know the German feed-in tariff system…., but, from what I understand and from what has been explained to me….it allows you to better adapt the mechanism….to match the production of renewable electricity to demand" (F4)*

Other respondents highlighted that the German support mechanism reforms gave rise to greater uncertainty and that this could be pernicious to the confidence of financial stakeholders. Participant F3 argues that renewables have not reached the phase of maturity yet and, therefore, will struggle without state support, given uncertainty about future energy prices, due to the volatility of the electricity market, and uncertainty over whether the renewable generator would sell the volume of electricity they produce in the absence of a guaranteed tariff. F6 warns that such uncertainty would likely dampen investor sentiment, as business plans become more unpredictable. This may apply to the French context too, now that similar reforms have been introduced there, and the uncertainty caused by the reforms may be more acute in France, in view of perceptions about the weaker market for renewables compared to Germany.

A remark about differences between French and German national culture towards environmental issues was striking:

> *There is a German mentality which is not the same as the French mentality. These are people who, for a long time, have been more sensitive to environmental aspects…in France, it has been very recent thing. So, we want to be green, but as long as it does not cost money. The mentality is different. (F3)*

F3 feels that a more embedded environmental consciousness means the Germans are more willing to pay to protect the environment. In contrast, in France, where this awareness is more recent, sustainability is only accepted where it involves no economic trade-offs. In the case of financing the expansion of renewable energy, there is a cost implication and greater environmental awareness may affect the the legitimacy of the support schemes for renewables among the public.

In general, the French participants felt that renewables had had an easier start in Germany thanks to the inherent characteristics of the German energy market to do, principally, with the different stance on nuclear power. Moreover, there was an impression of a more favourable attitude towards environmental protection in Germany than in France and this leads to a public that is more accepting of cost of supporting eco-innovation, in the form of renewables. Substantial criticism of the decision to abandon nuclear is reflective of more moderate expectations among French participants in the study, of the potential of renewables to replace conventional energy sources. There was a clear feeling that phasing out nuclear would be of benefit to electricity produced from coal which is ironic for a nation aiming to decarbonise its energy industry.

5.3 Sample 3: Germany

As stated in section 4.3, Germany's energy sector has undergone a major shift in recent years characterised by both the expansion of renewables and the phasing out of nuclear power. Citizen energy - Bürgernenergie - has been especially strong in Germany, accounting for around 50% of renewable generation (trend:research, Leuphana Universität 2013). This strong participation of citizens is a distinctive feature of the Energy Transition in Germany and is more pronounced than in the other two countries. As in the British context, the German interviews took place at a time of major reform to the Renewable Energy Law – which will be referred to as the EEG from now on. These reforms are outlined in section 4.3. The changes have substantial implications for new ventures in the German energy sector.

5.3.1 German entrepreneurs' perceptions of domestic energy policy

In the following section, German respondents' perception of German energy policies will be discussed. As in the previous country sections, attitudes towards the direct support mechanisms will feature. In addition, perceptions of wider, more indirect factors which potentially impact on new ventures in the German context will be discussed.

5.3.1.1 *Perceptions of credibility of government action to accelerate deployment of eco-Innovation in the German energy sector*

Germany has been a first mover in launching support mechanisms for renewables, with the iconic Renewable Energy Law of 2000, discussed in section 4.3.3, being a catalyst for the development of green energy. A certain sense of pride about the EEG was apparent in the interview data, with this law being described as a "role model" and, implicitly, an inspiration for other nations:

The EEG implemented the incentive......and the technology developed fur-ther......always being moved on.....the installations got bigger......., the volume of generation increased.....this is a successful model.(G2)

When you look at Germany, we are the role model with our EEG which through the certainty it offers in terms of planning, the feed-in tariff, has massively developed the dissemination of wind power, PV and biomass installations" (G8)

Through this EEG, new business opportunities emerged and our business model developed from it (G14)

According to the above statements, the EEG has been successful in stimulating the diffusion of renewables in Germany, especially thanks to the certainty that the feed-in tariff mechanism offered entrepreneurs in terms of planning (G8), in view of the fixed payments available for the generation of renewable power. Indeed, G14 cites the EEG as the catalyst for the development of their firm's business model, giving rise to commercial opportunities.

This notion of the EEG as a catalyst for change in the energy market is discussed by G8, who describes it as a structural change, in shifting the orientation of the energy market from centralised, fossil-fuel based generation to decentralised generation from renewables:

It (the EEG) is a structural change......and this has become a battle. Every structural change brings that with it, because an economic power struggle takes place......unfortunately, the politicians only think from one parliament to the next... (G8)

This notion of an "economic power struggle" is interesting and reminiscent of similar ideas in the French responses in relation to nuclear power (section 5.2.1.4). The continued expansion of renewables threatens to displace the fossil fuel based industries, represented by conventional energy giants like RWE and E.On and, thus, there may be resistance from such groups. In such a struggle, there is a danger, to which G8 alludes, that politicians place their short-term political interests over the long-term priorities for the country's energy system. This disruption of the energy market will be contentious as it involves winners and losers.

The EEG has facilitated the securing of external finance according to G13, as the fixed payments, in the form of feed-in tariffs, provided security for investment and, in the absence of the feed-in tariff, obtaining such finance would be harder. Indeed, participants G5 and G7 claimed that the feed-in tariff was essential to the existence of their business and the functioning of their business model:

> *For us, as a business, the EEG meant a degree of certainty, that we had priority in feeding what we produced from our installations into the grid. Through this, we had security for our investment, in the eyes of the bank...in other words, the bank can give us a loan and says: 'Ok, you have a fixed feed-in tariff- no problem.' Financing, using external capital....is considerably easier with this than if we did not have it (G13)*
>
> *For us, without the EEG 2004, our firm would not exist…It was the reason we set up….. (G5)*
>
> *Without the feed-in tariff, it doesn't work (G7)*

Other more general comments about the law highlighted that it had been effective in implementing the desire to expand renewables through market mechanisms; the technology was already in existence (G11) and G3 claiming that the Law had enhanced the market prospects for their firm:

> *The innovation is there.....the technology for biomass boilers.....or wind power...is not new....it is ancient.......it is just a question of bringing this technology forward and to make renewable energy usable....that is the right way to go (G9)*
>
> *For our firm that (The EEG) is clearly a good thing... be-cause it's a plus for these new energies....and is relevant for us, because we get more contracts and that is already noticeable. (G4)*

Given the cycle of reforms to the Renewable Energy Law, undertaken by the German Government, G2 appeared to be considering a point at which the Law would no longer exist:

> *If things continue the way they have been going......then we won't need the feed-in tariff anymore....We can envisage profitability even without the EEG (G3)*

In G2's view, renewable energies are approaching a maturity in Germany at which point they will be self-sustaining, even without the support mechanisms. This is indicative of how far these technologies have been advanced by the support mechanism, that they are now considered to be viable alongside other, more traditional generation methods. However, there was evidence of anxiety about the reforms recently undertaken to the EEG:

> *At the moment, we have a lot of insecurity caused by the political dis-course.....in the PV and wind sectors, there is a lot of uncertainty.....we must consider this..... (G8)*

> *It (the EEG) was credible until it was recently reformed and since then it has lost a lot of credibility (G6)*

G8 and G6 describe the reforms as leading to uncertainty and harming the credibility of the EEG.

The EEG is perceived by the entrepreneurs above as a game-changer in stimulating renewables and, as such, credible in terms of its purpose. However, there is evidence of thought about a post-EEG scenario, on the part of the respondents and this has major implications for the business model of the German sector.

5.3.1.2 *Attitudes towards support mechanisms in the German energy sector*

Although they work in a similar manner to those in France and the UK, the German feed-in tariffs have been in place much longer which partly explains the more advanced state of renewable energy in Germany. It could be said that the German feed-in tariff system has been a victim of its own success; with the reduction in costs of renewable energy technologies, there is now substantial renewable power generation in Germany. This growth has provoked concerns about the rising costs of supporting such technologies and, as a result, the support mechanism has undergone several major reforms, the nature of which is discussed in section 4.3.3. Most reactions relating to the support mechanisms centred on these reforms and their potential ramifications. Both the reform to the Renewable Energy Law in its general sense and its specific aspects provoked reactions.

In a general sense, entrepreneurs perceived the reforms as "putting the brakes" on their activities and as being adverse to the powerful citizen-led energy movement in Germany. Several comments about the reforms in general included:

> *Currently…..the EEG…the way it is going to be determined and implemented…will….certainly slow us down (G8)*

> *The brakes are being totally put on renewables in Germany at the moment….If they had not buried renewables like this…then we would have got there….We will get there in shorter time if we are just left to get on with it….However, they are putting the brakes on us (G3)*

> *The EEG was very important to me for a long time, because it provided a really good base…I must, however……, because in recent years….a bit from 2009, and in a really big way from 2012…..it has become much less generous…..and now, in 2014, the change is massive…..It is being reversed…..They are forcing renewable energy operators…..to go in a direction that can only be negative (G12)*

The reforms are causing a deceleration in the expansion of renewables in the German context according to the above respondents. In the above quotes, there is this theme of the way in which the law is evolving – respondent G4 describes the current reforms as tantamount to a "reversal" of the original principles of the legislation and this is echoed by respondent G12, claiming that the trajectory of the Act is unfavourable for actors in the renewable energy sector. Underlying these responses is a sentiment that renewables are not ready for such a dramatic change in the support framework at this point and that the reforms will be detrimental to these operators' business models.

In terms of the actual ramifications of the reforms, respondents discussed financial implications of the reforms for the renewables industry, with the market having imploded in the wake of the changes according to G10, G8 and G6:

> *We have firms with which we work…..and the market has collapsed by 50%....an SME tried to keep going….but they had to let people go……These are the consequences of the restructuring of the EEG. (G10)*

> *The rate of expansion of installations is decreasing rapidly, because the feed-in tariff is not as generous for investors……it makes the investment model more complicated (G8)*

> *The reforms are not slowing down the branch….they are killing it. Of the four biggest operators in Germany, two are already bankrupt….with the third soon to follow (G6)*

The changes have led to bankruptcies in the sector, as they undermine existing business models through both reducing the incentive to adopt renewable power and increasing the uncertainty regarding the financial returns from generating renewable electricity.

Respondent G2 argues that the restructuring of support is particularly unjustified since the entrepreneurs took the risk in entering the market, incurred sunk costs to enter the market and are now in a financially precarious position due to the reforms. Such entrepreneurial actors are less able to absorb market insecurity, especially as the profit margins were already tight before the reforms:

> *We dared…..We went into the market…..and we face even more limitations… and the conditions that we had are now being changed. We have entry…..marketing costs…..that through this….preferential treatment….can be borne……now that this treatment is gone…..we cannot afford these marketing costs…..The profit is not so large, that all that is viable……the margin*

> *is very small…..the profit per customer is very small…..If the legislators fiddle with that too often….it will become impossible to calculate….too uncertain……and and you keep away from the market….You only do what is very secure…. (G2)*

Respondent G14 echoed the concerns of the above participants, criticising the poorly planned and unpredictable evolution of the support mechanisms in Germany and claims that the reforms have been motivated by pressure from utilities, perhaps concerned about the impact of the EEG on their market share:

> *The large utilities' lobby has led to this atmosphere against the EEG and this pressure arose to make much more drastic changes to it (G14)*

Respondents G1 and G8 expand on this idea about the increasing difficulties for small-scale generators in the context of the restructuring of the EEG. This is primarily to do with the direct marketing initiatives in addition to the introduction of the tender system for generation above 100KW. The bureaucracy involved in the reformed mechanisms was perceived by G8 as difficult for citizens and small operators to navigate whilst also hampering the confidence of investors. G8 goes on to make an intriguing comment about the utilities like RWE:

> *RWE, for example, in recent years, they have neglected the issue and, so they are now looking at ways in which they can jump on board with renewables…. (G8)*

The suggestion is that the reforms bias the support mechanism towards larger-scale renewable generation which is more suited to the traditional utilities' business models. The respondent argues that these organisations failed to appreciate the potential for renewables and are now taking fright at the growth of green energy and the market threat that they could pose. Similarly, participant G1 claimed that the tender system would undermine the citizen energy movement, as citizens would face greater difficulty in obtaining finance due to the enhanced risks entailed and be less willing to invest their own money due to the uncertainty of returns:

> *That's wrong, citizens won't risk money….no bank will finance it…if they do not have security. If they have to spend money first…..and don't know what will come out of it….until half the money has been invested… (G1)*

Claims about misconceptions about the underlying costs of the EEG were identified as having played a role in the pressure for reforms to the EEG. G8 and G12 claim that it is not supporting renewables that are the main driver of the costs of the support mechanisms but other costs to do with balancing and providing exemptions, dis-cussed in section 4.3.3. Indeed, G12 argues that the costs of the support mechanism are poorly distributed and that this has caused resistance to support:

> *We have a false balancing mechanism…a false mechanism in terms of distributing the costs….The feed-in tariffs only make a third of the 6.24 cents (average cost per kWh of supporting mechanism)…two thirds come from other costs…It is a bad way of distributing the costs… (G12)*

G8 claims that, partly, because of the lack of demand-orientated production of renewables, there are periods when, as a result of weather conditions, there is an oversupply of renewable electricity and costs of electricity on the market are unsustainably low for the large operators. This could partly explain the rationale behind the introduction of direct marketing and tenders for generation above the 100kWh threshold.

A suspicion was expressed that the public had been misled about the cost of supporting renewables – there had been this "manipulation" of public opinion against renewables by negative coverage in the media and, again, this was believed to have been fomented by energy utilities by G14:

> *It is psychological….because information was given in the press, in the media that the cost of financing feed-in tariffs for renewables was becoming exorbitant…disproportionate….They carried out this psychological manipulation…argued against renewable energy which benefited…..of course in on these measures are the incumbent energy companies producing other forms of energy (G14)*

The perceived role of public opinion in motivating the reforms reinforces the relevance of public perception to energy policy, as explored in section 5.3.1.7.

Participants criticised the volatility associated with the support mechanisms. Respondent G2 highlighted how frequent changes to the regulatory framework made planning very difficult, especially since certain projects required substantial preparation time and the volatility of the energy market context was a major risk, from the respondent's point of view. There was also concern that major changes, principally, the shift from feed-in tariffs to direct marketing were being brought in without sufficient time to implement a functioning market. Selling renewable power on the market as opposed to receiving guaranteed fixed payments for power fed into the grid involves different rules of the game – there are transaction costs associated with selling power and operating in a market in addition to greater exposure to price and volume risks. This may be, initially, difficult for SMEs to absorb. The frequent changes to the institutional framework are particularly challenging for sectors in which project development times are longer. By the time a project is planned, the framework has changed as G7 claims:

> *The main problem in Germany at the moment is that the Renewable Energy Law is being reworked at too frequent intervals….to build a windfarm or a PV installation….you need half a year….to plan a biomass plant, you need two to three years….and the Renewable Energy Law is being reformed every three years….and that makes it very difficult to do anything in this field….Once you have finished the planning…the law changes and investors don't invest…because there is no legal foundation (G7)*

For certain branches like biomass, characterised by longer time horizons, the reforms could be especially pernicious. This unpredictability may also dissuade investors who lose confidence in the existence of a stable legal framework for energy.

Respondents in the study also expressed opinions about the specific elements of the reforms, namely: the shift to tenders, the tax on renewable energy produced for personal consumption, the exemptions from contributions to the EEG and the shift towards direct marketing. Reactions to these components of the reforms largely focused on their perceived disadvantages for smaller producers. The shift towards tenders was seen as being to the advantage of larger firms, as they have the capacity to absorb the risk entailed by tenders and to handle the administrative burden associated with participation in the new schemes:

> *With the tenders, there is the risk factor. What are the rules of the tenders? Those are still being worked out, this is new territory for Germany. There is some experience with these systems abroad....there only the big guys could participate...the small guys don't have the capacity.......the costs, the know how....the manpower to think it all through and to understand it. (G2)*

> *The problem is that tenders are, per se to the advantage of larger businesses….you have to plan the whole project before you get the money......That is a huge risk.....how can we, as a community energy company run such a huge risk....?.....With large companies.....that get cheap loans.....and can drive competition........unfair...completely unfair........They have a diversified portfolio....they do ten projects....and from those, six will come off.... (G11)*

> *The four large energy utilities have pushed that through.....They have lobbied and said: 'We can do that, so that is what we'll do......we're learning how to do that in France, in the UK.....we can also say that we are shifting towards regionalised, decentralised......going against this capitalist system of four monopolistic providers....from whom we are taking 30% market share. They are starting to fight back.... (G13)*

Throughout the above responses, the administrative costs, principally manpower, involved in participating in the tenders are highlighted as burdensome for smaller actors and this is compounded by an ongoing lack of clarity about how the tenders will be organised and the rules that will govern the scheme. More seriously, the new ventures face the risk of not being successful in a tender competition after having incurred sunk costs in preparing land, conducting evaluations and so on. As new ventures are less diversified than larger utilities, if they lose out in a tender round, this could lead to bankruptcy, especially since new ventures have lower financial reserves to withstand such a situation. Pressure to shift towards the tender system was perceived as having been led by large utilities perhaps fearful of the rise of High Growth David energy firms (Hockerts, Wüstenhagen 2010) in Germany which have been eroding their market share. Respondent G13 claims that the rise of decentralised power, which the EEG has permitted, has acted as a counterweight to the monopoly over the power market held by the utilities. There are parallels here with Dean’s & McMullen’s (2007) argument that breaking monopoly structures is an effective way to foster environmental entrepreneurship, as newer actors are an antidote to the sclerosis and resistance to change, characteristic of the utilities. Overall, the respondents' sentiments were that this system of tenders was unfavourable to energy entrepreneurs.

Linked to this tender system is the direct marketing obligation, compelling renewable generators, above a certain threshold, to sell their electricity in the market to an energy supplier. One respondent stressed the need to create an institution, like a platform, to enable smaller scale producers to engage in this market operation.

Respondent G14 was not critical of direct marketing in itself, but argued that it was being imposed at too low a level and should be reserved for generators with an output of 1MW or more. This resonates with recommendations from German MP, Julia Verlinden, in section 6.1.3. The direct marketing obligation at such a low level of generation restricted opportunities for citizen energy, as smaller generators would struggle to manage the demands associated with the obligation:

> *The market and investment has gone down in Germany…., because people say….am I supposed to do direct marketing with this appliance that has a peak of not MW, but 100KW….It doesn't make sense…..If you want to make renew-able energy possible for the many, it doesn't make sense…..One MW should be the threshold… (G14)*

For this respondent, it is not so much that these reforms are being undertaken; rather, it is the fact that they are being imposed at too low a level of generation. The cumbersome direct marketing process is impractical for smaller actors, in their view.

The reforms have substantial implications for investor confidence. Direct marketing may be a source of anxiety for external investors, with respondent G13 remarking:

> *They (the bank) say: 'If you no longer have the 20-year certainty....what security do you have with the direct marketer?' I say: 'I have a contract'. They say: 'Sorry, this is no use...... If they go bankrupt...what will you do then? (G13)*

Under the feed-in tariff, generators could simply feed in to the electricity grid to receive a guaranteed remuneration, so there was little by way of financial risk from an investor's perspective. However, if they are expected to sell their electricity to a direct marketer, such as an electricity supplier, then there is the possibility of bankruptcy of that marketer and the loss of the contract. Clearly, this implies lower security of investment for the bank and may make it harder to obtain external finance for the new ventures.

Direct marketing of electricity is very much related to the reform involving tenders. However, there is evidence of concern among entrepreneurs of exposure not only to price volatility, but also potential default of the third party direct marketer. It is apparent that entrepreneurs perceive a higher level of inherent risk and uncertainty in the market-orientated support mechanisms compared to the feed-in tariff approach.

Interviews revealed further controversy, among the participating entrepreneurs, over how the costs of financing the EEG were distributed. This controversy focused on two issues: the consumption tax and the exemption from the EEG, discussed in section 4.3.3. Comments reflected the impression that the consumption tax penalised those who were aiming to become self-sufficient through generating their own energy:

> *This consumption tax……is being compared with other things…if I pick an apple from my apple tree and eat it….and have to pay tax on this…(G8)*
>
> *I see it (the consumption tax) as problematic. It is as though you grow a tomato in your own garden, eat this, and then have to pay tax on it (G3)*
>
> *When I produce my own energy, I have to pay a tax and I have to invest too….I consider whether I should do it….it is a deterrent measure which is inappropriate (G14)*
>
> *We have a number of customers….firms…..who want to produce their own energy…through wind, solar, biomass….There are many firms who can produce their own energy, but now that they must pay a duty on this….they have started to step back a little from this… (G1)*

The metaphors are powerful in capturing the perceived unfairness of the measure for two reasons. Firstly, these producers have invested their own time, effort and money in developing the capacity to produce their own energy, much as one would do to cultivate fruit or vegetables in one's own garden as per the metaphors. Since they have made this personal investment, it appears unfair that they should not be able to enjoy the full benefit of this. Secondly, much like growing your own food, generating your own energy leads to greater sustainability and independence for the country as a whole. Since there are collective societal benefits from this activity, in terms of an enhanced environment and energy independence, there is a real question over why a tax is applied to those engaging in it. Participant G14 eloquently describes the consumption tax as a "deterrent measure", as it is an additional financial consideration, given that those who generate their own energy must already make an investment. In fact, according to G1, firms who may have been interested in producing their own energy have become less enthusiastic, indicating that the tax is acting, to a degree, as a deterrent. There were arguments that the money raised from the tax should be used to lower energy bills for the end consumer:

> *It would be fair if they used this money (from the consumption tax) to lower the electricity price, but the state takes the power and does not give any price reductions whatsoever….and. There will be no relief for the end user…(G3)*

Using the revenue from the tax to relieve the pressure on the end-consumer would perhaps help to strengthen public support for financing the cost of renewable energies. Respondent G11 claimed that the tax would mean that smaller generators would contribute to the cost of the electricity grid which is a public good on which the expansion of renewables in Germany depends:

> *I can understand….that people must pay for the energy they produce….because they also use the electricity grid……put demands on the electricity grid…. (G11)*

The issue of the consumption tax must be viewed alongside the exemptions to the EEG contributions enjoyed by certain industrial actors, criticised by many respondents:

> *The exemption list is actually rather large….if I run a regional transport company, exempt from contributing to the Renewable Energy Law…..it is clearly not competing internationally…(G8)*

> *If the big guys create jobs….then it may be that we should protect them….The question is…should we be protecting this number…..I am of the view that many companies are being helped….that do not deserve this help….. (G3)*

> *This opt out for large firms….I don't agree with it…..because the burden is always transferred to the citizens….. (G10)*

> *How can a business with a consumption of so many million MW each year be exempted from contributing to the Renewable Energy Law? (G6)*

> *It is clearly not justified that in Germany large firms can purchase their power very cheaply whilst the public pay considerably more…. (G7)*

The quotes above reveal frustration at the way that the costs of the EEG are distributed. They consider that the exemption to contributing to the EEG is applied too widely, especially for firms that are responsible for a high degree of environmental damage and that do not genuinely face international competition (the two justifications behind the exemption). This serves to foment resentment in wider society about supporting renewable power (G6 and G7). Further perceived iniquity is caused by the fact that the growth of renewables has reduced power prices for energy intensive firms, entitled to exemptions, according to interviewee G5, so they have profited from the growth in renewables without having contributed financially to the expansion of alternative energy sources. In contrast, the energy entrepreneurs have been subject to the consumption tax accompanied by the other reforms to do with direct marketing and tenders that they do not consider favourable to them. This is reflective of the distortive nature the support mechanism, raised by respondent G12.

The EEG, in its original form, was seen by the entrepreneurs as marking a shift towards more decentralised, entrepreneurial-driven energy provision in Germany. However, the restructuring of the law is, largely, believed to be to the benefit of larger utilities and threatens to choke off this vibrant entrepreneurial activity, in the opinion of the participants. The reforms do not merely affect new ventures engaged in generation; they have implications for the wider supply chain, including installers, producers of technology and consultants. New ventures could be engaged at any point across this supply chain.

5.3.1.3 *Role of wider industrial policy*

In the interviews with German participants, discussion focused around the support given to research and development, as there is a large programme of public research grants, the Energy Research Programme, outlined in section 4.3.4. Indeed, respondent G8 had two projects financed by the programme which indicates that it is accessible to SMEs operating in the sector. Respondent G3 stressed the value of this programme:

> *In my view, this programme has arrived far too late……It's now catching up, with projects on energy storage….biological cells…but, in my view….before the support came into force….this has been neglected (G3)*

Opportunities have been missed, as the research programme has been introduced only recently, but exciting projects are now being supported – energy storage, for instance, is one of the obstacles to the integration of renewables.

Respondent G2 suggested that it was difficult for SMEs to engage in the programme:

> *It (the programme) is perhaps more suited to the larger firms that have the know-how, the knowledge and can fulfil the application process….. (G2)*

This concern about the administrative burden associated with the programme is a recurrent theme, identified by entrepreneurs in Britain and France as well (see sections 5.1.1.3 and 5.2.1.3). As regards institutions to support environmental entrepreneurship, respondent G8 mentioned the Energy Agency in the state of North-Rhine Westphalia:

> *The state of North-Rhine-Westphalia has the Energy Agency….and the Energy Agency has several working groups…..PV, wind energy, heat pumps….etc…. (G8)*

Although the Energy Agency was not established specifically to promote entrepreneurship in the energy sector, the existence of an institution like this at state level is, arguably, relevant to entrepreneurs such as G8. Institutions like this can also further collaborations and knowledge exchange among actors in the sector through working groups. Institutions like this can also act to represent the interests of the renewables industry in the absence of a capacity for major lobbying – this is discussed in section 2.2.5. Scepticism about this public relations role was expressed by interviewee G1:

> *The state founded the Energy Agency, that is supposed to advance energy…and what does it do? Adverts on tv…and exhibitions…otherwise nothing…. (G1)*

However, it could be argued equally that advertising on TV and organising exhibitions are exactly what the Agencies should be doing, if its role is, in fact, to act as a proxy lobby for renewable energy actors and to influence public opinion in relation to energy.

The energy research programmes offered in Germany are substantial and the existence of the Energy Agencies could influence the institutional context in favour of renewable operators, as suggested by Schaltegger & Wagner (2011).

5.3.1.4 *Policies towards incumbent technologies*

Germany's decision to abandon nuclear power distinguishes it starkly from Britain and France. Moreover, there was a perception of substantial influence of the fossil fuel industry in the German context. Lobbying on the part of the fossil fuel industries was considered detrimental to the expansion of renewables in the country, with respondents G3 and G4 stating:

> *It is not a question of whether it is feasible to be 100% renewable….the question is how big is the incentive to be 100% renewable, because there are a lot of interests that will perhaps come out against it….Oil, coal….Now we have grown….we have become a competitor…..that's our problem, that we've become too big….There is no lobby group for solar. There is no lobby group for solar or for the renewable energies generally….In contrast to other lobbies, it is laughable…. (G3)*

> *In my view, it is of course interesting to bring in a tax…to create an incentive to produce less C02. On the other hand, lobbying for industry is very present in Germany. In Germany, there is always the argument that if the government started something like this, then this would lead*

to production being outsourced abroad. That is always the strongest argument in Germany. (G4)

G3 highlights the existence of interests that stand to lose from the expansion of renewables and suggests that, because of these competing interests, it will be difficult to shift completely to renewables, even though it would be feasible to achieve this transition. It is suggested that this is, partly, due to the minimal lobby power for the renewables industry in comparison to that which exists for the conventional fossil fuel companies that the participant believes are attempting to hinder the expansion of renewables. This perceived inequality in influence leaves the renewables industry at a disadvantage in influencing government energy policy and is, likely, to constrain the transition to the provision of energy completely from renewable sources in the view of the respondent. Lobbying, for instance, makes it less likely that measures like a carbon tax will be introduced, with German industry arguing that this would weaken its position against overseas competitors, as respondent G4 claims. This point links back to findings in the British context (see section 5.1.1.1) in which there was emphasis on the need for international action on adopting measures such as a carbon tax to address this argument about the need to protect industry from measures to reduce emissions. Unilateral action on carbon emissions is considered to penalise a country's domestic industry and, therefore, infeasible politically.

There was evidence of a more critical attitude towards nuclear power among German respondents in contrast to French and British participants. A more general ethical objection to nuclear was more apparent:

When you start to get involved a little with the technology….and we have already had experience…..not just Fukushima, but Chernobyl too…..what we inflict on the climate…..the waste…. (G8)

That is why the Energy Transition came about…..We had Chernobyl… (G2)

> *It is simple…when you see what happened in Fukushima, when you see what happened in Russia…when you see everything that can happen with nuclear power plants…there is no longer any question….The only question is how soon we forget about all that again…we of course forget it again…we should never forget. When we go down the wrong road….it always comes to bite us at some point….The question is not if, but when. What do you do with the waste….? (G3)*

> *When you work it all out, it's (nuclear power) not worth it…but it's not us who pay, but people in one or two thousand years. (G6)*

In the above comments, the reference to the Chernobyl and Fukushima incidents demonstrates the participants' concern that there are inherent dangers to nuclear power that are unacceptable in addition to the risks posed by the waste. This notion of the costs of nuclear being transferred into the future is expressed by G6 and reflects similar criticisms levelled by British and French entrepreneurs; this gives rise to concerns about inter-generational equity raised by Patzelt & Shepherd (2011) in section 2.2.2 of the literature review as a motivating factor of sustainable entrepreneurship. However, G3 expresses fear that this consciousness and concern about the dangers of nuclear could be ephemeral. This betrays a certain doubt, on the part of this entrepreneur, that the policy towards abandoning nuclear power will be sustained by the government. They believe there is a tendency in energy policy to fail to learn from past mistakes.

Although the participants above were critical of nuclear power, respondents G4 and G12 referred to the destabilising effect that the phase out of nuclear has had on the energy system and described unintended consequences associated with the policy to abandon this form of energy:

> *In Germany, we have the problem that…at night….when there is no solar power….and when the wind does not blow….we have to fire up the coal power stations….We have this big abandonment of nuclear power….and, ultimately the result is that we are bringing back the coal power stations massively….It has a flip side…This impression from Fukushima is, in my view,*

that it is not thought through properly…..I believe it is a good movement, but from the planning point of view…….it is not so advanced…..(G4)

We are obliged to sell solar and wind power in a daily period during parts of which negative prices occur...if at moment x enough power is available....when the coal plants are left on...power demand will be met from that source... (G12)

G4 discusses the difficulties caused by the intermittency of renewable power sources. At points of excess demand over supply, there has been reversion to coal power to make up the shortfall in the electricity supply caused by the loss of the reliable baseload power provided by nuclear. Preferably, the shortfall, at times of low renewable generation, would be compensated by natural gas, a cleaner fuel than coal, but, unfortunately, due to the merit order effect (Dickel 2014b), natural gas has too high a marginal cost to fulfil this role and coal is being used in its place. G12 alludes to episodes of negative prices in which the oversupply of renewables has led to such an overcapacity in supply that operators have had to pay to put power on the grid – this phenomenon has also been discussed by Gawel & Purkus (2013). They describe how coal power plants are not shut down in periods of low demand because they are inflexible; it is cheaper to let them run at a loss than to switch them off and then turn them on again. Nuclear power, with very low marginal costs, can withstand such periods of price volatility far better than natural gas plant operators with far higher marginal costs; they cannot function in periods of such price instability (Dickel 2014b). Therefore, in Germany, in the absence of nuclear power, coal has been used for back-up power as opposed to natural gas and this is, of course, very negative form an environmental point of view. G4 believes that the decision to phase out nuclear has not been thoroughly planned and this reflects British and French reactions to the policy, namely that it is overly hasty and politically motivated as opposed to grounded in facts (sections 5.1.2.2 and 5.2.2.2).

What is conspicuously absent from the interview data is discussion of how the abandonment of nuclear energy impacts on the market prospects of the energy entrepreneurs. It would have been reasonable to expect that a decision to phase out a major competing source of power would have been perceived as an opportunity by the respondents, but this does not appear to be the case. It is, possibly, attributable to the comparatively low share of nuclear in the energy mix to begin with, as illustrated in section 4.3.1. It could also be that the loss of nuclear in the short-term has led to a (temporary) renaissance of coal rather than generating greater market opportunities for the renewable operators.

German participants in the study had a greater affective response to nuclear power and this distinguishes them, to a large extent, from British and French entrepreneurs who were rather more ambivalent towards this form of energy. However, there was a perception that the policy to abandon nuclear power had problematic aspects and there was not a strong sense that this policy would be of benefit to the growth of their firms, at least in the short term.

5.3.1.5 *Reflections on the wider energy system*

Whilst there were hints of a movement towards self-sufficiency and users generating their own energy in the French interviews, this theme was much more evident in the German data. German respondents revealed perceptions that the energy industry was heading towards a new business model based on producing energy close to the point of use and users producing energy for their own consumption. Although this theme was present in the British and French interviews, it was more marked in the German data:

> *Perhaps we could design it in a more decentralised, intelligent way (G2)*

> *With renewables, it is about this decentralised.....working with the local authorities, towns…(G4)*

> *In PV, it is increasingly the case that those who install a PV appliance use this to supply themselves…..that is the biggest economic lever…..less so the feed-in tariff (G1)*

> *The Energy Transition is being driven forward regardless of the political situation here in Germany….by citizens and businesses that want to do it themselves….that can produce energy cheaper themselves (G8)*

G8, G2 and G4 suggest that localised production would foster the integration of renewable energy, as it is easier to reconcile supply and demand at a local level, with decentralisation a more intelligent approach, according to G2. This could be enabled by the increasing use of demand-side management and smart grids. In a similar vein, G4 advocates greater partnership with local authorities and towns to develop capacity and an energy strategy at a local level. Increasingly, according to G1 and G8, self-sufficiency is becoming the main incentive for the adoption of renewables and this could replace the feed-in tariff as the principal driver of the expansion of renewables in Germany, as it now costs less to produce one's own energy – this is perhaps even more so the case in Germany than in France, as electricity prices are higher in Germany.

In a similar respect to more localised, decentralised production, respondent G2 argues that having many, smaller actors is simply a better way of ensuring a more efficient energy market, with greater competition and more appropriate prices. This contrasts with a situation hitherto whereby a small number of large firms have dominated the market and set the prices:

> *The question is how do you create markets? How do you create competition? When you have two monopolistic providers, then they can dictate the price…When you allow many different actors on to the market, then you get different prices (G2)*

This issue to do with the social costs of monopolies is discussed in section 6.1.6. It could be that a greater diversity in the power market will lead to genuine competition and a better outcome for the consumer in terms of sustainability at an acceptable cost. As regards the extension of the electricity grid in Germany, respondent G3 was rather critical of this policy, arguing that it was unnecessary in the context of a model of energy provision based on decentralised, self-sufficient generation of renewable power. Ac-cording to the respondent's perspective, grid-based infrastructure is adaptable to the operating model of large renewable generators, namely centralised generation of renewable power in large plants which is then transported across long distances to the consumer.

The respondent goes on to suggest the incumbent utilities try to skew the *Energiewende* towards their own interests, reiterating the views expressed by respondents in section 5.2.1.2 that incumbents have become fearful of the competitive challenge posed by new ventures to their market position and they must now craft a new role for themselves in Germany's energy future. This has happened because the Emerging Davids have become "too big" according to the respondent; they have been a victim of their own success. It is this lobbying and the resulting political influence that are constraining renewables in Germany rather than the feasibility and viability of these technologies, according to the respondent. Similarly to a contribution by F5 in section 5.2.1.5 of the French data, respondent G3 accuses the incumbent utilities of playing a double game in which they are ostensibly acting against renewables whilst at the same time investing in green energy themselves:

> *RWE…..build the biggest installations for themselves…….whilst screaming and hissing…. on the other hand……interesting…you know….if the oil ran out tomorrow….ask me how long it would be before we would switch to renewables?(G3)*

This is akin to a hedging strategy for these firms. Other contributions highlighted the suspicion that there was a whole fossil fuel supply chain that was working counter to the progression of the *Energiewende,* with Bürgerenergie (citizen energy) perceived as a contradiction to their revenue model:

> *If it is about individual citizens, it's not in the interest of the energy utilities, because their business has up to now been supplying people with power and making a profit from doing so…The utilities are working in collaboration with the coal industry, oil industry, gas suppliers worldwide… (G14)*

G5 makes an interesting point about the political ramifications of the threat of Bürgerenergie (citizen energy) to the prosperity of large utilities, especially as they are important economically to certain states (and, of course, to the country more generally):

> *Up to now in Germany, we have had a monopolistic energy sector….we tried to bring SMEs in…that was very successful with the EEG…many businesses emerged…and, for a few years, the big guys laughed at it…and, now, they notice that this could be an existential threat to them….In North-Rhine-Westphalia…an SPD heartland….where E.ON and RWE have their headquarters and pay a lot of taxes and dividends…..they don't want SMEs, they want to keep these big guys…..That's the political issue… (G5)*

This underlines the complexity posed by the progression of the energy system's transformation in terms of the potential economic consequences. Although the *Energiewende* leads to new economic opportunities, it also causes economic disruption in the form of the decline of revenue and market share of utilities and, potentially, job losses. This could, of course, as respondent G5 states, lead to a reduction in tax revenue which could be particularly acute in certain states, like North Rhine Westphalia in which companies like RWE are particularly prominent.

As mentioned earlier in this chapter (see section 5.3.1.2), resistance to the Energy Transition on the part of the utilities is considered by entrepreneurs as a barrier to this further decentralisation of energy generation and, thus, the further diffusion of renewable energy in Germany.

Contributions reprised this idea that the Energy Transition was about a structural transformation in the energy industry. Such a transformation implied changes in the way in which markets are conceived:

> *In the energy sector, you are seeing the emergence of an electricity market, a mobility market and a heat market. From my point of view, these must become more integrated….Electricity-Heat-Mobility market….. (G8)*

Possible domination of the future mobility market by electric vehicles would lead to a greater symbiosis between the electricity market and the mobility market, as cars would be primarily powered by electricity. Integration would, therefore, appear sensible as there is greater inter-dependency among these three energy markets. In fact, respondents G8 and G3 emphasise that this structural change is the true challenge as opposed to the technology, with participant G14 proposing that energy storage is the cornerstone of integrating renewables into the energy market:

> *We already have solutions, the big problem is this structural change….the technical feasibility….the generation….that we have solved (G8)*

> *The nuclear plants that were developed twenty or thirty years ago…they were heavily subsidised by the state….This has been forgotten…that kind of money must now be invested in energy storage…all problems would then be solved…(G14).*

> *Let's look at how far the storage technology has developed. There are already really good storage devices….there are very promising options with batteries. There are possibilities to store energy in liquid form….the feasibility is not the issue, it is the interest…. (G3)*

> *The use of renewable power costs nothing, but the adaptation of the system….is very expensive….and that has driven up these power costs. (G7)*

Overcoming the system costs, to which respondent G7 refers, associated with this "structural change" is the main obstacle and the principal cost component of the Energy Transition. A possible way of enabling this structural change towards decentralised renewable energy provision in Germany would be to invest more heavily in storage – this appears to be a cornerstone in addressing this challenge of systems adaptation. Energy storage is far more prominent in the German data and this indicates that there is greater preoccupation in Germany with how renewables can be integrated into the market.

5.3.1.6 ***Public perception***

As in Britain and France, the German public could be seen as playing two roles in *the Energiewende*; as the electorate, they have to consent to the *Energiewende* policy and, as consumers, they must adopt renewable technologies. This adoption is either through installing micro-generative renewable technologies or through taking green electricity tariffs. This issue of the importance of public consent is highlighted by G6:

> *If we wanted to and were prepared to spend the money we could reach an energy mix with 50% renewables in Germany…it would be possible, but can you sell this? We are barely at 10% renewables and everyone says that electricity is already too expensive, then we cannot go to 50%. (G6)*

The ambition for renewables is constrained by the public acceptance of the cost associated with the expansion. As described in section 4.3.3, the cost of the support mechanism for renewables is levied from consumer energy bills and, as such, the public's willingness-to-pay will be decisive to the durability of the support mechanism. In recent years there has been controversy in relation to the EEG Umlage – the amount the support mechanism costs per kWh (Wiese 2015) and, as G6 states, it is important to consider how to "sell" the expansion of renewables to the public, so that there is greater acceptance of the costs of support. To reach a share of 50% of renewables in the energy mix, it may be necessary to socialise the costs entailed in such a shift to an even greater extent and to consider this as an investment in the country's future.

As regards consumer behaviour, respondents G8 and G2 contributed:

> *They've produced a TV that consumes less energy, but you have two or three TVs now….that means….that we have more and more electronic devices that are more efficient, but additional consumption negates this improvement.. (G8)*
>
> *Demand directs technology. The customers could say: 'I am only buying green energy. I am not buying coal or renewable energy any more…' So, only green energy would be promoted….When customers say: 'I only want green energy', then they influence demand….and that will be developed further…. (G2)*

G2 argues that consumers have the power to create pressures in favour of certain technologies, as producers have to fulfil the desires of customers and this illustrates the potential value of green marketing (Belz 2006) in orientating consumers towards more sustainable choices and, potentially, stimulating the further growth of renewables. It is possible that this change in consumer attitudes will have to be driven by social marketing in order to influence behaviour change in favour of sustainable consumption choices (Peattie, Peattie 2009).

Moreover, there will have to be change on the energy demand side, as G8 implies, if the progression of the Energiewende is to continue successfully. An interesting point about eco-efficiency is made by G8, namely that greater energy efficiency has been offset by an increase in the number of appliances and this relates to Petersen's (2003) contrast of eco-efficiency with eco-efficacy, in section 2.2.1. To facilitate the Energiewende, consumers will have to modify their behaviours to better manage their demand of electricity, to enable the integration of greater renewable power into the electricity market.

Germany's tradition of social market environmentalism, as described by Isaak (1998) in section 2.2.5, in which market forces must, to a greater extent, respect environmental protection (Schreurs 2002) means perhaps that environmental values are more embedded into the national consciousness in Germany. However, if the Energiewende is to be fulfilled, then issues to do with public willingness to pay and consumer behaviour are as pertinent as in Britain and France.

5.3.1.7 *Geopolitics as a driver of the adoption of renewable energy*

In contrast to Britain and France, Germany is more directly exposed to the immediate geopolitical crisis in the Ukraine, as Germany is more dependent on energy imports from Russia, with 36.7% of its gas imports coming from Russia in 2011 and 43% of its coal imports coming from Russia in the same year (International Energy Agency 2013). Although the impact of geopolitical crises on entrepreneurship in the renewable sector may be difficult to determine, as energy security operates at a national level, there was evidence of a view that the Energiewende led to opportunities to enhance Germany's energy independence:

> *The Energiewende means quite clearly independence from energy imports (G8)*

> *With our firm, we want this independence from abroad…..We want to deliver decentralised, small plants…..We want to get away from this global thinking and move towards decentralisation (G4)*

There is a starker link in German responses between the Energiewende and energy security. G8 argues that the Energiewende will result in less dependence on energy imports, with G4 advocating a move towards decentralised renewables as a better energy system for Germany, reducing exposure to the volatility of global events. This contrasts with British and French perceptions that were more critical of the Energiewende as, in fact, undermining German energy security and leading to greater vulnerability to energy imports, principally due to the nuclear exit.

Participant G6 made more direct reference to the Ukraine crisis and the way in which this might raise awareness about the risks of relying on external energy suppliers:

> *…What Mr. Putin is doing…it is becoming clearer to many Germans that this dependency carries a risk factor…which leads…in the medium term to all these things about energy security….It is not overnight, but it does lead you to think how you can reduce this dependency on external suppliers and, of course, going for renewables is a good idea. (G6)*

The respondent proceeds to discuss the ramifications of Russia denying energy to Germany and Middle East producers ramping up energy prices. The respondent suggested this energy security debate could bolster the case for expanding renewables. If the public started to perceive the severity of these risks, although this might be a rather long-term process and G6 implies that a disruptive energy shock may be necessary to mobilise public awareness of energy security and the role that renewables could play in reducing Germany's vulnerability to geopolitics.

Likewise, interviewee G14 stresses the need for energy independence in order to avoid an "energy war" with the likes of Russia and that this reinforced the case for expanding renewables:

> *…Geopolitically, I think it makes sense to become independent from energy suppliers like Russia or Saudi Arabia…arab countries…..I think the geopolitical situation should strengthen the interest in and efforts to develop renewables…this is about conducting an energy war….something the Americans always have in mind. No one wants to wage an energy war…It is more intelligent to be independent…(G14)*

The term "energy war" is powerful, as it emphasises the strategic nature of energy, with the possibility of countries using energy exports as strategic tool to exert pressure on others for foreign policy purposes. For example, Russia could use Germany's dependence on gas supplies to influence German foreign policy, as suggested by respondent B6 in section 5.1.2.2. G14 expresses the view that this geopolitical vulnerability will likely strengthen the case for renewables in Germany. G14 does not limit their discussion to Russia, but also alludes to the Middle East which reinforces the possibility that geopolitical concerns extend beyond the immediate crisis in Ukraine and are a more pervasive issue.

Participants recognised the value of their activities in achieving better energy security for Germany and this was especially important given the situation in Ukraine. This issue is of strategic interest, but is possibly rather abstract for new ventures and there is not yet full understanding of its meaning for their business models.

5.3.2 German participants' perceptions of foreign energy policy

In this section, the reactions of German participants to policy differences in the Britain and France are examined. Towards the end of the interview, German respondents were told about policy differences in Britain and France and asked for their reactions. As illustrated in chapter 4.3, Germany's Energiewende policy is distinct from that of Britain and France, given its non-nuclear nature and the strong presence of Bürgerenergie.

5.3.2.1 *Perceptions of British policy*

In general, the German respondents were rather critical of the distinct features of British policy, essentially the British Government's stance towards nuclear power and fracking. British nuclear policy was the most contentious issue for respondents G2 and G8 who high-lighted the risks of accidents:

> *I view it (British policy towards nuclear power) critically. How safe is nuclear power really?...It's not cheaper when you factor in the treatment of the waste….(G8)*
>
> *I see the dangers of nuclear power. That is not a good thing if nuclear power is being expanded. For me, it's too dangerous…Fukushima…The problem is that this technology…that has impacts over many years in the event of something going wrong, of an accident….there are effects for decades. Great Britain has responsibility for Europe….it's fine for Great Britain, but, if something goes wrong…there are effects for everyone in Europe (G2)*

G2 claims that British nuclear policy has externalities for the rest of Europe, as the consequences of an accident, such as radiation, would spread to neighbouring countries. Unintentionally, the respondent raises questions about the rationale behind the German nuclear phase out. If Germany is surrounded by Britain and France – countries which operate a substantial nuclear fleet – then, effectively, its nuclear phase out is partly invalidated, as Germany is still vulnerable to accidents in neighbouring countries despite having phased out its own nuclear power stations. This raises again the issue, featured in section 5.1.1.5, that energy policy is still made on national as opposed to European level; an abandonment of nuclear power, for example, makes sense only on a European Union scale in view of the externalities of one country's use of nuclear power to which G2 alludes.

Echoing criticisms of French nuclear policy in the British data (section 5.1.2.1), respondents G3, G1, G5 and G7 made reference to the transfer of part of the cost of nuclear power on to the public, reiterating the notion that part of the cost is concealed:

> *I would wonder…as a member of the public not even as an entrepreneur.....when everyone knows how dangerous these reactors are….everything that can happen….the unresolved issues….why these costs are being passed on to the public…, because there is a problem with the waste, with power generation, nuclear power is by far the most expensive that there is….I would also ask where the interests behind nuclear come from….and why I, as a member of the public, are funding them…. (G3)*

> *I have less fear about the operation of the plant….rather the unresolved waste issue….I consider it unfortunate to commission and build new plants if these problems have not been resolved (G5)*

> *I consider it wrong to use nuclear power…it is irresponsible to use a technology which produces a waste that you do not know how to handle……I think it is irresponsible for future generations….(G7)*

These indirect costs corresponded to the handling of the waste resulting from the generation of nuclear power, with the respondents above suggesting that there remained uncertainty as to how to deal with the waste properly. Problems to do with the management of nuclear waste featured more heavily in the German interviews than in the British and French ones. This could be partly because of the recent controversy regarding the storage of nuclear waste in Bavaria which has led to a dispute between the German Federal Government and the Bavarian State Government, with Bavaria reluctant to accept responsibility for handling the waste (Die Zeit 2015). Recurrent in the above comments is a feeling that these indirect costs are not factored into the evaluation of the case for nuclear power.

Participant G1 criticised Britain's mechanism for financing nuclear power, namely through the contracts-for-difference, arguing that it was distortive in that nuclear power operators required a high price to remain competitive given the decreasing costs of renewables:

> *They are only building plants if the government guarantees the price for 35 years….35 cents or something…and the tariffs rise with inflation..they want a guarantee with a high price, because the Energiewende means falling costs, because wind and solar have no real cost...(G1)*

In the British and French interviews, participants were more guarded about the potential of renewables to become central in the electricity market and more accepting of a greater role for nuclear power in the energy mix. In contrast, G1 is far more sanguine about the Energiewende's ability to lead to lower costs on the energy market and implies greater scepticism about nuclear power's role; in fact, providing guaranteed tariffs to nuclear providers, committing Britain to buying a set amount of nuclear power at a fixed costs, may even represent an opportunity cost in light of a context of falling energy prices thanks to the growth of renewables. This idea about opportunity costs associated with British energy policy is reflected in G14's contribution:

It's (the policy on nuclear) like a return to the stone age. If I know that nuclear power has all these unresolved issues and then say that I am going to build even more plants in the future….that doesn't make sense to me, because you have to invest "know-how" into energy sources of the future….and put everything in to finding new ways…rather than going back to old solutions (G14)

Britain's policy to return to nuclear power is a retrograde step, according to G14, and the investment in new nuclear plants undermines the Britain's capacity to develop new sources of energy – "energy sources of the future". This could be regarded as an opportunity cost inherent in British energy policy, as it may divert research and finance away from renewable energy technologies and storage.

In relation to Britain's endorsement of fracking, there was criticism of the potential environmental repercussions of the practice, principally in terms of pollution, with G4 warning that there was substantial uncertainty about its actual effects and claiming there is substantial opposition to fracking firms in Germany. G8 and G14 expand on the concerns about fracking:

Fracking has two aspects….a) it causes C02 emissions regardless of where the gas comes from and secondly runs huge risks in terms of ground water….chemicals being pumped into the Earth….I know that here in Germany, at least, that there is a broad opinion base that we do not need fracking…..I don't know what it's like in Britain…. (G8)

This fracking…has risks that even the scientists cannot evaluate…..its consequences, the resulting damage…that it will cause…..All these things, they favour the big utilities (G14)

These issues around public opposition and risks in relation to fracking were reflective of findings in the British data, covered in section 5.1.1.4. Respondent G6 was sceptical of the impact of fracking on their business model:

It (fracking) has no visible impact….in terms of money that they will get for their power….in Germany, that is fixed……so it doesn't matter if twenty of them are built….it makes no difference.(G6)

Since the revenue received by (most) producers is currently guaranteed, from a German perspective, the potential competitive threat of fracking to renewable operators is minimised. However, it remains possible that if renewables were competing with conventional energy sources on the market that fracking would be more problematic for entrepreneurs.

Overall, German entrepreneurs considered British energy policy on nuclear as irresponsible and inappropriate and voiced concerns about fracking.

5.3.2.2 *Perceptions of French policy*

Criticism was expressed by German entrepreneurs about the extent to which France was reliant on nuclear power and the destabilising effect that this dependence has on the French energy market:

> *I know that the French have enormous problems in the summer months to find customers for their nuclear power…..There are surpluses and the power stations have to be powered down….and they have to import a massive amount of energy from Germany. ..I have read about that….so I am critical of what French do…, but I am no expert…(G4)*

> *France has made the mistake of having an inflexible electricity production system…. France has relied so much on nuclear power…Nuclear power is really more useful for providing base-load electricity…You can't quickly turn nuclear power stations on and off….You cannot match nuclear generation to demand….because they have subsidised nuclear power….electricity is relatively cheap for the public…., so the public heat their homes a lot with electricity….that means, however, that, in summer, where there is practically no need for heating, there is a surplus of power….and when winter comes, and there is a lot of heating, France does not have enough power and must import this from Germany… In winter, France imports a huge amount of power from Germany, because they would freeze otherwise…., as the power stations are inflexible…(G1)*

Since it is very difficult to adapt nuclear power to varying levels of demand, France faces swings of energy surpluses and deficits and must, therefore, resort to imports of energy at points, as stated by the above respondents. G1 raises an important point, suggesting that nuclear is more efficiently used to provide base load electricity. For a renewable energy operator, it would seem that this idea has merit, as nuclear power could be used to compensate for the intermittency affecting renewable power sources. Therefore, nuclear power could, actually, be an effective partner, providing backup for renewable operators and aiding the market to function efficiently. However, as the above participants reflect, nuclear is simply too hegemonic in French energy policy. The artificially suppressed power prices, cause by nuclear power, have led to an over-reliance on electric heating and this means that, in winter, France is short of power and must import electricity from Germany. The participants imply that the reliance on nuclear power has made the French power system rigid and unadaptable to changing conditions.

Public opinion was perceived as being vastly different in France compared to Germany on the issue of nuclear power. Nuclear was seen as far less controversial in France where there has not been the level of opposition that is common in Germany and this has made the structure of French energy policy possible. This reinforces the role of culture in the energy debate and the manner in which cultural differences may reflect different choices in energy policy. A quote from respondent G6 illustrates this point:

> *"In France, as far as nuclear energy is concerned, there is a much greater public consensus that it is a safe technology. In Germany, it started to be viewed critically far earlier….In France, nuclear power is such a high share of energy provision and far less controversial than it ever was in Germany…..you know waste can be transported through the streets without police protection….such a thing would be unthinkable in Germany" (G6)*

In contrast, in Germany, there has been a long-standing scepticism regarding the security of nuclear power – indeed, there has been a tradition of protests against the transportation of nuclear waste through Germany. G3 and G14 emphasised the potential for the future expansion of renewables in France:

> *They (the French) look across the fence at us….what we are doing here…and, in France, it the expansion of renewables has begun….albeit not on the same scale…as a trial phase…it is perhaps a little under exploited…..but there are installations on the grid in France that show a lot of promise…. (G3)*

> *France has a huge west coast, there is limitless wind energy….tidal power…..it is being developed and there is intensive work being done on this….but to use this…France would be able to supply itself with power….and would no longer need nuclear power…They also have sun….are further to the south than Germany….so, they could at switch at least to the same extent as Germany. However, there, I think….EDF….the big utility….state-owned…we don't know what other interests are behind all this… (G14)*

France has substantial natural advantages, such as a large coastline, and there are, thus, significant opportunities to further develop renewables. However, implicit in the above comments, is that the growth of renewables in France has been somewhat suppressed, with alternative energy sources "under-exploited" (G3) and G14 claiming that increasing renewables is a good thing, but, ultimately, the French position is still too weak. Respondent G14 hints that this lacklustre development of renewables in France may be connected to the existence of the state-owned energy provider EDF which may have cause to protect the position of nuclear in France. This indicates that the dominance of nuclear power in France is perceived as having hampered the growth of renewables relative to Germany. Despite favourable natural conditions for renewables, there was recognition that France had disadvantages in increasing the diffusion of renewable energy. The French are starting from a low-base and G6, drawing on the German experience, believes that transforming the French energy portfolio will be a long process – Germany has been a first-mover in this respect and the transition to renewables is still very much a work-in-progress:

> *If the French are thinking about at some point moving away from this energy source….I think that's good, but the French cannot switch overnight to an energy portfolio made up 100% of renewables….This will have to develop over years…We have been doing it for years in Germany….The first solar plants came on line in 2002. We have had intensive massive support for renewables for around 12 years….and we are at just under 10%....It takes a while. (G6)*

Other comments in relation to French energy policy referred to the carbon tax and the pace of change in France compared to Germany. Participant G14 felt that the carbon tax introduced in France would simply not be suitable for Germany, in view of the difference in the electricity price between both countries:

> *The cost per kWh for the private consumer is half what it is in Germany….So, I think…to increase the price further through a carbon tax is inappropriate, because it affects consumers and not the big users…They probably get a discount with these arguments about international competition…the private individuals, private consumers would be the losers at the end of the day…(G14)*

A carbon tax may be inappropriate in Germany, given its high electricity prices, because, in the view of the respondent, price increases would fall disproportionately on consumers, with energy-intensive users enjoying protection from contributing to the tax. This may engender greater resistance to the Energy Transition and perceptions of unfair sharing of burdens between major polluters and ordinary consumers. Participant G7 claimed that French energy policy was, in fact, more sensible in that it prohibited fracking and, also, was a more gradual process. In Germany, the change was perceived as being too rapid and this idea is perhaps is represented by the current situation of drastic reforms and other perverse effects which have emerged in the German Energiewende:

> *That seems to be the right way….not to allow fracking…to cut down on nuclear power….support renewable energy. You don't have to do it as fast as in Germany….In Germany, it has been a bit rushed….we haven't taken the right decisions…..to go slowly in this direction, I think that is a good way…. (G7)*

From a German perspective, France has historical disadvantages in the transformation of its energy sector, stemming from its past decisions to focus on nuclear power and it appears that this makes the French context is less favourable to entrepreneurship in the energy sector, despite signs of increasing interest among French policy makers in promoting renewable power and reducing the dependence on nuclear energy.

5.3.2.3 *Perceptions beyond the initial country context of this project*

There was evidence of frustration at the effectiveness of attempts to regulate carbon emissions on a European level:

> *What we've never managed to get off the ground is emissions trading. It just doesn't work (G8)*
>
> *Do you introduce specific taxes for countries or do you create a pan-European emissions trading system?..... because it is mutual on a pan-European basis….because the wind carries C02 from Germany to Britain…..With a regional taxation system, the effect is still on a European level. A European solution would be better. (G2)*
>
> *The basic idea (behind the European Emissions Trading Scheme)is very good, it's just the implementation that has been disastrous……Those that have high emissions buy the bonds and continue as before… (G3)*

G2 emphasises that a carbon trading scheme must operate on a European level and be reciprocal, as the effects of climate change do not respect borders. A scheme, therefore, must reinforce collective action in the EU to address carbon emissions. G3 laments the way that the emissions trading scheme has been implemented, targeting the ability to exchange permits which weakens the integrity of the scheme, as countries performing poorly can avoid taking action by purchasing permits from countries that exceed their targets. The respondent implies that a more stringent scheme is necessary if credible progress on carbon pricing is to be achieved. This requires stronger action from the European Union. Although it may be that a stronger carbon pricing mechanism would be rather abstract for new ventures and would not have a direct impact on their business plan, it is possible that an indirect effect would manifest itself through the higher price of fossil fuels, making renewable technologies more competitive.

6 Overarching narratives and integration

In section 1.2, two of the aims of this study were stated as, firstly, exploring entrepreneurs' perceptions of green policies common to the three settings and, secondly, their perceptions of green policies unique to the other setting(s). Key narratives relating to these perceptions are analysed in section 6.1 and are constructed based on the findings and field notes from practitioner conferences which serve as triangulating sources of evidence. The third aim is to integrate the three cases and propose recommendations for the further expansion of energy entrepreneurship in the EU. Section 6.2 uses Foxon's (2013) Transition Pathways Framework to consider the entrepreneurial orientation of energy policy in the three countries. It also applies Vroom's (1964) Expectancy Theory to reflect on the influences on entrepreneurs in the energy sector. Finally, recommendations are made on the basis of this integration as to how to retain entrepreneurial activity in the energy sector and promote it further, even in a context of reduced support in the form of cuts to the support mechanisms (like the feed-in tariff).

6.1 Narratives emerging from entrepreneurial perspectives

From the seven themes in the findings chapter, eight particularly powerful narratives emerge which can inform the critique of energy policy in the three countries, presented in section 6.2.2. These narratives are enriched by the inclusion of field notes taken form practitioner conferences in Britain, France and Germany.

6.1.1 The global carbon framework

In order to be meaningful, the view was expressed that carbon reduction efforts must extend beyond the national level – they must be at a European or international level. Although mechanisms like a carbon tax, carbon price or carbon trading scheme seemed to be of limited direct relevance to entrepreneurial actors compared to the support mechanisms for renewable technologies, they have greater indirect importance in influencing investor confidence in renewables, as they increase the price of substitutes, namely fossil fuels such as coal, thereby increasing the competitive advantage of new ventures.

In the literature section 2.2.5, authors draw links between the price of fossil fuels and investor confidence in renewables. Bürer & Wüstenhagen (2009) have found that US investors are particularly sensitive to price signals, principally the price of oil; this may be different in the EU, owing to greater government intervention in energy markets. This is supported by Kenney (2012) who identifies oil prices a major determinant of venture capitalist investment in cleantech start-ups. De Vries & Tabner (2015) present a powerful argument that future fossil fuel prices are inherently uncertain and that, as such, investing in renewables is an effective diversification strategy and that, therefore, investment in renewables is still worthwhile despite the fall in the oil price. This is a pertinent point, but the dramatic collapse in oil prices which fell below $40 per barrel in the first quarter of 2016 may adversely affect the investment appetite in renewable energy projects. Falling oil prices have been compounded by the ongoing economic fragility in the EU and BRIC countries, with participants suggesting that in times of economic hardship, sustainability goals are sacrificed – indeed, the support mechanisms for renewable generation in the EU have been reduced partly due to fiscal contraction due to the debt crisis. Although very little power is generated from oil in the three cases, natural gas is a by-product of oil and the price of oil and natural gas (a serious competitor to renewable power) tend to be highly correlated. Moreover, to a degree, the oil price is a symbol of the health and availability of fossil fuels.

It is possible that stronger carbon pricing would help to release finance for renewable energy entrepreneurs. Leitner, Wehrmeyer et al. (2010) in section 2.2.5, emphasises the importance of regulation in bringing about more systemic, architectural environmental innovation, due to the greater degree of risk, complexity and investment associated with these types of innovation. They suggest that this may require "smarter regulation" embodied by mechanisms such as emissions trading. A carbon price and the consequences of a fall in the oil price appear in field notes in Table 6.

Table 6 Field notes on the global carbon framework

Antione Cahuzac, CEO of EDF Energies Nouvelles, speaking at French Renewable Energy Union Conference, Paris, February 2015	"C02 knows no borders. Initiatives cannot be solitary. We must work on an international basis."
Jean-Louis Bal, President of French Renewable Energy Union, speaking at French Renewable Energy Union Conference, Paris, February 2015	"The price of oil does not make our projections void. The falling oil price does not make it a more sensible choice – we must import it and there is no guarantee that the price will remain so low, this could be a temporary blip. The economic crisis has been accompanied by a climate debacle."
Podium Discussion at Low Carbon Scotland Conference, February 2015	"In terms of the impact of this crash in the fossil fuel price, there will be another rise. Looking towards 2050, there is a real problem with the overdependence on fossil fuels and this current drop in the oil price will not have much of an impact."
Jörn Leuschner, Richter GmbH, speaking at Lüneburg Energieforum, Lüneburg, September 2014	"The higher oil price was important for business: between 2008 and 2011, the oil price was significantly higher."
Chistian de Perthuis, Professor of Economics at Paris Dauphine, speaking at French Renewable Energy Union Conference, Paris, February 2015	"The value of the climate is zero, it is not included in our economic analysis. The challenge is how to attach a real cost to the climate…..We need a mechanism to attach a price to carbon regardless of where it is emitted. This is necessary to accelerate action against climate change.
Adnan Amin, Director General of the International Renewable Energy Agency, speaking at SER Conference in Paris, February 2015	"A carbon price would make renewables a much more cost-effective solution."
Ignacio Galán, Chairman of Iberdrola, delivering lecture "Global Energy Challenges: The Role of Renewables". University of Strathclyde, 4th of February, 2015	"There is a need for a carbon price mechanism to reinforce the European Emissions Trading Scheme."

Whilst there were those who stressed that the fall in the oil price did not weaken the business case for renewables, given the long-term uncertainty over the evolution of fossil fuel prices, Jörn Leuschner claimed that the higher oil price experienced a few years ago had been important to Richter GmbH, engaged in renewable heat. Higher oil prices perhaps motivated adoption of renewable technologies by consumers in the case of his firm. It is probably the case that fossil fuel prices have, at least, the potential to be an important factor in the expansion of renewable technologies. This is supported by other speakers, featured above, who call for a more effective carbon price as a way of accelerating the deployment of renewables. A stronger mechanism to price carbon would create far clearer economic rewards for investing in and developing low-carbon energy and, thus, break down the “green prison” (Pacheco, Dean et al. 2010), and overcome environmental market failure, described by Dean & McMullen (2007) in section 2.2.4 of the literature chapter. In support of this, Professor de Perthuis argues that a carbon price would effectively integrate environmental well-being into the decision making of economic actors whilst acting as a mechanism to deliver climate finance which has been rather elusive up to now. It is interesting to note that Ignacio Galán of Iberdrola, a utility with a high renewable generation fleet, calls for a carbon price to supplement the European Emissions Trading Scheme. For a utility generating renewables on a mass-market scale, a robust carbon price may have considerable significance for the market performance of this side of their business, as a small change in the market price applied over a large volume could, in aggregate, have a substantial effect on the business model. A carbon price, therefore, could stimulate the adoption of green energy by large utilities operating on the mass-market, accelerating the diffusion of renewable power. For new ventures, the impact of a carbon price would be at too macro a level and would be more relevant in terms of its influence on the behaviour of financial investors than its direct market impact.

Although a carbon price is not as important to new ventures as the support mechanisms for renewables, this is an instrument that policy makers could employ to mobilise finance for energy entrepreneurs, especially in view of the volatility of fossil fuel prices.

6.1.2 Corporate political activity and the public mind-set

In sections 5.1.1.6, 5.2.1.6 and 5.3.1.6, respondents comment on the public's role in the transformation of the energy sector. As stated previously, public support is important to the endurance of an entrepreneurial energy policy and the successful diffusion of renewable energy depends partly on the willingness of the consumer to adopt environmental innovation.

A recurrent theme in the three countries was the link between the economic climate and the public's commitment to sustainability and this is proposed, in section 7.6, as an avenue for future research. There was suspicion, especially in Germany and France, that lobbying has a pernicious effect on public opinion towards renewable energy. The French nuclear lobby was identified as especially strong by entrepreneurs from all countries and the drastic reforms to the support mechanisms for renewables in Germany were viewed as partly resulting from influence exerted by large energy utilities keen to stem the ascent of smaller operators in the energy market. Utilities have the resources to finance large, powerful lobbying activities whereas renewable operators lack this influence, although they do have their own representative bodies. Sühlsen & Hisschemöller (2014, P.324) warn that innovative energy firms that fail to invest in lobbying will likely have their needs overlooked by policy makers, claiming that political decisions are made in policy networks that "institutionalize and lead to conservatism and impair innovation" (P.324). Drawing on section 2.2.3, new ventures in the energy sector have an insurgent quality (Muñoz, Dimov 2011), as they must work counter to the existing institutional context which reinforces the position of incumbent actors, namely the fossil-fuel based utilities (Schaltegger, Wagner 2011). As Schaltegger & Wagner (2011) propose in section 2.2.3, energy and green technology clusters could assume the role of a lobbying force for the renewable energy sector, acting as a counterweight to the political activities of the utilities. According to Dahan (2005), public policy, or privileged access to it, is very much one of the bundle of resources from which firms' competitive advantage is drawn, with firms competing with each other to influence policy. Bonardi, Hillman et al. (2005) claim that firms are more likely to participate in corporate political activity when their business is dependent on the government and since the energy sector is highly regulated and contingent on the direction of policy, corporate political activity can be seen to have high importance. It can be said, therefore, that corporate political activity is important to new ventures' competitive advantage. Pinkse & Groot (2013) highlight the resource constraints preventing sustainable entrepreneurs from engaging in corporate political activity to gain access to policy makers and influence public policy.

Given the resource constraints, sustainable entrepreneurs often rely on "aggregators of political interest", such as industry associations, but these are often dominated by incumbent firms which frame the activities of these collective associations to correspond to their own needs; this is a pervasive struggle for entrepreneurial actors in the energy sector. Pinkse & Groot (2013) propose alternatives to this conventional route of corporate political activity which may be better suited to the capabilities and interests of the sustainable entrepreneurs. They suggest forming links with civil society actors, therefore "building alternative coalitions" and being active across several fronts at the same time to maximise influence. Sustainable entrepreneurs could develop unique and inimical capacities (Barney 1991) in a certain area and promote their venture, based on these capacities, as a solution to collective societal problems – the authors cite the example of a Dutch solar energy venture that enjoyed success in the political sphere thanks to its unique expertise in solar technology; its knowledge and expertise was a resource that it could promote as a contribution to a particular sustainability problem in order to acquire political influence (Pinkse & Groot 2013).

A principal obstacle that new ventures confront in the energy sector is their unfavourable position in corporate political activity. They may have to rely on industry associations and clusters to represent their interests despite the inherent problem of collective action to which Pinkse & Groot (2013) refers or develop alternative strategies to influence policy makers, as discussed previously.

Declining feed-in tariffs present new challenges in terms of motivating the continued adoption of micro-generative technologies. There are indications in the findings of a producer-consumer dissonance in which the public exhibit a far greater willingness to produce renewable electricity in return for a fixed feed-in tariff than to adopt green electricity tariffs. Under green electricity tariffs, “the electricity supplier guarantees that all or part of the supply of electricity has been generated using renewable energy technologies” (MacPherson, Lange 2013). Macpherson & Lange (2013) and Diaz-Rainey & Ashton (2011) find a disconnect between support for renewable energy and the adoption of green electricity tariffs, with uptake far stronger in individuals who belong to the highest income quartile and who have completed tertiary education. In addition, they find that membership of the Green Party is an important predictor variable. Their findings indicate, however, that active green consumer behaviour in the electricity market is rather limited to niche markets. The wider diffusion of green energy depends on breaking out of these niche markets, as Belz & Binder (2015) suggest. The field notes below in Table 7 are relevant both to public opinion and the consumer side:

Table 7 Field notes on corporate political activity and the public mind-set

Bertrand Picard, Solar energy entrepreneur, speaking at the French Renewable Energy Union Conference in Paris, February 2015	"We have lost the public who think that the problems are too enormous, too costly. A pessimism has been created."
Rainer Baake, State Secretary at the Federal Ministry for Economic Affairs and Energy speaking at the French Renewable Energy Union Conference in Paris, February 2015	"The ability of the public to earn money in producing electricity has heightened public support for the EnergieWende."
Podium discussion at Lüneburg Energieforum, Leuphana University, Lüneburg, September 2014	"The EnergieWende is being throttled down. We see that the old energy economy again…Old players have gained in influence. Costs, costs, costs…has been planted in the minds of citizens….This is due to the existential threat that the old players face due to the decentralisation of energy provision"
Helmut Jäger, Founder of Solivs GmbH (Renewable Heat), speaking at Lüneburg Energieforum, Leuphana University, Lüneburg, September 2014	"We have to wait until energy prices rise again, because we are a bit like frogs in water – in other words, consumers get used to higher oil and gas prices and tolerate these rather than turning to renewable energy."
Jörn Leuschner, Richter GMBH (Renewable Heat), speaking at Lüneburg Energieforum, Leuphana University, Lüneburg, September 2014	"We need a boiler scrappage scheme…..like the car scrappage scheme that operated during the financial crisis…This would drive our business forward"
Leonora Holling, Legal Adviser to the German Energy Consumer Alliance, taking part in a podium discussion at the Lüneburg Energieforum, Leuphana University, Lüneburg, September 2015	"What does green electricity mean? The green electricity mark does not necessarily mean that it is green, it is too abstract. People are primarily concerned with the price and green electricity is more expensive."

In Germany, the field notes illustrate a sentiment that the pace of the *Energiewende*, is being reduced partly because of the influence of the "old players" who are perceived as having succeeded in shifting public attitudes against the transformation, through focusing on costs associated with the expansion of decentralised, citizen energy. In concert with comments in the German interviews (section 5.3.1.2), it was suggested that the incumbent firms were stoking such concerns relating to costs in order to stymie the expansion of decentralised energy which they perceive as a threat to their market share. Indeed, Bertrand Picard refers to pessimism among the public to do with an assumption that sustainability is costly, with this undermining consent to green policies; in the public mind-set, there is a danger that the discourse on costs starts to prevail over the potential opportunities within sustainable development.

Rainer Baake attributes the high public support for renewables in Germany to the ability of Germans to earn money in generating renewable power, suggesting that the greater the citizen engagement in the transformation of the energy sector, the greater their commitment is likely to be. Feed-in tariffs are, therefore, seen as an effective instrument in mobilising public support for sustainability efforts. If the *Energiewende* offers such opportunities to the public and to entrepreneurs, it may lessen resistance to the cost of financing the support mechanism.

In relation to the consumer side, the field notes reveal frustration among entrepreneurs with the pace at which consumers adopt green technology. The metaphor comparing consumers with frogs in hot water is particularly effective in illustrating the manner in which it was felt that consumers tend to adjust to the higher prices of fossil fuel based technologies rather than proactively seeking out renewable alternatives. This could be to do with the annual savings in energy bills being insufficient to incentivise consumers to invest the capital in, especially, renewable heat technologies in return for a long-term benefit (Scarpa, Willis 2010). The feed-in tariffs do not apply to renewable heat technologies in France and Germany, although there is a feed-in tariff for renewable heat in Britain, as stated in section 4.1.3. Despite the financially attractive terms of the feed-in tariff for renewable heat, Snape, Boait et al. (2015) have found that, in the early phase after rollout, uptake has been dramatically below expectations made by the Department for Energy and Climate Change. They attribute this to non-financial barriers, stating that consumers' adoption was very sensitive to a "hassle" factor - beyond a certain threshold, adoption fell away and administrative requirements such as environmental assessments were contributing to the reaching of this “hassle” threshold beyond which willingness to adopt declines. The ease with which the average consumer can shift to green energy is essential.

There may be other non-financial barriers behind the producer-consumer dissonance. Leonora Holling, participating in a podium discussion at the Leuphana Energieforum, attributes the slow uptake in green electricity tariffs to both cost issues, claiming that green electricity tariffs are more expensive in relation to conventional tariffs, and also mistrust. She suggests that consumers often doubt the integrity of green electricity labels, with a perception among consumers that the “green tariff” did not always correspond to “green electricity”, with consumers lacking trust that “green tariffs” always corresponded to an increase in the production of green power. A green tariff is distant from consumers who feel that they cannot verify that taking up a green tariff contributes to an increase in total renewable power produced. Abold (2011) recognises this difficulty, describing energy as a “low involvement product” for consumers, as it has “no colour, no taste and no smell (P.263). This contrasts with other more tangible green products, such as organic food. Pastakia (1998) emphasises the need to develop trust around the sustainability credentials of environmental innovations through creating mechanisms to verify the integrity of claims made by actors regarding the environmental performance of their products or services through creating mechanisms to verify the integrity of claims made by actors regarding the environmental performance of their products or services. It is possible that a stronger audit and quality mark system relating to green energy tariffs would increase the credibility of green electricity tariffs among the public and incentivise greater uptake.

There is a perception that appears justified that consumers are slow to change their behaviour and that energy innovations struggle to break out of niche markets – addressing this problem could form part of an ongoing strategy to promote entrepreneurship in the energy sector through targeting the consumer side. An intriguing suggestion is made by Jörn Leuschner that the government introduces a boiler scrappage scheme similar to the car scrappage scheme introduced in a number of EU countries as a response to the recession that broke out in the wave of the financial crisis of 2008. Such an initiative would incentivise consumers to replace inefficient boilers. The analogy with the financial crisis is insightful – at that point, governments provided grants for car scrappage as a response to the economic crisis affecting the automotive industry. A similar initiative applied to boilers would be a response to the environmental crisis in which we find ourselves. Indeed, renewable heat alternatives could be promoted to replace older boilers that are being scrapped under such a scheme. Initiatives like this might accelerate consumer uptake of eco-innovation. However, bearing in mind the difficulties featured in the previous section regarding incentivising consumers, it is important that such schemes are well-designed – this idea is taken further in section 6.2.2.

The importance of inculcating sustainability into the public mind-set links to this notion of environmental entrepreneurship being embedded in society (Anderson 1998). If society values environmental well-being, there will be markets for the eco-innovative goods and services launched by entrepreneurs (Anderson 1998) thanks to enhanced environmental consumption norms (Meek, Pacheco et al. 2010). Amplifying these consumption norms may be especially important for “high involvement products”, as described by Jansson (2011), and renewable energy would certainly come under this category. For entrepreneurs, the issue extends beyond environmental consumption norms; they are concerned with the extent to which the public are willing-to-pay to support the transition to sustainability, in terms of the cost of financing the support mechanisms, levied from energy bills. There is a view, among entrepreneurial actors, that this public support is vulnerable to a negative narrative renewable energy technologies motivated by fear of the growth of this technology and its power to displace current structures.

In order to help new ventures break out of niche markets, having strong representation would be valuable, primarily in ensuring high levels of public support for renewables. For new ventures, however, they lack the resources to do this and must rely on collective organisations to gain representation. Institutions like the German Energie-Agenturen, featured in section 5.3.1.3, may offer a useful model as to how to better organise PR for the renewables industry. Engaging the public in the transformation of the energy sector may also be valuable in building consent; supporting decentralised generation is a way of doing this. However, there is also a need to tackle the barriers that might be slowing the adoption of green energy technologies among consumers.

6.1.3 Support mechanisms and the transition to a post-support context

In all three cases, the feed-in tariff is perceived as pivotal to the flourishing of entrepreneurial activities in the renewable energy sector. The principal benefit of the feed-in tariff has been the certainty that it has brought; entrepreneurs engaged in power generation activities are guaranteed to sell the power that they produce and they know what price they will receive for that power for a given period of time, usually between fifteen and twenty years. Crucially, the smaller actors have fewer resources to withstand market risk, so a mechanism which minimises this risk has removed entry barriers for entrepreneurial actors. Moreover, entrepreneurs stress the way that stable returns thanks to feed-in tariffs have enabled access to external capital. This is especially important given the volatile nature of the energy market and correspondingly unstable power price. The context of the economic downturn and the ongoing absence of a serious mechanism for attaching a price to carbon beyond fairly perfunctory and standalone carbon tax schemes have exacerbated the impact of this market volatility.

The feed-in tariff has been a victim of its own success in that it has been so effective in incentivising uptake that its costs have grown to become rather significant and this has led to pressure to reduce the tariffs. Germany has among the highest electricity prices in the EU (Eurostat 2015a) and there have been growing concerns about the cost of the support mechanism to the consumer and the possibility that high electricity prices could undermine the economic competitiveness of German industry (Wiese 2015). Likewise, in Britain, following the impact of the recession and increasing austerity, the Government took on an ever more negative tone towards green levies and taxes, part of which were dedicated to financing the feed-in tariffs, with David Cameron even describing such initiatives as “green crap” (Carter, Clements 2015). This has been accompanied by a cut in feed-in tariff rates for PV of two thirds in 2016 (Department of Energy & Climate Change 2015).

The importance of mechanisms like the feed-in tariff relates back to the motivations underlying environmental entrepreneurship. In section 2.2.2, authors in the sustainable entrepreneurship field distinguished between economic drivers underpinning entrepreneurial activity and environmental values that may influence entrepreneurs. Linnanen (2002) and Pastakia (1998) categorise environmental entrepreneurs according to whether their motivation is primarily “economic” or to effect social and environmental change. With regards to energy entrepreneurs in this study, the social and environmental motivations may have played a part, but, it does appear that the feed-in tariff has in many cases acted as the catalyst for their entrepreneurial activities. This follows Walley’s & Taylor’s (2002) innovative opportunist characterisation, with the support mechanisms perceived as a market opportunity. That is not to say that an element of the visionary champion, seeking to overhaul a dysfunctional energy system, does not exist within their mind set, but the pecuniary motivation appears instrumental in stimulating entrepreneurial activity and achieving environmental change is contingent on the existence of a viable business model. The feed-in tariff has given rise to a viable business model. Relevant field notes are shown in Table 8:

Table 8 Field notes on the support mechanism

Michael Liebreich Chairman of Advisory Board at Bloomberg New Energy Finance, speaking at the French Renewable Energy Union Conference in Paris, February 2015	"The retrospective change to policies, such as the support mechanisms is a big problem."
Jean-Louis Bal, President of French Renewable Energy Union, speaking at French Renewable Energy Union Conference in Paris, February 2015	"The lowering of the feed-in tariff is not justified by the volume of generation connected to the grid. The industry is also suffering from the irregular nature of tenders for large-scale renewable generation in France."
Note 3 (Arnaud Mine, Co-founder of Urbasolar), Speaking at SER Conference in Paris, February 2015	"The delay between tenders has been long – two years. The moratorium on feed-in tariffs was a rather blunt move. The development of tariffs for generation under 100KW has been illogical. There is a need to overhaul the support mechanisms."

The field notes refer to problems with the feed-in tariff instrument and are from the French Renewable Energy Union Conference in Paris, 2015. Although they relate to the French context, they have relevance for all three countries. Whilst the feed-in tariff is a good instrument for stimulating entrepreneurial activity, the remarks are critical of its implementation. In addition to retrospective changes to the support mechanisms which undermine their credibility, the comments above target the erratic nature of the French feed-in tariff which has caused market instability for actors in the sector. This raises the issue of how to better manage the support mechanism, so that it evolves in a way consistent with establishing a stable framework for new ventures engaged in renewables. Although the comments target the French feed-in tariff mechanism, they apply to Britain and Germany too.

In introducing support mechanisms, policy makers in France, Germany and Britain have formed protected niche markets for new ventures (Jacobsson, Bergek 2004). The reforms to the support mechanisms in the three countries outlined in sections 4.1.3, 4.2.3 and 4.3.3, mean the partial withdrawal of this “protection”. It is crucial that the transition to a post-support context for renewables is managed well and, as support mechanisms are pared back, there must be consideration as to how *Emerging Davids* and *High Growth Davids* (Hockerts, Wüstenhagen 2010) can modify their business models to adjust to the new market conditions.

Risks associated with the reformed mechanisms, namely the contracts-for-difference scheme in Britain and France and the direct marketing and tenders in Germany were perceived as considerable. This was primarily because of anxiety that new ventures would be less able to absorb the sunk costs involved in participating in a tender (administration, connection to the grid etc.) if they are ultimately not awarded a contract on completion of the process. In the case of the UK, the Renewables Obligation Certificates are subject to volatility in their value, but, at least, there is no competitive element as with the contracts-for-difference scheme. The feed-in tariff is a far more stable framework than the new market-orientated mechanisms.

Although the change in support mechanism will apply to large-scale generation in Britain, market-orientated mechanisms will replace the feed-in tariff from rather low levels of generation in France and Germany. German respondents were apprehensive about these changes, claiming that they will be very detrimental to the grassroots “Citizen Energy” movement, driven by smaller, independent energy generators. Indeed, there is suggestion that the reforms are a means of arresting the expansion of "Citizen Energy" in Germany, with utilities fearful of the continued erosion of their market share. Utilities like E.ON and RWE appear to have underestimated the ascendance of decentralised renewable energy in Germany and there was suggestion that reforms to the support mechanism would aid them to regain advantage over the entrepreneurial operators, christened by Hockerts and Wüstenhagen (2010) as "High Growth Davids". In the German context, there is a real danger that the restructuring of the support mechanisms will be detrimental to the "Citizen Energy" movement, as smaller actors may be unable to cope with the uncertainty inherent within the scheme and the administrative burdens associated with participation.

French respondents have experienced particular challenges due to the presence of the "nuclear rent" and place particularly strong emphasis on the need to protect their particular market niche. An excellent metaphor from a French respondent was that renewable energy firms, like theirs, were going through the "adolescent" phase. "Adolescence" connotes the *High Growth Davids*, gaining in power and professionalism, but still vulnerable if fully exposed to market forces, principally the price of energy; paring back the support mechanisms at this point of energy price fragility could prove detrimental to entrepreneurial activity in the British, French and German energy industries.

There is evidence that respondents are increasingly thinking in terms of new business models based on self-sufficiency whereby it is worthwhile for consumers to adopt renewable energy to meet their own needs and become less dependent on conventional energy sources. However, the energy market remains unpredictable – Helm (2014) highlights that the global economic slowdown, Eurozone crisis and rise of unconventional sources of gas have challenged assumptions made about continually rising fossil fuel prices and an approaching energy crunch upon which he claims the EU Climate and Energy Package was predicated. There is still a strong case for diversifying the energy mix, as future energy prices are unknowable (De Vries, Tabner 2015), but the retreat of the support mechanisms is problematic at this time of energy market volatility.

The reforms may undermine investor confidence in the sector, making it more difficult for entrepreneurs to secure external finance. Respondents emphasised the reliability of returns which the feed-in tariff had guaranteed, reassuring investors of the security of their investment and this is supported by Bürer & Wüstenhagen (2009) and Hofman & Huisman (2012), underlining the attractiveness of these policies from an investors' perspective. In a more difficult investment climate, moving to a position in which renewables have to be more self-sustaining, new ventures may have greater recourse to alternative finance sources, such as crowdfunding which is recognised as an emerging part of the entrepreneurial finance landscape (Harrison 2013) – crowdfunding is discussed in the next section (6.1.4).

The field notes in Table 9 make reference to the evolution in the support for renewables in Britain and Germany (as in these countries the shift is most dramatic). Rainer Baake illustrates the complexity facing policy makers – in section 6.1.2, he attributes high public support to the feed-in tariffs giving rise to opportunities for the public to earn revenue from the Energiewende and participate directly in energy production. However, if the cost of the support mechanism rises to too high a level, this will lead to resistance on the part of the wider public and a loss in support for renewables. This demonstrates the difficulty of managing different stakeholder needs in the Energiewende.

Table 9 Field notes on support mechanism reforms

Rainer Baake, State Secretary at the Federal Ministry for Economic Affairs and Energy, speaking at French Renewable Energy Union Conference in Paris, February 2015	"With the fall in the cost of solar panels, Germany made up 50% of the market for solar panels. This was becoming a huge financial burden, so there was a need to reduce investment to prevent the costs becoming prohibitive and the loss of public support"
Ignacio Galán, Chairman of Iberdrola, delivering the lecture "Global Energy Challenges: The Role of Renewables". University of Strathclyde, 4th of February, 2015	"Argued that market-based approaches, involving the progressive integration of renewables into the energy market were the best approach. The best mechanisms were incentives with minimal intervention, such as green certificates and carbon pricing mechanisms."
Podium discussion at Lüneburg Energieforum, Leuphana University, Lüneburg, September 2014	"The EEG Reform undermines big successes of the *Energiewende*. The *Energiewende* has been bottom-up and there is the danger that the reforms will jeopardise "Citizen Energy".
Presentation by Thomas Schomerus at Lüneburg Energieforum, Leuphana University, Lüneburg, September 2014	"This (the reforms) will really disadvantage "Citizen Energy". What will the entry requirements to participate in tenders be? This has not been resolved. Those that are unsuccessful in obtaining a contract will not receive any support. Who can afford that? By and large, the big players. That is the theme here – the big players are back in business."
Presentation by Julia Verlinden, Green MP in German Parliament, speaking at Lüneburg Energieforum, Leuphana University, Lüneburg, September 2014	"Direct marketing means that revenues are more uncertain and the financing costs for projects rises. The "Citizen Energy" movement will have greater difficulty in future: up to this point, citizens have been responsible for half of the installed renewable energy capacity. Greens propose that there should be no direct marketing for projects generating less than 500KW or 3MW for wind energy projects. Projects under one MW or six MW for wind energy should not be expected to participate in tenders"

However, there remains fierce criticism, within the field notes, that the German reforms are too drastic, with experts commenting that measures such as direct marketing and the tenders are inappropriate for entrepreneurial actors. This reinforces similar comments made by interview respondents in section 5.3.1.2. Professor Schomerus remarks that these reforms appear to be advantageous to large players at the expense of smaller operators, as the former are better able to manage the administration and risks which the new system entails. This resonates with findings from the extended interviews, in which entrepreneurs believed that the EEG reforms were partly motivated by fears that the growth of “Citizen Energy” posed an existential threat to incumbent utilities and that these market-orientated schemes offered a way for the large players to strengthen their position in the market.

Ignacio Galán, chairman of *Iberdrola*, a utility with a substantial renewable power portfolio, favours market-orientated approaches involving “minimal intervention”, such as green certificates and carbon pricing, as opposed to more extensive instruments like the feed-in tariffs. For a mass-market operator, like *Iberdrola*, mechanisms like carbon pricing are more consistent with their business plan based on the large-scale generation of power – a small increase in competitiveness thanks to a carbon price would make a large difference for a company operating at such a large scale of renewable generation. In contrast, for entrepreneurial actors, these schemes based on minimal intervention would not change the rules of the game sufficiently to make a significant impact on their business plan and to convince financiers that they are a secure investment. Minimal intervention mechanisms, like carbon pricing, would form a key part of an energy strategy focused primarily on the deployment of renewables by incumbent firms.

Julia Verlinden recommends that the obligations to do with direct marketing and tenders should only apply beyond a certain generation threshold in order to protect the entrepreneurial actors in the sector, reiterating the difficulties this could pose in terms of unpredictable revenues and securing external finance. If adjustments were made, this would protect entrepreneurial actors – she emphasises how much *Citizen Energy* has contributed to the transformation of the German power sector up to this point. Her advice could be directed at policy makers across the three countries. France has introduced German style reforms and the insights from Germany could be highly useful for the French Government.

If policy makers wish to retain the "entrepreneurial flavour" (Wüstenhagen, Wuebker 2011) of energy policy, they should reflect on the extent of the reforms to the support mechanisms and consider whether there are possible safeguards which could protect entrepreneurial actors. This could be accompanied by efforts to help renewables to become more self-sustaining – through tackling the consumer side, as discussed in section 6.1.2

6.1.4 Sustainable entrepreneurial ecosystem/Industrial ecology

Cohen's (2006) model of a sustainable entrepreneurial ecosystem, introduced in section 2.2.5, is a good framework for understanding the elements that should be in place to nurture a vibrant context for environmental entrepreneurship in a geographical setting. This ecosystem revolves around three core elements: green clusters, public R&D for environmental technology and support to facilitate access to finance or direct provision of finance for green entrepreneurs. Britain, France and Germany have elements of such a system, but emphasise different features. It is suggested that France and Germany offer more extensive up-stream support in terms of R&D programmes, British respondents attributing this to a perceived comparative advantage over Britain in engineering. In spite of possible weaknesses in engineering capacity, Britain was viewed as a good place for the commercialisation and financing aspects of the renewable energy industry, owing to its strengths in financial and services. There is a potential danger, however, for Britain in not investing sufficient resources in the up-stream activities, related to the manufacturing side of renewable energy technologies, as this is where substantial value added can be captured. In contrast to France and Germany, there was criticism at points in the British data of a failure to develop a domestic renewables industry, especially an industrial base, and the opportunity cost that this implies.

Finance remains an obstacle for entrepreneurial actors across the three countries. The French framework for crowdfunding is impressive and the way that the French Government envisages a role for crowdfunding in the Energy Transition could be insightful for policy makers in Britain and Germany. Harnessing the power of the public in financing green energy could be a valuable additional aid for environmental entrepreneurs and also serve to improve public support for renewable energy projects, particularly in instances where these are more contentious, such as wind farm installations.

Certain authors in the literature (Tagar, Cocklin 2010, Audretsch, Grilo et al. 2007) focus primarily on the manner in which structures like clusters and incubators foster collaboration and knowledge sharing. Lindhult (2011) proposes that they could adopt "additional functions" involving lobbying, communication and education – which he describes as "market development activities". It is suggested that these market development activities are not, in fact, "additional", but integral to the work of incubators and clusters and will gain in importance as energy ventures operate in a market with reduced support, with market growth having to become more self-sustaining. According to Meyskens & Carsrud (2013), in section 2.2.5, partnerships between nascent green ventures and the public, not-for-profit, education and private sectors, fostered the growth of the ventures, but did not influence sustainable development or innovation. This may indicate that environmental sectors present different challenges partner organisations, such as business incubators, and that these organisations must endeavour to act on the sustainability and innovation sides as opposed to only striving to help new ventures to grow in size (see also field notes in Table 10).

Ségolène Royal alluded to public sources of finance, namely the two financial institutions with the promotion of green energy in their remit. The Banque Publique d'Investissement was established in 2013 to provide financing, partly due to the difficulties in obtaining external finance in the aftermath of the financial crisis and, unlike the UK's Green Investment Bank, has placed greater importance on dedicating financial support to SMEs and "intermediate size" firms (Banque Publique d'Investissement 2014). Part of its mission is to promote innovation that responds to needs not met by the market and, as such, eco-technologies and the Energy Transition are strategic priorities – the bank provided 156 million euros of risk capital for SMEs in the sector in 2014, with a classic example being 7.5 million euro investments in two eco-technology companies, one of which manufactured wind turbines (Banque Publique d'Investissement 2014).

Table 10 Field notes on sustainable entrepreneurial ecosystems

Ségolène Royal, French Minister of Sustainable Development, speaking at French Renewable Energy Union Conference, Paris, February 2015	Discussed *Banque Publique d'Investissement* equipped with 5 billion euros in addition to the *Banque de la Transition Energétique*
Emmanuel Julien of SERGIES (a French Renewable Energy Company), speaking at French Renewable Energy Union Conference, Paris 2015	Discussed three renewable energy projects financed by crowdfunding through the use of a crowdfunding platform. This allows citizens to get involved in the Energy Transition. There is resistance to crowdfunding, a feeling that it is complex, but it is not.
Jean-Louis Bal, speaking at French Renewable Energy Union Conference, Paris, February 2015	Companies and SMEs can exploit export markets with the help of the state, but this depends on a stable and growing domestic market. Support and help with exporting is part of the government's strategic role.

Within the literature, substantial attention is given to the relative difficulties in obtaining venture capital for environmental entrepreneurs (O'Rourke 2010, Randjelovic, O'Rourke et al. 2003) and, specifically, for renewable energy entrepreneurs (Bürer, Wüstenhagen 2009, Hofman, Huisman 2012). However, there is a tendency to overlook the needs of SMEs, corresponding to Hockerts' & Wüstenhagen's (2010), High Growth Davids that are seeking risk finance for ongoing projects. Policies such as Britain's Green

Investment Bank generally operate at too large a scale for such firms, whereas venture capitalists are seeking opportunities for investing in start-ups. A system such as the French Banque Publique d'Investissement seems to more likely to cater for this important group of firms in addition to financing large-scale projects.

Kenney (2012) expands on the shortcomings of venture capital as a means of financing energy ventures, stressing that the energy sector has starkly different characteristics to the high tech sector in which venture capital has experienced great success with certain start-ups that have yielded massive returns for investors. Energy does not offer the same opportunities as the high tech sector to make exponential returns quickly (Kenney 2012), entailing longer processes of technological development and commercialisation (Marcus, Malen et al. 2013). Ultimately, Marcus, Malen et al. (2013) reinforce O'Rourke's (2010) point in section 2.2.5, by saying that venture capital investments in energy require longer commitment times at both the stage of technology development and commercialisation. It may be that, in view of these differences discussed above, that venture capital will always be insufficient for energy entrepreneurs. This demonstrates the need for public financing options similar to those available in France that are targeted at entrepreneurial actors in the sector. This accompanies the growth of alternative financing routes, such as equity-based crowdfunding, discussed by Emmanuel Julien of SERGIES above.

Interventions to foster a sustainable entrepreneurial ecosystem are often influenced by a country's wider industrial policy which may be driven by where its comparative advantage lies. A good entrepreneurial ecosystem will ensure that R&D schemes and public venture capital are accessible to smaller actors. Moreover, a legal framework conducive to citizen lending (through crowdfunding), such as that which exists in France, appears promising.

6.1.5 Role of nuclear power and shale gas

The starkest contrasts among the three settings lie in the position taken towards incumbent technologies, especially nuclear power. As stated previously, UK and French policy is more orientated towards nuclear power whereas Germany has pledged to be nuclear-free by 2022. It is proposed that this area of policy is complicated, as it entails striking a balance between the danger of nuclear and shale crowding out eco-innovative renewable technologies on the one hand, and the potential value of these forms of power in balancing green energy in the transition towards a low-carbon power sector.

For British and French respondents, nuclear power was not, generally, perceived as inherently inimical to the expansion of renewables. It was, rather, the lack of transparency over the costs of nuclear that concerned French and British participants; they simply wanted to compete on equal terms with nuclear power. It is not the fact that energy policy includes a future for nuclear power; it is, rather, the extent to which nuclear power is favoured over other renewables that is a preoccupation for entrepreneurial actors. In France, the dominance of nuclear power has depressed energy prices and this was regarded by respondents as having constrained the market prospects for renewables. Likewise, the formidable French nuclear lobby was seen as acting against the expansion of renewable energy for fear of renewables infringing on its market share and this is perhaps symptomatic of the over-dominance of nuclear power in the French context.

Nuclear power was regarded as an energy source which could co-exist with renewables in the transformation of the energy sector. In balancing renewable energy sources, currently affected by problems of intermittency, nuclear would, ultimately, form part of a balanced energy portfolio and could, even, enable the transition to renewables if used in appropriate quantities. British and German criticism of the hegemony of nuclear power in

France focuses on its opportunity costs; the artificially depressed prices were seen as an entry barrier for eco-innovative renewable energy. Indeed, this was felt to have led to France not exploiting its renewable resources fully, risking becoming laggard in green energy. Britain runs the danger of nuclear power jeopardising the growth prospects for renewables – at points French respondents warned that although the UK market was attractive at the moment, shale gas and nuclear cast a shadow over the future. This is perhaps reminiscent of their experience in a market dominated by nuclear power. Nuclear power and renewables may not be mutually exclusive, but a balance between the two must be found.

Nuclear can complement renewables – France will have the experience of having to integrate both sources of energy (Buchan 2014). In comparison to coal, nuclear power is far more flexible in that its output can be adjusted more easily, therefore can, to a certain extent, "load-follow" – in other words, the output of nuclear power can be adjusted according to variations in demand throughout a certain period (Nuclear Energy Agency 2011). Moreover, it can cope better than natural gas with volatile energy prices, as it has low variable costs, with the high fixed costs, in many cases, having already been recovered due to the length of service of existing nuclear plants (Buchan 2014) – this is important given the number of incidences when there is surplus energy (and low prices) caused by renewables, the output of which varies according to weather conditions. Buchan (2014) suggests that the more gradual approach of integrating renewables into the market, adopted by the French, may be preferable, as this does not lead to excessive demands on the energy system as seen in Germany with its more rapid expansion of renewables. In Germany, the decision to abandon nuclear has had the unintended consequence of greater reversion to coal power to compensate for renewables intermittency. Germany has always had a greater affinity towards coal, as it produces this domestically, but, in addition, gas prices are simply too high in relation to coal for natural gas to replace the lost nuclear power in balancing renewables (Dickel 2014). This is primarily because the price of carbon is too low to shift the merit order from coal in favour of natural gas in the provision of base load power (Dickel 2014). According to the merit order, sources of power with the lowest marginal cost should be prioritised in an energy system. In practice, this often means that, in Germany, when renewable electricity is insufficient to meet demand, that coal power comes on-line to supplement renewables and, if this is still not sufficient to meet demand, natural gas plants will be switched on. In effect, in the absence of nuclear power, green energy is being balanced with coal, due to the lack of economic competitiveness of gas, and this is an ironic state of affairs for Germany’s Energiewende in which green energy is balanced with coal. This reveals the complexity of the debate around the role of nuclear and shale gas in the transformation of the energy sector. It is proposed that the question for policy makers is not so much whether or not energy policy should include nuclear, but, rather, how much nuclear feature in the energy portfolio without compromising the growth of renewables.

A striking difference between the three countries in this study is a visceral, verging on moral, reaction to nuclear power which was common to German respondents, but rare in the other two contexts. In the German data, there was far greater discussion of the risks of nuclear power, in the form of waste and also the possibility of an accident, with reference to both Chernobyl and Fukushima. German entrepreneurs regarded the Britain’s renewed support for nuclear power as retrograde and irresponsible in view of the danger of accidents and the contagion for other EU countries. Opposition to nuclear in Germany stands in direct contrast to the greater acceptance of this form of power in the Britain and France. The greater opposition could be attributed to the experience of the Chernobyl nuclear accident, as Germany was one of the countries that was worst affected by the radioactive emissions resulting from the meltdown (Peters, Albrecht et al. 1990). Eiser, Hannover et al. (1990) indicates a link, in comparative study of national attitudes, between the proximity to Chernobyl and attitudes towards nuclear power, highlighting strong anti-nuclear feelings identified in Berlin, located close to the incident in Ukraine. The political dynamic may account partly for stronger opposition to nuclear in Germany; the left of centre SPD party pledged to abandon nuclear power following the Chernobyl incident and environmental groups, hostile to nuclear, have enjoyed a wider audience in Germany than is perhaps the case in other countries (Peters, Albrecht et al. 1990). These factors may accompany wider cultural and social factors underlying attitudes towards nuclear power.

The evidence base suggests that, for entrepreneurs, nuclear power is not necessarily contradictory to stimulating and supporting their activities. It depends on whether nuclear power is treated by policy makers as a source of balancing power, enabling the further integration of renewables or a panacea to decarbonising the energy sector. Britain and France run the risk of over-relying on nuclear power in the transformation of the energy industry whereas Germany's policy on abandoning nuclear power has jeopardised its previously impressive performance on carbon emissions targets. As far the other environmental risks associated with nuclear power are concerned, this is an issue that policy makers will have to judge and carefully evaluate. Foxon's (2011) model of co-evolution describes how technologies, institutions, business strategies and user practices mutually influence one another in the transition from one economic or industrial system to another. Elements influence each other's "ability to persist" through two mechanisms: they alter the selection criteria within the system (i.e. a change in the institutional framework which changes the rules of the game in favour of larger-scale generation technologies) or they may change "the replicative capacity of individual entities" – in other words, the ability of particular entities to disseminate through the system. For instance, a change in business strategy favours the development, or "replicative capacity" of new technology compared to existing technology (Foxon 2011). It is important to understand that these elements interact with one another, influencing each other's development and, ultimately, the overall trajectory of a transition, such as the transformation of the energy sector. In applying this model to the transition to a low-carbon economy, Foxon (2011) analyses elements of the existing energy regime, such as: institutions, namely the transmission and distribution network, "regulatory constraints and incentives" in addition to user practices involving consumer behaviour in the energy market. If nuclear power has a privileged position in the energy market, through distorting power prices downwards, it may increase its own replicative capacity through making other forms of power less competitive. Likewise, if nuclear is dominant in an energy system, the transmission grid infrastructure will perhaps be more suited to its needs and this, therefore, alters the selection criteria in its favour.

This co-evolutionary framework indicates that an energy policy that is strongly nuclear, as in Britain and France, could change the selection criteria away from renewable technologies and adversely affect the replicative ability of green energy in ways that are not entirely predictable at this point in time. Foxon (2011, P.2263) claims that the challenge for policy makers is "how to maintain appropriate levels of diversity amongst different low carbon options" when managing the transition to a low-carbon economy. It may, in fact, be more appropriate to discuss how to maintain diversity among energy sources more generally and how to ensure a vibrant renewables sector is maintained.

The spectre of shale gas is present in the minds of entrepreneurs, but, currently, it remains a vague threat. Although it could be an attractive source of cheap natural gas, as it has proven to be in the USA, respondents are, generally, rather sceptical of its potential to displace investment in renewables. Fracking has faced legal restrictions and there are doubts about its safety and its viability in the EU. It was perceived that shale gas could have rather more indirect ramifications by undermining the USA's desire to reduce its reliance on fossil fuels and that this would, therefore, jeopardise the EU's climate ambitions, given that it has to take into account its economic competitiveness vis-à-vis the US. However, shale gas was not regarded as an immediate danger.

There was very limited data in the field notes on nuclear and shale gas; this may be primarily because the practitioner conferences did not pay much attention to nuclear power.

6.1.6 The debate between small-scale and large-scale renewables

As the share of renewable energy in overall energy consumption has climbed, a debate has arisen as to whether the focus should be on large-scale, centralised renewable generation, or smaller-scale, localised generation. This debate has intensified as larger utilities have sought to enter the renewables market using business models, based on large scale, centralised renewable generation, employing the economies of scale suited to their particular capabilities and resources. A dilemma for policy makers is the extent to which they favour large-scale generation of renewables, far from the end-user, or smaller-scale, localised generation which is close to the point of consumption.

It is the German context where citizen energy and localised energy generation is most pronounced, accounting for around half of current renewable generation capacity (trend:research, Leuphana Universität 2013). This contrasts with Britain in which solar PV, the main recipient of support for decentralised power, accounts for a far lower share of renewable generation, with wind and bio-energy far more important (Department of Energy and Climate Change 2015) which indicates that citizen energy is far less powerful in

Britain. Likewise, in the French energy sector, characterised by a strong role for large-scale hydropower in renewable generation, citizen energy is more limited than in Germany.

Respondent G2 frames the debate between large-scale and small-scale renewables in section 5.3.1.5, suggesting that it is a choice between trusting a small number of monopolistic providers to deliver an effective market and designing a market in which multiple actors emerge. This is a contentious problem, as the field notes indicate, with Ignacio Galán, Chairman of Iberdrola claiming, in his lecture at Strathclyde University:

There is no point in solar PV on roofs when large solar plants are possible

Whilst one must take into account the fact that he represents a utility, the Chairman of Iberdrola raises an important point, namely that large-scale solar plants might be a more cost-effective and efficient way of deploying renewables compared to smaller-scale generation. This relates back to literature on co-evolution, in section 2.2.1, which reflects on incumbents' strengths in adapting eco-innovations for dissemination on the mass-market (Hockerts, Wüstenhagen 2010, York, Venkataraman 2010, Schaltegger 2002), with Ignacio Galán implying that the further diffusion of green energy should be conducted by utilities like Iberdrola that have the resources and knowledge to build large plants which enjoy the cost advantages associated with economies of scale. It may be that the continued expansion of renewable power through large incumbents is the most cost-effective solution.

There is debate about whether a monopolistic market structure, based on a small number of large firms, is efficient. Demsetz (1968) argues that natural monopolies, whereby it is cheapest for one firm to provide a good or service often because industries like energy,water and rail rely on fixed infrastructures like track networks and pipes, are not necessarily adverse to consumer well-being. He is sceptical that natural monopolies necessarily lead to monopoly prices and places greater importance on making sure that the costs of negotiating for contracts are as accessible as possible for each party, so that the most favourable bidder wins the contract to become the main provider of the good or service, with Breyer (1982) concurring that there are efficiency gains associated with natural monopolies, but that regulation must be imposed to minimise abuse. However, Posner (1974) highlights the weaknesses of regulation, in that regulation is often used to promote interests of certain groups, to restrict competition in an industry, for example, and warns of the danger of "regulatory capture" in which a regulatory agency becomes "dominated by the industries regulated". Kwoka (2006) argues that it is worth compromising, to a certain degree, economies of scale benefits associated with natural monopolies through increasing cost competition and emphasises the force of competition in exerting "cost discipline" on an industry. Therefore, he is indicating that the social benefits to do with competition can outweigh the economies of scale efficiencies which natural monopolies bring. In the context of the decarbonisation of the energy sector, it is not merely about cost to the consumer, but also environmental innovation and it could be that greater competition is conducive to higher levels of environmental innovation in the energy market.

The question of centralised generation versus localised generation is even more fundamental than this. One particularly striking comment made by B1, in section 5.1.1.5, can be recalled here, reflecting on how human society is organised geographically. Historically, in Scotland, the central belt became a population centre because of the coal deposits in the region which supplied energy to fuel the steel industry. Under a scenario in which renewables are the important energy source, this way of organising society no longer makes sense – as the populous areas in which energy is consumed are located far away from the abundant resources on the coasts of Scotland. Energy has to travel far to the consumer. It is an intriguing idea to introduce policies to encourage the location of industry and population settlements in areas in which these renewable resources are the most plentiful. In the longer term, there could be a reorganisation of society towards areas in which renewable energy sources abound, if it were decided that localised energy systems were the best solution for managing energy provision. Of course, this idea is beyond the scope of this thesis.

Whether to promote the deployment of renewables on a large-scale by incumbent firms or by entrepreneurial actors is one of the most fundamental issues in energy policy. The benefits of economies of scale, enjoyed by mass-market actors, may be off-set by the disruptive force that entrepreneurs can bring to the energy market. It is proposed that adopting an energy policy with an "entrepreneurial flair" (Wüstenhagen, Wuebker 2011) and, thereby, creating disruptive force in the energy market would be beneficial to meeting decarbonisation goals. Nurturing a context favourable to entrepreneurship would be more conducive to disruptive environmental innovation in the market and force incumbents to react and alter their business models to survive. A market in which renewable entrepreneurs co-exist with incumbent operators of large-scale renewables is conceivable.

Foxon (2013) proposes three transition pathways to a low-carbon energy system: a market-rules pathway, a central coordination pathway and a thousand flowers pathway. Under, his "market rules" pathway the government establishes the institutional framework and then allows the market to deliver the low-carbon system. This would involve the deployment of instruments such as carbon prices and emissions trading schemes and corresponds to a "free-market" environmentalist approach, described by Isaak (1998) in section 2.2.5. The main characteristics of this pathway is a focus on large-scale renewables, carbon capture and storage in addition to nuclear power, with a "high electric" future a mainstay of this pathway. Costs of investment required by the low-carbon system are passed on to consumers under this pathway. Foxon (2013) highlights the danger of economic or technical failure of CCS technology and public opposition under this pathway, pointing out that the consumer's role is passive. This public opposition could be towards new nuclear build or simply take the form of unwillingness to change energy behaviour in the household.

Central coordination entails more direct government intervention in the governance of the energy transition, with the government setting up a Strategic Energy Agency to steer the transition, through employing technology push policies (i.e. public private partnerships to develop off-shore wind technology) and tendering out large-scale low-carbon generation. This pathway, in fact, resembles the market rules pathway, in that it is biased towards large-scale generation and involves a future energy supply heavily dependent on electricity in which the role of the consumer is "passive". Similar risks arise too - there is the risk of CCS proving unfeasible and there is the possibility of public opposition to investment in decarbonisation coupled with low incentives to change consumer behaviour.

In contrast to the other two pathways, Foxon's (2013) Thousand Flowers pathway entails a bottom up, decentralised energy transition strategy which has a greater role for civil society, namely the community and environmental groups. This is the level at which decentralised energy generation is situated and is the level that mostly creates opportunities for entrepreneurs as power generators, installers of renewable technologies and producers of technology. This approach emphasises the dissemination of distributed generation – power generation at the point where it is consumed. This pathway envisages incumbent utilities changing their business models to become Energy Service Companies, offering a broader range of services to support distributed generation (i.e. retrofitting, IT monitoring products to manage virtual power plants in a community etc.) in addition to operating the remaining residual fossil fuel and nuclear capacity. A feature that distinguishes the Thousand Flowers pathway from the other pathways is that it embodies a social movement; local solutions are accompanied by stronger public environmental awareness and a more holistic public perception of energy which extends beyond economic factors (P.19). Foxon (2013) associates the risks of potentially higher costs of distributed generation and pressure on governments arising from concerns about the ability of local solutions to respond properly to the challenge of energy security with the Thousand Flowers Pathway.

From Foxon's (2013) pathways, it is apparent that each pathway carries a certain degree of risk and, with this in mind, it is perhaps sensible for policy makers to attempt to combine elements of each pathway in their energy policy - as said in the previous section, an entrepreneurial energy policy can co-exist with other strategies to meet the three goals of decarbonisation, energy security and economic competitiveness (European Commission 2015). He makes the pertinent reflection that:

> *In the end, choices relate to the trust in different actors to deliver* *(P.13)*

"Trust" is fundamental to the direction of energy policy; it is not merely a question of the ability of market actors to deliver a low-carbon energy sector, but, rather, whether they will cooperate with this policy goal. This chimes with a comment made at the 2015 Lüneburg Energieforum by Jens Kerstan, the Senator for the Environment and Energy of the City of Hamburg, who said:

> *You have to think of Schumpeter: the old structures are resisting change; the Energiewende must be bottom-up, decentralised*

This notion of resistance resonates with literature discussed in section 2.2.1 and, although it may not be feasible for the *Energiewende* to be entirely led by decentralised and bottom-up forces, this comment reinforces the potential value of retaining this entrepreneurial activity as a counter force to possible resistance from incumbent actors to the continued decarbonisation of the power sector. The reference to *Schumpeter* is testament to this policy maker's view of the importance of disruptive, entrepreneurial organisations to the continuation of the *Energiewende* and is further justification of implementing energy policy with an entrepreneurial bend.

6.1.7 System costs

Given that renewables represent a paradigm shift in the organisation of the energy system, there are substantial system costs associated with their integration into the market. System costs result both from the intermittency of renewable energy sources, giving rise to a need to balance power supply and demand. As mentioned in the previous section, there are further costs to do with the rigid nature of the electricity transmission grid which is not suited to decentralised energy provision.

Developing better technologies for the storage of energy should be priority. Better technologies would permit the storing of renewable energy at times of surplus production and the release of that energy at times when there is a deficit. This would mean that supply would correspond to demand better and overcome a major obstacle to the expansion of renewable power. Within the UK data, there was reference to support in the form of subsidies for energy storage in Germany (and in California), with the implication that energy storage was a problem that warranted public financial investment given the contribution it could bring to overcoming this barrier (i.e. the intermittency) to the integration of renewable energy. In the UK and France, policy makers should explore possibilities to support energy storage technologies, perhaps emulating the German initiatives.

As for the electricity grid, this is currently a major constraint to the expansion of decentralised renewable power in each setting. It requires updating and extending, both to accommodate the higher volume of decentralised producers wishing to feed-in to the grid and to transport power that is produced in areas remote from human settlements – at coasts, for instance. Although self-sufficiency is becoming more common, it seems likely that the diffusion of renewables will continue, certainly in the short to medium-term, through generators feeding power into the grid. Upgrading the infrastructure would, therefore, be beneficial. A selection of comments on system costs is presented in Table 11:

Table 11 Field notes on system costs

Adnan Amin, Director General of the International Renewable Energy Agency speaking at French Renewable Energy Union Conference, Paris, February 2015	Once we go beyond 30% renewables, system change will be required: pioneering countries like Germany will do this.
Matthew Lumsden of Connected Energy, speaking at Low-Carbon Scotland Conference, Edinburgh, February 2015	There is no mechanism to capture value from the storage of renewables – in the US, they have schemes rewarding energy storage mechanisms. Here, district network operators do not provide an incentive for storage: no "behind the grid mechanism.
Jens Kerstan, Senator for the Environment and Energy, City of Hamburg speaking at Lüneburg Energieforum 2015	It is no longer about the integration of renewables into the energy system; it is about the overhaul of the system.

System costs become particularly severe once renewable capacity exceeds a certain threshold – Adnan Amin cites 30% as the point at which system change is necessary for further integration. As renewable power accounts for an ever greater share of power consumption, issues to do with intermittency and transmission – the so-called "system costs" need to be addressed. Adnan Amin suggests that Germany will be "pioneering" in implementing system change to resolve these system costs that hinder the further diffusion of renewables. Jens Kerstan, in Table 11, concurs with this view, stating that the challenge is now one of redesigning the energy system in Germany as opposed to integrating renewables into the energy market. It is, as of yet, not clear what this "system change" entails. It may involve a more intelligent electricity grid, such as a smart grid, that can manage the difficulties of intermittency posed by renewable sources of energy. It may involve greater recourse to energy storage which offers potential as part of the response to these system costs. Matthew Lumsden argues that storage is currently not incentivised unlike in the USA. The introduction of mechanisms to reward storage in the EU, perhaps modelled on those which exist in the USA, would promote innovation and spur on the development of better storage solutions. This would help to overcome this system cost associated with intermittency and give the market an incentive to improve and implement this storage technology.

Governments have been effective in stimulating the growth of renewables through measures such as feed-in tariffs. However, there is a growing need to consider how to fully integrate green energy into the market, as its share of total generation increases. Accelerating the upgrading of the energy transmission grid is likely to be important to facilitating expansion in the short to medium term. Introducing incentive mechanisms for renewable energy storage, perhaps inspired by those that exist in the USA could be a sensible priority for policy makers seeking to overcome barriers to continued entrepreneurship in the renewables sector.

6.1.8 **Geopolitics**

Although climate change is the dominant narrative in the debate about environmental entrepreneurship, geopolitics has emerged as possible driver of entrepreneurial activities in the renewable energy sector. From the perspective of US investors, Bürer & Wüstenhagen (2009) demonstrate that climate change is subordinate to energy security and competitiveness, in terms of their confidence to invest in the sector which shows the potential significance of non-environmental factors to entrepreneurship in the sector. The crisis in Russia and Ukraine has a more immediate effect on gas supplies and prices which may encourage conversion to renewable power. In the longer-term, the crisis may raise greater awareness about the vulnerability of EU countries to political volatility due to their reliance on imported energy.

The theme of energy security arising from the conflict in Russia and Ukraine was especially pronounced in the British and German data, as these two countries are more reliant on imports of Russian gas and coal, as natural gas makes up a greater proportion of their energy mix (as described in section 4). Interruptions to the EU's gas supply could be economically damaging. The possibility of higher and more volatile gas prices, caused by such political events, could make renewables more attractive financially relative to natural gas and cause certain consumers to convert from gas to renewables.

A real possibility exists of Russia disrupting supplies to the EU over the rising political tensions to do with Ukraine and Western sanctions (Richter, Holz 2015), with Buchan (2014) stating that:

> *It is in the dependence of some of its member states on Russian pipeline gas that constitutes the EU's most acute vulnerability* (P.6)

Buchan (2014) claims that, for Western European nations, the Ukraine crisis confirms the rationale behind the deployment of renewables and the improvement of energy efficiency as part of an energy security strategy. Certainly, in the case of France, Germany and Britain, the Ukraine crisis bolsters the case for pursuing the energy transition policies with a strong orientation towards renewables.

There are, however, mitigating factors in the relationship between the Ukraine crisis and the case for renewable deployment. The Nord-Stream pipeline has reduced the EU's vulnerability to the interruption of supplies to Ukraine (some of the gas supplied to the EU must pass through Ukraine), and the EU has increased its imports of liquefied natural gas from the Middle East, diversifying sources of supply (Richter, Holz 2015). Perhaps more importantly, the “shale gas revolution” has been decisive in, not only, offering countries the potential to become more self-sufficient in gas (Jaspal, Nerlich et al. 2014), but it has also reduced US demand for liquefied natural gas from the Middle East (Kropatcheva 2014), leaving greater supplies available for the EU. Moreover, the shale gas revolution has led to the US dumping coal on EU markets; reverting back to using greater coal to produce electricity has been seen as an option to reinforce energy security (Kropatcheva 2014), but this option jeopardises environmental goals, as coal is far more polluting than natural gas. Certain solutions, such as liquefied natural gas, may not be the panacea they appear; there is ever greater competition for LNG from emerging market (Pirani,S., Henderson, J., Honoré, Anouk, Rogers, H., Yakimava, K. 2014). Nuclear could become more attractive again, as it has a relatively secure fuel supply with minimal dependence on imports (Buchan 2014). For Germany, the Ukraine crisis brings its decision to abandon nuclear power into greater scrutiny. Buchan (2014) describes how Poland argued that Germany’s policy of phasing out nuclear whilst simultaneously expanding renewables, with gas and coal providing back-up power, put it in a position where it could not confront Russia over its actions in Ukraine. It is suggested that energy security is an issue that extends beyond the current Ukraine-Russia crisis, as demonstrated by ongoing turmoil in the Middle East and increasing competition for resources from emerging markets.

Renewable power offers genuine energy independence and policy makers could decide that continuing subsidies to accelerate the expansion of renewables would contribute to climate goals and, as a by-product, energy security and this argument about energy security may be persuasive to the public.

Geopolitical issues may be influential; however, the effect of the geopolitical crisis may be moderated by other factors. For instance, the Russian-Ukraine crisis may increase the appeal of shale gas – Jaspal, Nerlich et al. (2014) discusse how shale gas is being seen as a "game changer" in securing Poland's political and economic independence from Russia. Likewise, in the French data, it was suggested that concerns about energy security and independence simply confirmed the case in favour of retaining a substantial nuclear fleet to protect energy provision.

In essence, it is difficult to assess how these geopolitical issues directly translate into market opportunities for renewable entrepreneurs due to these other interacting factors. However, the Ukraine-Russia crisis highlights the extent to which energy is, in fact, of strategic importance for the three countries. Dependence on imported fossil fuels can leave countries vulnerable to geo-political volatility. This need not come in the form of aggression from regimes seeking to wage an "energy war" by cutting off supplies. Other scenarios can be envisaged: exporters of fossil fuels may reduce exports during times of energy shortages, for instance. Imported energy carries risks and renewable energy offers greater energy independence, therefore, reduces those risks. According to entrepreneurs in the study, the strategic nature of energy needs to be instilled in the public mind-set in order to reinforce the case in favour of renewables – this would be to their benefit. Field notes on geopolitics are shown in Table 12:

The excerpts below indicate that, at the policy formulation level, geopolitical concerns are highly influential. The French Prime Minister cites it as one of the three objectives for European energy policy. In fact, the third objective "competitiveness of energy" is linked to energy security, as the affordability of energy to power the economy is contingent on reliable supply. In alluding to Libya, Manuel Valls is not limiting the geopolitical crisis to Ukraine – the instability in the Middle East, especially with the emergence of the Islamic State, shows that geopolitics is a wider and more enduring preoccupation that extends beyond the current turmoil in the Ukraine.

Table 12 Field notes on geopolitics

Manuel Valls, speaking at the French Renewable Energy Union Conference, Paris, February 2015	European energy policy has three objectives: fighting climate change, energy security (given the situation in Ukraine and Libya) and the competitiveness of our energy
Professor Dr. Marjan Peeters, Professor of Environmental Law and Policy, Maastricht University, the Netherlands, delivering the lecture "Perspectives on Current and Future Renewable Energy Law", Edinburgh Centre for Carbon Innovation, February 2015	Geopolitics will become the main driver for renewables – even more important than environmental concerns
Dr. Erik Hansen, Visiting Professor of Energy Transition Management, Leuphana University, Lüneburg, speaking at Lüneburg Energieforum, Lüneburg, September 2014	Oettinger (Energy Commissioner) says that the Ukraine crisis shows that the heat sector transition (Die Wärmewende) is a political question. I find that relatively dramatic.
Podium discussion at Lüneburg Energieforum, Lüneburg, September 2014	Putin problem: we must be more independent in Germany

Professor Peeters goes further, claiming that energy security will come to dominate over environmental concerns as the primary motivation for the expansion of renewables. At the Lüneburg Conference, the reference to the "Putin Problem" is indicative of fears about the vulnerability of Germany to Vladimir Putin's transgressions due to Germany's considerable gas imports. Growing concerns about energy security could, ultimately, be positive for entrepreneurs. Climate change requires action from individual countries in favour of the collective good and success in marshalling efforts to respond to climate change has so far been limited, because of free-rider behaviour. Increasing energy security is firmly in each country's self-interest and, as such, is a powerful argument to expand renewable energy in order to diversify the energy mix. Such arguments relating to the national interest may be more appealing to the public and, therefore, boost public willingness-to-pay for supporting renewables and this would have obvious advantages for entrepreneurs in the sector.

Professor Erik Hansen thinks that to describe the transition to renewable heat as a "political question" is an exaggeration. This is possible for the reasons previously discussed, namely that Germany could diversify its gas supplies to weaken its reliance on Russia and would, potentially, have the option of exploiting its shale gas reserves, although public opposition could hamper this.

Geopolitical volatility supports the case for greater energy independence and energy entrepreneurship can play a role in delivering this enhanced independence. The importance of geopolitical issues as a driver for renewable power will vary according to a country's energy mix – in Britain and Germany, more reliant on imports, this is a greater preoccupation than in France.

6.2 Integrating the three cases

Foxon's (2013) Transition Pathways Framework, introduced in section 6.1.6, is proposed as an excellent tool for contrasting the entrepreneurial orientation of British, French and German energy policies. Following the contrasting of British, French and German energy policy using Foxon's (2013) framework in section 6.2.1, Vroom's (1964) Expectancy Theory will be introduced in section 6.2.2 to discuss how energy policies may impact on the motivation of entrepreneurs in the renewable energy sector.

6.2.1 **Energy Policy through Foxon's lens**

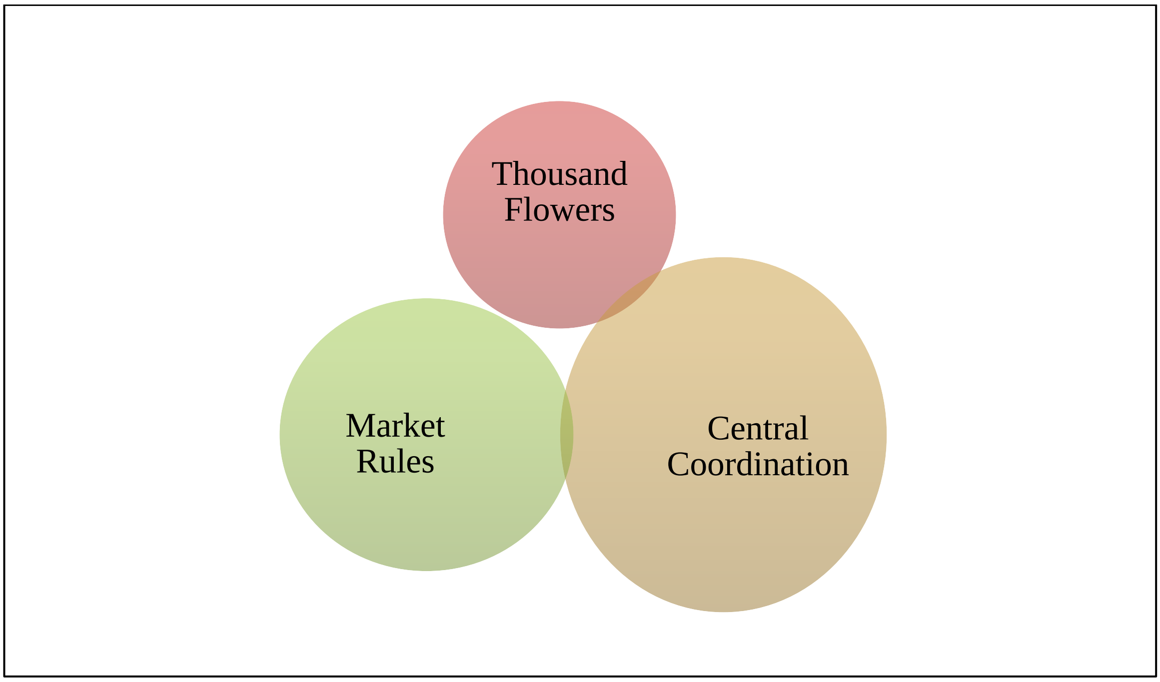
Foxon's (2013) Transition Pathways Framework consists of three pathways: the market-rules, thousand flowers and central coordination pathways. Each country's energy policy includes elements of all three pathways - they have a mixed approach to energy policy.

However, the strength of each pathway varies from one country to another, showing the diversity of energy policies across Europe.

Illustrating energy policy in *Britain*, Figure 4 shows that Britain has a less pronounced thousand flowers strand than particularly Germany. Feed-in tariffs were not established until much later and wider industrial policy appears less favourable to environmental entrepreneurs than in both France and Germany.

Policy is going to become less entrepreneurial in the light of changes brought by the Electricity Market Reform and continued reductions to feed-in tariffs which may amount to the phasing out of this instrument. The approval of new nuclear power stations and the support of shale gas indicate that there will be greater competition for decentralised renewables in the longer-term, especially given the generous treatment of nuclear power under the contracts-for-difference scheme.

Figure 4 British energy policy in terms of Foxon's pathways



Market instruments have been implemented in Britain, conforming to the Market Rules Pathway, but they are limited. Whilst the government has introduced a carbon price floor, this is set at a relatively low level and was not considered to have fundamentally changed the rules of the game in favour of renewables in the data. Mechanisms, such as carbon prices, seem more relevant to utilities, as they are better able to factor the impact of this into their strategy than entrepreneurs – Ignacio Galán's discussion of the carbon price in his lecture reinforces this. For entrepreneurs, a carbon price is likely to have a rather indirect influence, as it is harder to predict its effect on their revenue and market success, although it will affect the competitive advantage of competing technologies like nuclear. Similarly, climate obligations, as expressed in the Climate Change Act, are associated with substantial uncertainty as to how they will be implemented and, ultimately, whether they will be implemented.

Ultimately, Britain's policy is shifting towards a centrally coordinated approach dominated by tenders for large-scale renewable generation and nuclear power with this accompanied by a capacity market for conventional fuels (such as natural gas plants and coal with carbon capture and storage). Nuclear power will be a mainstay of this centrally coordinated approach. Policy is moving towards a scenario in which renewables compete more openly on the market, with much reduced feed-in tariffs and technology neutral support for large-scale generation beyond 2020. This means that, after the next few years, British energy policy will have a stronger market rules strand. It remains to be seen whether there will be a stronger carbon price which would raise the competitiveness of renewables under a more market rules-based approach.

If British energy policy continues in its current trajectory, its entrepreneurial flavour, represented by the thousand flowers approach, will be further reduced from its current level, with the centrally co-ordinated approach becoming dominant along, supplemented by market instruments, followed by a further move down the market rules pathway.

France is pursuing a long-term strategy heavily based on nuclear, although the proportion of nuclear in the generation portfolio is set to decrease. France is unique in terms of the market position enjoyed by nuclear power. The distortionary effect of such an intense nuclear portfolio on the reference price of electricity appears to make business models of generating energy for self-sufficient consumption less viable.

Figure 5 French energy policy in terms of Foxon's pathways

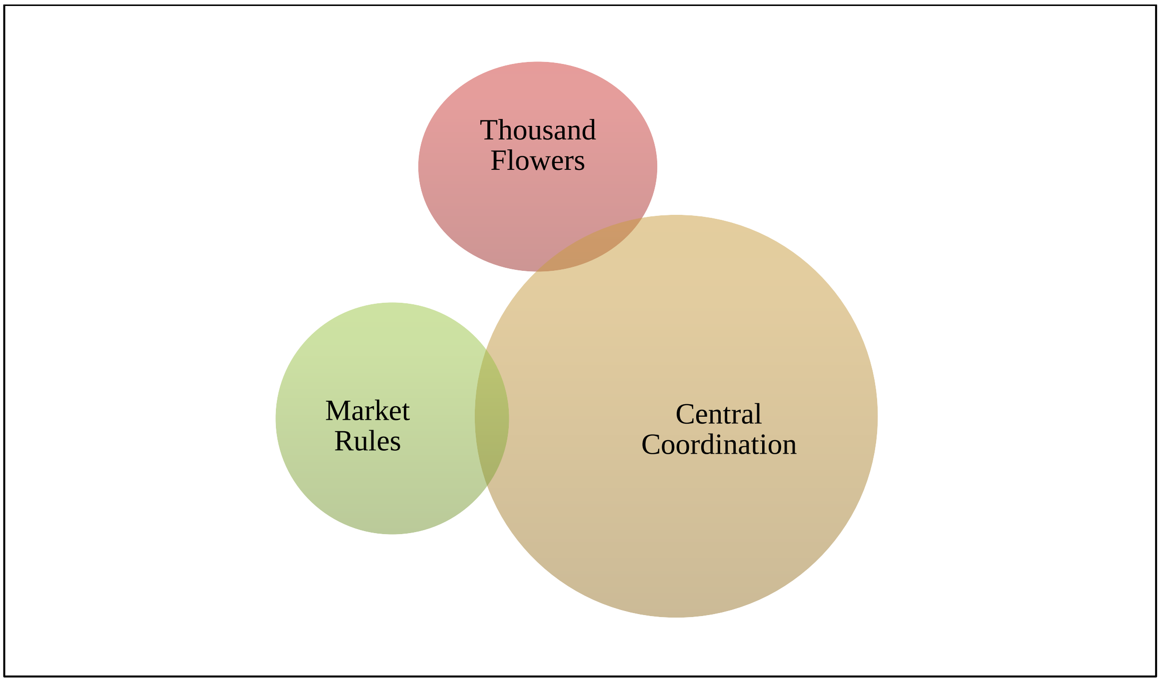


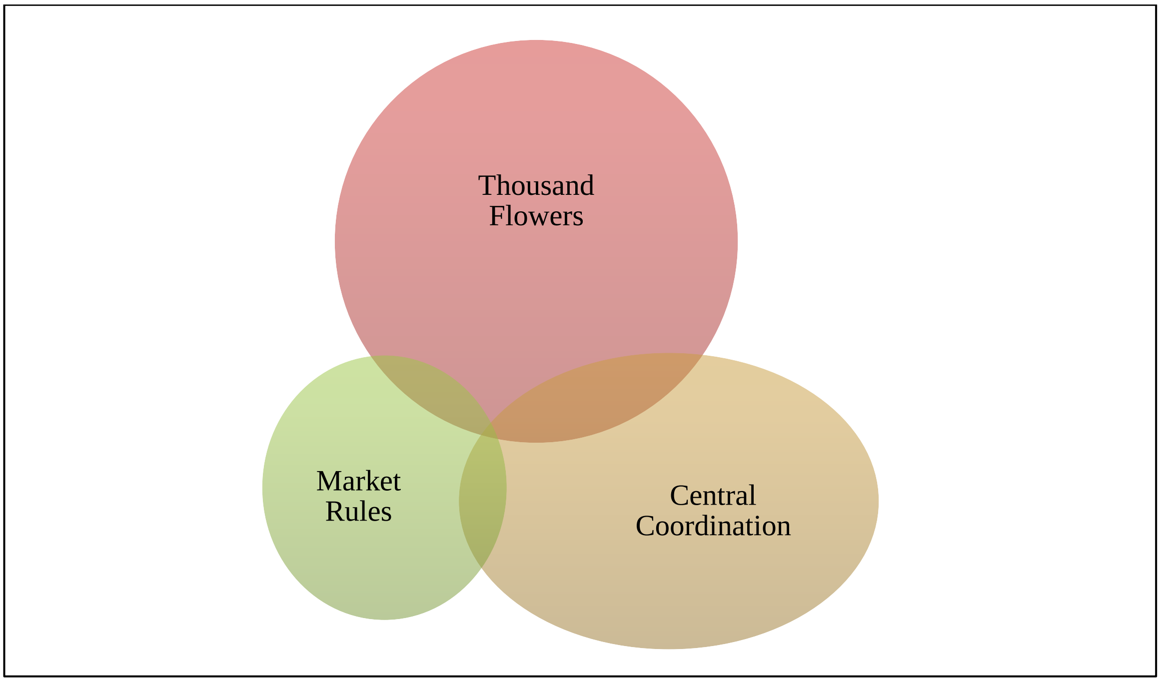
Figure 5 shows that in terms of the thousand flowers pathway, France has a feed-in tariff and this is perhaps even more necessary given the preponderance of nuclear power in the energy mix and the resulting low average electricity prices. The strong nuclear focus and the tenders for large-scale renewable electricity generation mean that French energy policy fits heavily into the Central Coordination pathway. The recent reforms in 2015 to bring in tenders for PV installations about 100KW further intensify French energy policy's central coordination flavour. Like in Britain, elements of the Market Rules pathway are present, such as a carbon tax, although the effect of this is perhaps more marginal, given the position of carbon-free nuclear power on the French electricity market. The centralised nature of French infrastructure is not suited to decentralised renewables and the policy to upgrade the grid must be accelerated in addition to support for energy storage inspired by a German model - this would improve entrepreneurs' perceptions of longer-term market prospects in France.

In the shorter-term, conditions appear difficult for entrepreneurs in the French market. It is introducing similar reforms as in Germany, but, the market conditions for renewables are, arguably, more challenging and new ventures in the French market may struggle to withstand such exposure to market forces. However, France puts significant emphasis into public financing targeted at SMEs in the renewable energy sector, both thanks to more accessible public finance and a regulatory context favourable to crowdfunding, with the government envisaging that renewables as a sector in which crowdfunding will be used to raise finance. French entrepreneurs enjoy good support in terms of policies designed to nurture a sustainable entrepreneurial ecosystem (i.e. clusters, public financing, R&D support.

French energy policy, therefore, is rooted in the Central Coordination pathway, given the structure of its energy mix (high nuclear share) and the widespread use of market-based support mechanisms for renewables through tenders. The paring back of support for decentralised renewables is cause for anxiety in France, as new ventures confront potentially more difficult market conditions. The feed-in tariff reforms are detrimental to the thousand flowers element in French policy and, in view of this, the central coordination element in French policy will intensify and the market-rules element will become stronger.

Germany's Energiewende has, hitherto, been the most entrepreneurial of the three – as shown in Figure 6, Germany was an early mover in introducing feed-in tariffs, with its EEG law. Moreover, its decision to abandon nuclear power may, in the longer term, lead to greater competitive advantage for renewables, although, in the shorter term, the outcomes of this policy have not necessarily been beneficial to renewable actors, as discussed in section 6.1.5.

Figure 6 German energy policy in terms of Foxon's pathways



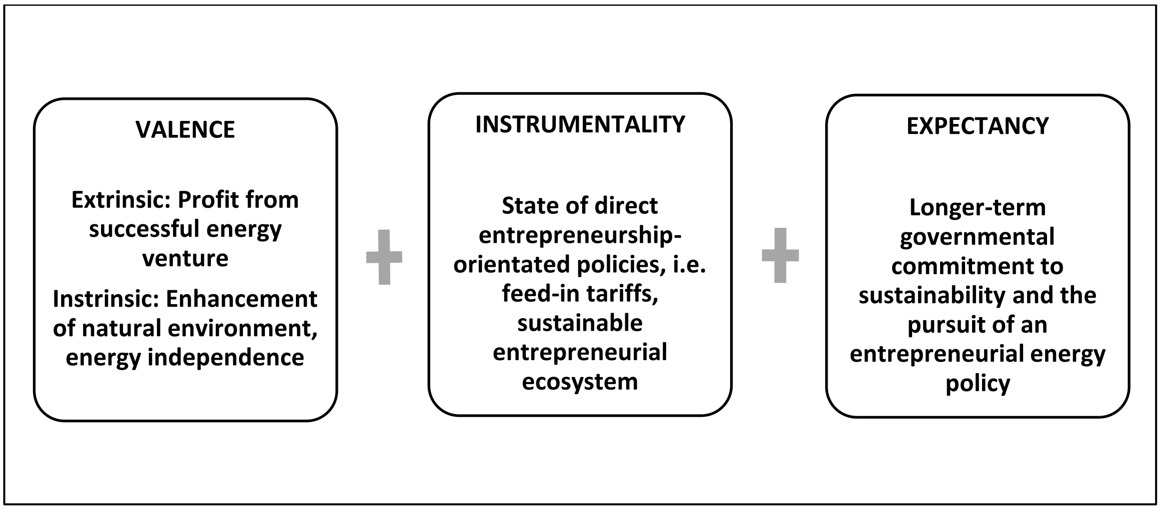
Arguably, Germany has the most coherent policy on energy storage and adapting the electricity grid, demonstrating its commitment to tackling these grid infrastructures which constrain the diffusion of innovation (Rogers 1995). Ostensibly, it is the policy with the greatest entrepreneurial orientation.

German energy policy is shifting away from the "Thousand Flowers Pathway". The evolution of the feed-in tariffs is, arguably, extremely damaging to entrepreneurial actors. Those with generation volumes of over 100KW, a very low threshold, will have to compete for Contracts-for-Difference and this involves considerable risk for them which, as new ventures, they will be less prepared to absorb. Admittedly, electricity prices are relatively high in Germany and this is partly to do with the EEG and there are limits to public tolerance. However, there is the question of the distribution of costs of financing the EEG and it is perhaps time to consider if the extent of exemptions is justifiable. To compound matters, a tax on solar energy produced for self-consumption will weaken consumer incentives to adopt renewable power at a time when feed-in tariffs are being pared back. Abandoning nuclear power has not necessarily been to the advantage of renewable producers either, as there has been a tendency to resort to coal to compensate – entrepreneurs in France and Britain have both pointed out the destabilising nature of the *Atomausstieg* and this implies that it is not is not a policy that is credible for entrepreneurs in the shorter-term, although might be advantageous in the longer-term. This move towards Contracts-for-Difference in addition to the other reforms, that appear detrimental to Bürgerenergie, indicate that Germany is moving from a Thousand Flowers Approach to a more Centrally Coordinated energy policy, more orientated towards large-scale renewables. As of yet, a carbon tax has not been established in Germany and it does not yet have such a strong Market Rules identity.

6.2.2 **Vroom's Expectancy Theory**

It is proposed that Vroom's work around motivation can be valuable to understanding the influences of environmental entrepreneurs in the energy sector. Vroom's (1964) Expectancy Theory has traditionally been employed to study performance at work and job preferences, with individuals motivated to take a particular course of action from a set of alternatives according to the motivational force associated with the particular action (Sheridan, Richards et al. 1973).

Figure 7 Vroom's Expectancy Theory in an energy policy context



This motivational force comes from three factors: the valence, expectancy and instrumentality associated with outcomes. Vroom's (1964) model starts with the idea of valence which is, essentially, the desirability or undesirability associated with outcomes. Applied to this research, valence may relate to the outcomes of extrinsic desirability of financial success from a viable new venture in the energy sector or the intrinsic desirability of contributing to the enhancement of environmental well-being and energy independence. Other outcomes may have positive (or negative) valence without leading to any particular satisfaction or dissatisfaction. They are simply means to achieving the ultimate desirable outcome – these means are perceived to have a relationship with the outcome, they are a mechanism for realising the desirable outcome; they have instrumentality in achieving the final outcome (Vroom 1964). In this case, these might be the more material support mechanisms and elements of the sustainable entrepreneurial ecosystem that are in place to directly enable market entry for new ventures into the energy sector, so that there is confidence, at least in the short-term, of a viable business model. Expectancy is about an individual's subjective probability that an action will lead to the desired outcome (Vroom 1964). Expectancy, in this case, is the more fundamental belief that energy policy is accommodating of entrepreneurship. The subjective belief that establishing or growing a new venture in the energy sector is likely to lead to desirable extrinsic and intrinsic outcomes is likely to depend on the view on longer-term governmental commitments relating both to sustainability and the likelihood of pursuing an entrepreneurial energy policy. Building such expectancy may require dedication on the part of the government, as this expectancy of desirable outcomes arising from entrepreneurial activity may be fragile.

The three case studies show that whilst the initial stimulation of green entrepreneurship in the energy sector may be straightforward, sustaining a context favourable to entrepreneurs as the transformation of the energy sector continues may prove more difficult. Forming that fundamental expectancy that there are enduring opportunities for sustainable development in the energy market is challening. As the *emerging Davids* reach a critical mass, there is an increasing resistance to support mechanisms both from the public and other interests aiming to defend market share. This is arguably what has happened in Germany where there is a danger of withdrawing the feed-in tariff prematurely prior to the point at which renewables can successfully displace fossil fuel technologies. On the German energy market prices are volatile and this is extremely difficult for SMEs that are exposed to market prices under the new EEG. In France, this could be even worse when reforms to the support mechanism are implemented this year. Similarly, with the paring back of the feed-in tariff, consumer adoption of renewables in the form of households fitting renewable appliances on their properties and community energy projects depend on perceptions about the likely evolution in energy prices, as these projects entail significant investment. Factors such as the possibility of shale gas in the UK, the dominance of nuclear in France, the instability on the German and global energy markets all undermine incentives for adoption. Entrepreneurs lament the slow rate of consumer change and this may be exacerbated if the feed-in tariff should wither away. In addition, the doubt surrounding feed-in tariffs is likely to exacerbate the difficulties in obtaining finance from institutions.

It is proposed that changing the terms of the feed-in tariff too drastically could thwart entrepreneurship in the energy sector. This is particularly the case in Germany, but applies to France and the UK too. These factors threaten to undermine the expectancy and instrumentality underpinning the motivation to engage in entrepreneurship in the energy sector.

As for accelerating the adoption of energy innovation among consumers, especially in terms of renewable heat technologies, the analogy of the car scrappage scheme, mentioned in the German field notes is insightful. To motivate consumer adoption, it is likely that strong incentives that are well promoted are necessary and that these will need to exceed previous schemes, such as Britain's Green Deal. The US *Cash-for-Clunkers* programme was the most prominent car scrappage scheme, allowing consumers to trade in inefficient vehicles in exchange for vouchers towards the purchase environmentally-preferable cars (Gayer, Parker 2013), but there were similar schemes in the EU, with Germany allocating the equivalent of $7 billion to finance its scheme, known as the *Abwrackprämie* (Kaul, Pfeifer et al. 2012). These schemes were launched in the midst of the severe recession, following the 2009 financial crisis, and aimed at marrying economic development with improvements in sustainability (Tyrrell, Dernbach 2010) and the scheme was successful in inducing sales of more efficient vehicles (Huang 2010), therefore, contributing to both goals, although there have been concerns expressed about the economic efficiency of the programme (Gayer, Parker 2013). Unlike measures such as the *Green Deal* and boiler scrappage schemes that have existed in recent years, the vehicle scrappage schemes attracted huge media attention (Li, Linn et al. 2011) and were, thus, more entrenched in the consumer mind-set. Tyrell & Dernbach (2010, P.490) emphasise the high consumer engagement in the Cash for Clunkers programme and suggest that a scheme like this is more effective than tax credits and other incentives that "reach relatively small fractions of the American public". They also stress that carbon prices and cap and trade schemes do not target individuals and this limits their effectiveness as means of compelling changes in consumer behaviour. Schemes like this are confronted with financing obstacles; Huang (2010) and Tyrell & Dernbach (2010) argue that they could be financially sustainable if funded through carbon taxes and taxes on inefficient vehicles. It is proposed that policy makers would do well to emulate a “Cash for Clunkers” style programme directed at household energy. For instance, a boiler scrappage scheme could be deployed in which vouchers were offered towards installing renewable heat appliances. A similar programme could be used for electricity, involving vouchers for installing decentralised electricity generation technologies. This programme could be levied from a carbon tax, so as to be financially sustainable. Programmes like this could compensate for the reduced or phased out feed-in tariff in that they have potential to sustain the market for energy entrepreneurs. Schemes like this would boost the instrumentality associated with entrepreneurial activity by improving the viability of entrepreneurial business models in the renewables sector.

Finance remains a barrier to entrepreneurial action and public financing schemes are likely to be insufficient to address this shortfall. Crowdfunding is increasingly regarded as an option for entrepreneurs seeking finance (Harrison 2013) and is discussed in section 6.1.4 in relation to the French energy market. In a context of diminishing support mechanisms and a potentially risk-averse investment climate, public financing through crowdfunding may be increasingly attractive for Emerging Davids. The example of the French company SERGIES also illustrates the power of crowdfunding as a means of local people investing in the Energy Transition of their region and this, again, could be a way of engaging the public in the transformation of the energy sector. From a policy maker’s perspective, crowdfunding shows real promise as an additional source of finance for entrepreneurs, especially in view of the drawbacks of venture capital, discussed in section 2.2.5. A good policy would be to consider how to use policy tools to promote crowdfunding as a way of enabling access to finance for energy entrepreneurs – perhaps crowdfunding could have tax advantages, for example, especially if the investment was directed at certain sectors. A financial climate accommodating of environmental entrepreneurship would, perhaps, change the fundamental expectation that financing the establishment and growth of a new venture was feasible.

It is not the case that policy must be binary, promoting the interests of entrepreneurs over the incumbents or vice versa, but it is argued that an energy policy that fosters entrepreneurship is advantageous. Crucially, policy in Britain and France should ensure that nuclear can coexist with renewables. In France, an over-reliance on nuclear power may undermine entrepreneurs' confidence in the endurance of a market for decentralised renewable energy in a post-feed in tariff context. On the other hand, Germany's *Atomausstieg* has had a destabilising effect on the energy market in the shorter-term which has been adverse to market conditions for entrepreneurs too. Nuclear power and energy entrepreneurship do not appear to be mutually exclusive; the central point is the extent of nuclear power and whether it is complementing renewables or competing with these sources. Policy makers must find a trade-off between nuclear power's capacity to contribute to decarbonisation and energy security whilst nurturing energy entrepreneurship. Building perceptions that renewables face fair competition from nuclear will reinforce entrepreneurs' expectancy that there are good market prospects and, thus impact on their perceptions of instrumentality leading to a good outcome, namely a viable energy business that enhances environmental well-being.

7 Conclusion

This PhD started from the premise that entrepreneurship is a powerful force which policy makers could harness to accelerate the transition to a low-carbon economy through the design and implementation of energy policies. This research has examined entrepreneurial perceptions of energy policies in Britain, France and Germany; these perceptions indicate how successful direct policies to support entrepreneurship (like the feed-in tariffs, the elements of the sustainable entrepreneurial ecosystem) are in stimulating and supporting actions of Emerging Davids. These direct policies exist within a wider framework and this study sought to capture perceptions towards features of this wider framework, as represented, for instance, by a country's stance towards nuclear power. Understanding these perceptions of the wider system is important to undertaking a more holistic analysis of the impact of energy policy on environmental entrepreneurship in the energy industry.

This chapter will evaluate how well the principal aims of this study have been fulfilled in addition to proposing contributions which arise from the work. Subsequently, recommendations directed at policy makers and practitioners will be advocated and avenues for further research, resulting from this study, will be discussed. Finally, the inherent limitations of this research will be addressed.

7.1 Returning to the aims of the study

In section 1.2, three aims were established for the study. Firstly, entrepreneurial perceptions of green policies across Britain, France and Germany would be explored. Secondly, the study would capture perceptions of policy differences which exist across the three countries. These aims would contribute to the fulfilment of the third aim – to integrate the three cases, reflecting on the "entrepreneurial flavour" of energy policy in each context, and to, ultimately, make suggestions about the future expansion of renewable power through entrepreneurship.

Following a systematic review of the environmental entrepreneurship literature, presented in section 2, and the collection of background policy information on the three countries (section 4), empirical work was undertaken. Conducting interviews with respondents across the three countries allowed the researcher to access rich perceptions from entrepreneurs in relation to the framework in their own and in the other settings. Field notes from practitioner conferences complemented and enriched the interview data and even enabled new insights to be drawn on green policies and their interaction with environmental entrepreneurship in the energy sectors.

In fulfilment of the first research aim, perceptions were analysed across seven main issues within the findings (section 5). Several of these issues had been predicted to be important, based on the outcomes of the literature review and the collection of background case information. Attitudes towards the support mechanisms and the role of wider industrial policy would fall into this category. However, less obvious issues also emerged in response to the first aim that had not been strongly envisaged. Examples of this are the importance of public consent, the potential influence of geopolitics and the ramifications of nuclear policy. Moreover, the reforms to energy policy, especially in Britain and Germany, added to the timeliness of this study and were a key focal point of the analysis. It is proposed that the depth and detail with which perceptions are analysed across these seven issues fulfils the first aim.

The second aim sought to investigate entrepreneurial perceptions of policy differences across the three cases. Ultimately, these differences were not rooted in the design of the support mechanisms directed at renewables; they were found, rather, in the wider energy framework in which renewables operated. Reactions were expressed towards the role of nuclear power in Britain and France by German respondents whereas French and British respondents' perceptions of German policy focused on the Energiewende. Although perceptions of policy differences centred on these major contrasts and other, smaller, factors featured less heavily, they were still relatively rich and insightful and, hence, aim two was largely achieved.

In section 6, the findings from the three cases led to an extensive discussion chapter consisting of eight overarching narratives that extracted core themes from the study for further debate. From this discussion, it was possible to evaluate the "entrepreneurial flavour" of British, French and German policy, using Foxon's (2013) framework in section 6.2. This was accompanied by a Vroom's (1964) expectancy theory model, to suggest how energy policies might combine to influence the motivation of environmental entrepreneurs in the energy sector. This guided the development of the recommendations given in section 6.2.2. The discussion section served to integrate the three cases and reflect on ways of furthering the expansion of renewables through entrepreneurship and this met the third aim outlined in section 1.2.

7.2 Contribution to environmental entrepreneurship and energy policy fields

Geletkanycz & Tepper (2012, P.257) claim that strong theoretical contributions serve as a "bridge between a study's findings and the larger literature". The sectoral focus taken in this thesis has led to opportunities to make linkages between the environmental entrepreneurship literature, in section 2, and the energy policy field. It is within these linkages that the bridge between the findings and larger literature are found.

Applying Vroom's (1964) model to environmental entrepreneurs' motivations is advanced as a contribution which connects this study to wider theory on environmental entrepreneurship. Using Vroom's (1964) model as a mechanism to illustrate how policy may affect entrepreneurs' motivations to launch and expand a venture could serve as a useful theoretical innovation for environmental entrepreneurship scholars. It is especially relevant in the context of entrepreneurs in the energy industry, as, effectively, their success is highly contingent on favourable policies and, hence, there is likely to be a link between policy makers' actions and the motivation of entrepreneurial agents. Vroom's (1964) Expectancy Theory may apply more strongly to entrepreneurs operating in sectors that are highly dependent on policy and regulation.

Using Foxon's (2013) Transition Pathways framework to analyse the entrepreneurial orientation of British, French and German energy policy in section 6.2, connects the environmental entrepreneurship literature with the transition management literature, employed previously in the journal Energy Policy to theorise about different routes to a low-carbon energy sector. In effect, Foxon's (2013) "thousand flowers" pathway, characterised by decentralised solutions which engage the public to a greater extent, reinforces the ideas in section 2.2.1 about the role of entrepreneurial actors in disrupting unsustainable economic structures. Moreover, his framework refers to risks associated with a pathway dominated by incumbent actors and technologies like nuclear and this can be read alongside the discussion of nuclear and shale gas in section 6.1.5 and the relative position of large-scale versus small-scale renewables in section 6.1.6. Geletkanycz & Tepper (2012) warn authors to the Academy of Management Journal against over-reaching in establishing theoretical implications that outstrip the data. This must be borne in mind in relation to the contributions of this thesis. Essentially, this thesis does not argue that energy policy should be dominated by entrepreneurship; rather, that policy makers should ensure that policy stimulates and nurtures entrepreneurship alongside other strategies more rooted in the central coordination and the market rules pathway. Specifically, it cannot argue that entrepreneurship is inimical with policies favourable to nuclear power, shale gas and larger-scale renewable generation - this is not a position that finds substantial support within the data, discussed in section 6.1.5 and 6.1.6. This thesis advocates, with regard to all three countries, that policy makers should be attentive to the need to create a framework in which entrepreneurial opportunities can co-exist with large-scale renewable generation and, in the case of Britain and France, nuclear power.

In section 6, more direct contributions to the environmental entrepreneurship literature are also made. The discussion of corporate political activity and the public perception in section 6.1.2 expands on the notion of environmental entrepreneurship being embedded in social institutions, in section 2.2.3. What emerges from this study is that it is not merely a question of changing the norms of the consumer, as described in section 2.2.3, attention must be paid to increasing public consent for the continued support of renewables, if opportunities for environmental entrepreneurship are to be maximised. The literature on the economics of environmental entrepreneurship makes substantial reference to instruments like environmental taxes and emissions trading. Whilst these mechanisms have an indirect effect on entrepreneurs, this study tends to suggest that they are far less important than the support schemes, principally feed-in tariffs. Feed-in tariffs are supposed to be withdrawn as the cost of technology declines. However, this study indicates that this decision to withdraw feed-in tariffs might not be as straightforward as it appears. In section 6, there are many factors other than the development of the technology which may need to be considered before paring back the support mechanisms, such as the cost of incumbent technologies, both nuclear and fossil fuels, the state of the economy and the importance of the feed-in tariffs for investor confidence. How to treat the support mechanisms as the transformation of the energy sector advances is a complex decision and this is reflected in the recommendations in section 7.4. Section 6.1.4 indicates that Cohen's (2006) sustainable entrepreneurial ecosystem extends beyond elements including R&D support, green clusters and public venture capital. A country's wider industrial policy can be a decisive in determining whether a country develops and retains a domestic renewables industry with corresponding opportunities for entrepreneurship. Moreover, whilst providing public green venture capital is useful, new and alternative forms of finance, principally crowdfunding, can also be harnessed - France is a good example of this being done and this can complement public initiatives to boost green venture capital.

A serendipitous contribution is the discovery of non-environmental factors in environmental entrepreneurship, namely geopolitics and energy security. Mindful of the desire not to over-reach in proposing implications, geopolitics is not necessarily a principal driver of environmental motivation, but could be significant nonetheless. This is a theme which is proposed as a further avenue for research in section 7.6.

The contributions of this thesis lie in the linkages between the discussion section, the environmental entrepreneurship literature and wider literature, such as work from energy policy. In addition, it enhances the smaller body environmental entrepreneurship literature in the ways suggested in the previous chapter.

7.3 Implications for policymakers and practitioners

It is not the goal of this study to provide policy makers with a prescriptive guide of how to design energy policy to promote environmental entrepreneurship. The desire is, rather, to raise serious questions about energy policy and its "entrepreneurial flavour" (Wüstenhagen, Wuebker 2011) in the three countries. Equally, although entrepreneurship is the object of the study, the thousand flowers pathway is not presented as preferable to the market rules or central coordination pathway. Elements of each pathway can be combined within an energy policy and, indeed, are combined within British, French and German energy policy. The underlying argument made to policy makers, in this thesis, is that the thousand flowers strand of energy policy, relevant to entrepreneurial actors, should be nurtured, since entrepreneurship is a disruptive force in favour of the sustainable transformation of the energy industry. Policy which is orientated towards creating entrepreneurial opportunities is likely to lead to more localised solutions, with correspondingly greater public support for the transition to low-carbon energy. Likewise, whilst recognising the substantial role that incumbent utilities are likely to play in the transition to a low-carbon energy industry, continuing to promote entrepreneurship should invigorate the energy market and avoid over reliance on incumbents to deploy low-carbon energy technologies.

In this thesis, energy policy in Britain, France and Germany are shown to have a different overall character. Policy in Britain and France is more strongly orientated towards the central coordination pathway, with characteristics of the market rules pathway. In contrast, German energy policy has strong elements of the thousand flowers pathway. In all three cases, there are challenges for entrepreneurs from the gradual withdrawal of feed-in tariffs, with this compounded by the market risk caused by policy towards incumbent technologies in Britain and France. In Germany, drastic reforms to support mechanisms pose a serious threat to entrepreneurship. In particular, policy makers in Britain and France could examine the German case to draw lessons as to difficulties and challenges as the Energy Transition advances. A recurrent theme is that entrepreneurial actors, above all, wish for a predictable framework in which to operate, so that they can plan more easily and so that investors have greater confidence.

As regards implications for new ventures, this study provokes debate about their role in the transformation of the energy sector. It points towards the impact that these new ventures could have in helping to accelerate the transition to a low-carbon energy sector. In many ways, this study could be seen as lending a voice to new ventures that are, perhaps, frequently overlooked by policy makers due to their smaller size. This thesis analyses in depth the views of these actors, permitting a rich understanding of how they interpret the current context in both their own and in the other two settings. In so doing, it offers a certain representation of this group's preoccupations and ideas about how energy policy should be shaped.

In engaging in a detailed discussion in the process of integrating the three cases, this thesis offered recommendations for policy makers in section 6.2.2. However, these recommendations are directed not only at policymakers, but at practitioners also. They may also offer inspiration as to what entrepreneurs may wish to demand from policy makers in their lobbying efforts. This lobbying may not be undertaken by the entrepreneurs themselves but through intermediaries, including collective associations and clusters, as suggested in section 2.2.3.

7.4 Recommendations

Recommendations in terms of how to stimulate and continue to support entrepreneurship in the greening of the energy sector are offered in this section.

The importance of the feed-in tariffs cannot be underestimated. They have been catalytic in creating opportunities for entrepreneurs (Shane, Venkataraman 2000) in that they have not only opened up a market among consumers adopting household micro-generation appliances, but have, in addition, removed risk for generators regarding the revenue they receive from their generation activities. This has also led to opportunities for installers and producers of green energy technologies. In the midst of high uncertainty in the energy market, caused by an unstable economic climate and energy price volatility, it is recommended that the market support provided by feed-in tariffs will continue to be necessary for entrepreneurs, as they have greater difficulty in absorbing market risks compared to larger organisations. It is suggested that this is the case despite reductions in the cost of renewable technologies. Germany's EEG reforms which will replace the feed-in tariff with contracts-for-difference appear drastic and detrimental to the success of entrepreneurs in the German energy market, with a perception that these reforms will increase entry barriers for new entrants are suited to the needs of incumbent firms. It is suggested that the generation threshold at which generators have to compete for a contract-for-difference should be far above the 100KW mark. Julia Verlinden (in section 6.1.3) calls for this level to be set at 500KW for PV, for instance. Whilst less drastic than the reforms undertaken in Germany, the British and French Governments are also paring back the feed-in tariff at an accelerated rate and, in the UK, for generation over 5MW, the Renewables Obligation will be replaced by Contracts-for-Difference in an attempt to minimise costs to the consumer. Specifically in relation to Britain, contracts-for-difference might reduce costs, but it introduces a competitive all-or-nothing element and, therefore, implies higher risks for entrepreneurs than the RO mechanism. Whilst the British government has embarked on this CfD path, it is recommended that it should consider how it can reduce the risk that this mechanism entails for High Growth Davids. Perhaps a certain proportion of CfDs could be reserved for new ventures or High Growth Davids, for instance, so that entrepreneurs, eligible for the CfD scheme, would have a better idea of their likelihood of obtaining a CfD. The core motivation behind reforming the support mechanism is the cost to the consumer which rises as the volume of renewable power generation increases. Reforms to the support mechanisms are designed to rein in those costs. Unfortunately, these reforms could, in fact, jeopardise the continued success of entrepreneurship in the energy sector in each country. In order to maintain the support mechanisms, alternative modes of financing could be devised. A serious carbon tax, for instance, could be used to finance these mechanisms and this could, in fact, raise support for such a tax, if it is perceived as an investment in the energy sector. However, to have credibility, such a carbon tax has to be multilateral and this is why it is proposed that policy makers attempt to secure an agreement on a carbon price in the near future – following on from the COP21 in Paris, or at one of the subsequent conferences, as funds generated could offer a way of sustaining or retaining support mechanisms directed at entrepreneurs.

The role of incumbent technologies in the energy transition is an important part of the debate. In particular, German entrepreneurs in the study expressed critical opinions about nuclear power whereas entrepreneurs in France and Britain were far more ambivalent. Setting aside environmental and safety concerns, nuclear power and energy entrepreneurship are not mutually exclusively. It is this question of using nuclear power "appropriately" which is central – its dominance in France is, arguably, excessive to be conducive to entrepreneurs. On the other hand, the destabilising effect of abandoning nuclear power in Germany is also adverse to entrepreneurial actors. The nuclear exit suffers from concerns about its feasibility, especially among French and British participants. It is proposed that the German phase out of nuclear power could be achieved on a more gradual basis and this would reduce volatility on the German energy market which is creating uncertainty for entrepreneurs. Likewise, if the French and British governments pursue energy strategies based on a high proportion of nuclear in their generation portfolio, they may have to revise the level of support for smaller generators.

Britain could learn from the French and German approach to nurturing an industrial base. In both countries, clusters, R&D support and public entrepreneurial finance appear better coordinated and more accessible to entrepreneurial actors than in Britain. It is not merely a question of how much R&D support, financial support is available; it is also about the design of that support. From the point of view of entrepreneurship, initiatives must be targeted at the right level – the British Green Investment Bank loans are, possibly, out with the scope of most entrepreneurial actors, even High Growth Davids, whereas the French and German schemes are more accessible for start-ups or new ventures at a more advanced stage. British policy makers could establish schemes that are more inclusive of entrepreneurial actors, inspired by the French and German positions in order to strengthen the British entrepreneurial ecosystem as per Cohen (2006).

A major theme from this study is the role played by the public perception in environmental entrepreneurship. Green policies can only be enacted with the support of the public – the support mechanisms, for instance, are dependent on the public's willingness-to-pay for renewable energy. The same logic applies to instruments, such as carbon taxes, as these imply a certain level of cost for the consumer. It is suggested that the governments in all three countries should endeavour to inculcate sustainability norms in the public mind-set - this is advocated by Meek, Pacheco et al. (2010) and would increase the feasibility of green policies. Governments could engage in social marketing relevant to the environment in order to shift institutional norms in favour of sustainability. Cluster organisations, specialising in supporting energy start-ups, could adopt a greater public relations role to influence the public mind-set in favour of supporting renewables. The German Energieagenturen (Energy Agencies) with their attempts to influence the public attitude towards energy offer a good model for doing this.

In terms of incentivising the adoption of renewables, especially in a context of declining feed-in tariffs, it is recommended that the "cash for clunkers" scheme could be adapted to promote the uptake of energy innovation. Such an initiative would have to extend beyond the previous rather perfunctory attempts to motivate uptake, as exemplified by the UK's Green Deal. A strategy like this could be particularly effective for stimulating the adoption of renewable heat technologies. Like the feed-in tariffs, a mechanism like this could be financed through revenue raised from a carbon tax.

System costs will pose ever greater problems as the volume of renewable electricity on the market increases. It is proposed that Germany's stance is the most effective in this respect, in terms of having robust policies on upgrading the grid and, perhaps more importantly, promoting energy storage which is a cornerstone to the further integration of decentralised renewables in the market. It is recommended that France and Britain could emulate German policies on these two areas.

As the investment climate for environmental entrepreneurs can be more challenging, fostering alternative entrepreneurial finance, such as crowdfunding is recommended. In all three countries, policy makers could improve energy entrepreneurs' access to finance by facilitating crowdfunding. This could be done in a variety of ways – tax advantages, for example, on crowdfunding investments. These innovative finance mechanisms would reduce entrepreneurs' reliance on potentially risk-averse investors.

7.5 Research limitations

Like most research, this study is subject to some limitations that have to be borne in mind when interpreting its outcomes. In this section, key limitations affecting this research will be addressed and reflected upon.

As described in section 3.2, this research is located within the naturalistic paradigm. As a naturalistic study, it aims to understand relationships, mechanisms and interpretations within particular contexts, but it cannot make law-like generalisations about policy and environmental entrepreneurship. As such, prescriptive outcomes and guidelines are not possible from this work; this study can only give rise to interesting questions about energy policy. The naturalistic approach has other merits which the Academy of Management Journal has begun to accept to a greater degree, with 11% of articles between 2001 and 2010 using purely qualitative data (Bansal, Corley 2011). The main merit is the “intimacy with the phenomenon of interest” which qualitative methods permit, with greater proximity to the “ideas, the people and the events that stimulated the researcher’s curiosity (Bansal, Corley 2011, P.235).

Three country cases - Britain, France and Germany - are the object of this study and this could lead to suggestions that the findings are context-specific and have limited application out with these contexts. It is argued here that, although the three cases, individually and together, may have unique characteristics, the findings are likely to contain useful insights for other geographical settings. Certainly, similar challenges in terms of decarbonising the energy system confront other countries in the OECD and most members in the European Union. Moreover, the fact that Britain, France and Germany are each modern, advanced and large economies is argued to be a sufficient basis to lend the findings substantial scope and impact.

As has been noted in section 3.4, interviews were not always conducted with the firm founders, but with other key members of the management team within the venture. For research on entrepreneurship, not having access to the founders in every case is a limitation, as these individuals have been the catalyst for the venture’s foundation. However, the idea of the “lone hero” (Cooney 2005), referred to in section 1.1, is often unrealistic and the entrepreneurial function (Schumpeter 1934) within new ventures, especially in the energy sector, may be distributed across a team of key staff around the founder(s). Therefore, the insight of key staff is proposed to be highly valuable regardless of whether they were involved at the firm’s inception.

In terms of the sampling, it must be noted that most of the participants were male, with only four female participants in the study. Such a gender bias could be regarded as unfortunate, as it is possible that gender may have an influence in environmental entrepreneurship research. Indeed, Outsios (2012) identifies differences between the identity of male and female environmental entrepreneurs in his research. However, the way in which gender would influence perceptions of policies is less obvious and, potentially, less of an issue in this work, although not insignificant.

7.6 Avenues for further research

Since environmental entrepreneurship remains a relatively nascent field, there is scope for substantial research to be done. Specifically emerging from this study, the research avenues discussed below are advanced as being of particular promise.

Outsios (2012) claims that entrepreneurship research tends to analyse solely the entrepreneur as opposed to viewing entrepreneurship as an interactive process dependent on the role of other stakeholders. This study underlines the importance of the public perception, both as the electorate and as consumers adopting innovation. Whilst there are numerous possibilities for studying the public’s role in the diffusion of green innovation, valuable work could be done in assessing the public’s preference between nuclear power and renewables. Behavioural science techniques could be particularly valuable in investigating this, with excellent data on environmental preferences now available within the British Household Panel Survey, for instance.

Pastakia (1998) distinguishes between social and commercial environmental entrepreneurs. Investigating the extent and nature of differences between both groups is suggested as a worthwhile topic of investigation. Studying empirically the differences in motivation, the different obstacles that entrepreneurs face and the different trajectories of social compared to commercial ecopreneurs would identify if the two groups have different support needs and if their activities lead to different well-being outcomes.

Environmental entrepreneurship can be studied effectively in its general form, across different industries, but, focusing on entrepreneurs in particular industries is an alternative strategy and this approach has been taken in this project. Conducting studies of entrepreneurs in other environmentally strategic sectors, such as transport, would be a useful research stream. Likewise, whilst this study examines environmental entrepreneurship in three Western European countries, there is substantial scope for researching other geographical contexts. In particular, the BRIC countries are important settings to study sustainability, as they have experienced rapid growth over recent years and face acute sustainability challenges and Chinese firms are investing heavily in renewable technologies, notably solar PV (Sharma 2014) . In these contexts, environmental entrepreneurs could have a far greater impact on overall environmental well-being than in countries in which the sustainability transformation is well underway, as in the EU. This study may act as inspiration for those wishing to research energy policy and entrepreneurship in those markets. If global climate emissions are to be tackled effectively, addressing sustainability problems in these countries is indispensable.

For energy policy scholars, the possibilities of a European Energy Union are particularly interesting. A policy of greater integration of EU energy systems would likely enhance energy security in the EU by making the system more resilient to external shocks (European Commission 2015).

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Appendix 1 Correspondence used with respondents[1]

Appendix 1.1 Introductory email

Dear [Name],

My name is Christopher Ball and I am a PhD student in the Department of Management, *Work and Organisation* at the University of Stirling. I am writing to request your possible participation in my PhD study which is focused on the effect of government policy on new ventures engaged in the renewables industry. This comparative study of France, Germany and Britain is interested in new ventures' perceptions of environmental and energy policies in these three settings.

It would be helpful to me if I could have a conversation with you to ask about your views on relevant government policies. I am aware that [NAME OF FIRM] is involved in innovative renewable energy activities and, therefore, your input would be very valuable to my project. If you are willing to participate, I would suggest that I come to visit your premises or that we speak over SKYPE or on the phone. An information sheet (attached to this email) is provided to give a brief summary of my project.

I stress that both your identity and that of your firm would be kept confidential. Although the data will be archived and used for scholarly research, all steps will be taken to ensure your anonymity and that of your firm. This project has been approved by the Ethics Committee of *Stirling Management School*.

I look forward to hearing from you.

Kind Regards

Christopher Ball

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[1] This section provides the English correspondence with participants. Similar correspondence was translated into French and German when approaching French and German participants and are available upon request.

Appendix 1.2 Contents of information sheet

Policy and Environmental Entrepreneurship in France, Germany and the UK: Insights from the Energy Sector.

You have been invited to participate in this PhD research project. In order to help you decide whether or not you would like to take part, this information sheet has been prepared to explain what the project is about and what participation involves. Please contact me if you need any further information or clarification – my contact details are given above.

What is the purpose of the study? This project aims to compare government policies relevant to new ventures involved in environmental innovation, as represented by renewable energy activities. It seeks to compare and contrast relevant environmental and energy policies in France, Germany and Britain with a view to suggesting best practice for policies to stimulate and support environmental entrepreneurship. Through semi-structured interviews, this project will ask participants about their perceptions of government policy features in their own country. Policy features unique to the other countries will then be explained to the participants and they will be asked about their perceptions of those.

Why have I been chosen? You are being invited to participate, as you are part of a relatively new venture which is involved in innovative renewable energy activities.

What will participation involve? Participation will involve a conversation lasting approximately one hour. During this interview, you will be able to express your opinions about the current UK policy context facing your firm and your feelings about policies in the other two countries. The interview will be recorded and transcribed into written format at a later point. Of course, you may have a final copy of the report if you would like one. In the interview transcript and the results section of the final report, you and your firm will be kept anonymous. Data from the project will be stored in the University of Stirling's archives and those of the *Economic and Social Research Council,* the body which is funding this PhD study.

Participation in the research is entirely voluntary and you are free to withdraw at any time, without giving any reason. If you withdraw, the data you have provided will not be used and will be destroyed. *[Contact and supervisor details included in information sheet]*

Appendix 1.3 Draft of interview guide

Section A: Perception of UK Policy Context

Command and Control Policies

The UK Government introduced the Climate Change Act in 2008 – a legally binding law to reduce emissions substantially by 2050. This Act was accompanied by a commitment to increase the proportion of renewables in final energy consumption by 2020.

1) How credible do you find this policy, in terms of the government's commitment to taking action on climate change and to boosting renewable energy?

2) What, if any, impact does the Climate Change Act have on your perceptions of future opportunities in the energy sector?

Demand-Driven Policies

Schemes have been implemented to generate demand for renewable energy. The *Feed-in Tariff* applies to smaller scale generation and is designed to support the market for micro-generation and to promote innovation. Tariffs are banded according to technology (and quantity of energy produced) and are subject to ongoing revision. The *Renewables Obligation* and *Contracts-for-Difference* apply to larger scale generators.

1) Is the feed-in tariff important to your business? If so, how?

2) Does the feed-in tariff impact on your ability to innovate?

3) How effectively, in your opinion, is the feed-in tariff scheme in supporting entrepreneurship in the energy sector?

4) If the RO/CfD mechanisms are relevant to your firm, could you please discuss how these affect your firm, bearing in mind that, under the Electricity Market Reform, the Renewables Obligation will be replaced by Contracts-for-Difference in 2017?

(IF APPLICABLE:

5) How important is the Renewable Heat Incentive to your business?

6) How effective has the RHI been as an incentive for the uptake of renewable heat technologies, in your view?)

Fiscal Measures

A Climate Change Levy has existed in the UK for around thirteen years, applying to electricity, gas and solid fuel. This was supplemented by a Carbon Price Floor, introduced in April 2013. It started at a rate of £9.55 per tonne in 2013 and will now be capped at £18 per tonne from 2016 to 2020.

1) How does this measure affect your confidence about the competitiveness of renewable energy?

2) Do these taxes change your view of opportunities for your own firm?

Overarching Energy Policy

In 2011, the Energy Secretary approved eight new sites for nuclear power, demonstrating a renewed commitment to nuclear energy. The UK Government claims that nuclear power will “compete” with renewable energy sources. In 2014, David Cameron introduced policies supporting the exploitation of shale gas in the UK.

1) Does the UK Government’s position on nuclear energy influence your plans for development? If so, in what way?

2) Does the UK Government’s position on shale gas influence your plans for development?

Section B: Perception of Unique Features of French and German Policy Contexts

We have talked about policies in the UK which are relevant to environmental entrepreneurs. Now, I would like to ask your reactions to certain policies which are unique to

France and/or Germany. What are your reactions to the following features of French and German policy?

German and French Support Mechanisms

Germany operates a feed-in tariff system which is called the EEG. This feed-in tariff covers both small-scale and large-scale generation, so both smaller ventures and large utilities are covered by the same scheme, however, of course, the subsidy received depends on the size of generation of the electricity and the type of technology used. The German system has been reformed recently. From 2017, instead of receiving a fixed tariff, generators of over 100kw will have to market their electricity directly to buyers. Support will come in the form of premiums (top ups to market price of electricity) for which generators will have to bid. The number of premiums available in each technology will be determined by government plans for expansion of different forms of renewable energy and the value of the premiums applicable to each technology will depend on value of the bids received. This reform is designed to better integrate renewable technologies to the market and control costs for the consumer.

France has announced the phasing in of direct marketing with market premium scheme for more mature technologies (i.e. on-shore wind and solar), although it is as yet unclear exactly how this will work.

German Tax on Generators to Fund Support Mechanism

From 2014, generators who install new generation capacity, for their own use, will have to pay a tax on the electricity they generate. This tax will contribute to funding the cost of the support mechanism, described above, alongside the money levied from consumer and firm energy bills. Energy-intensive firms are excused from contributing to the funding of the support mechanism.

French and German Clustering Policy

France and Germany have invested heavily in promoting industrial clusters, some of which are in cleantech and energy. These clusters regroup firms, research establishments and other institutions, operating in an industry, in one geographical location in order to promote collaboration and enhance competitive advantage. Germany has invested €600 million in cluster programmes and France has a similar programme of developing world-wide clusters. Since 2010, the UK's focus on clusters has weakened amid greater public spending austerity.

French Overarching Energy Policy

France has traditionally been very reliant on nuclear power – this form of energy will account for 50% of final electricity consumption by 2025 which represents a reduction on current levels of 75%. However, the French Government has decided not to go down the route of unconventional gas. So, nuclear and renewables will be key drivers of future French energy policy.

German Overarching Energy Policy

Following the Fukushima incident, the German Government has pledged to abandon nuclear power by 2022 and has launched its vision for an energy future called "Energiewende" or Energy Transition. Under this vision, Germany aims to increase the share of renewables in its energy portfolio, but admits that shale gas and fossil fuels will play a part in bridging the gap in the meantime, resulting from the removal of nuclear power. As part of the promotion of renewables, the German Government has introduced a law to accelerate the extension of the electricity transmission network and made this a key pillar of the Energy Transition policy.

Additional questions

How important do you consider issues, such as energy security as a driver for your firm?

Is the geopolitical situation in regions, such as Ukraine and the Middle East a driver for your firm, as a renewable energy producer?

Is there any other policy or initiative, that I have not covered, which you feel is relevant to your firm?

Appendix 2 Field notes

Appendix 2.1 Overview of field note opportunities

UK	France	Germany
Lecture "Global Energy Challenges: the Role of Renewables", delivered at the University of Strathclyde by Dr. Ignacio Galàn, Chairman of Iberdrola, February 2015	Attended annual 2015 conference of the French Renewable Energy Union in Paris	Practitioner Energieforum, Leuphana University, Lüneburg, September 2014
Lecture "Perspectives on Current and Future Renewable Energy Law", delivered by Professor of Environmental Law and Policy, Marjan Peeters, Edinburgh, February 2015		Practitioner Energieforum, Leuphana University, Lüneburg, September 2015
Low Carbon Scotland Conference, Edinburgh, February 2015		

Appendix 2.2 Field note sample

Practitioner Energieforum, Leuphana University, Lüneburg, September 2014

Begrüßung

Speakers
Prof. Dr. Thomas Schomerus, Professor für Energie- und Umweltrecht, Leuphana
Markus Mews, Leiter Innovation und Umwelt, Industrie- und Handelskammer Lüneburg-Wolfsburg & Sprecher „Umweltschutz" für den Niedersächsischen Industrie- und Handelskammertag (NIHK)

Notes
-Die EEG Reform verkauft grösste Erfolge.
-Die Breite der Energiewende ist auch wichtig: Wärme unnd Mobilität sind Kernproblemen
-Die Energiewende wird von Unten vorangetrieben. Es gibt die Gefahr, dass die Reformen die Bürgerenergie gefährden.
-Die EEG ist ein Kompromiss: die Akteure wollten die Beschleunigung des Netzausbaus mit niedrigen Strompreisen
-Die Industrie will eine bessere Kooperation zwischen Bund und Ländern

Podiumdiskussion

Speakers
Prof. Dr. Erik Hansen, Professor für Management der Energiewende, Innovations-Inkubator, Leuphana
Lothar Nolte, Leiter der Klimaschutz- und Energieagentur Niedersachsen, Hannover
Dr. Nina Scheer, MdB, Mitglied im Ausschuss für Wirtschaft und Energie, Mitglied des Beirates der Bundesnetzagentur
Wolfgang Schmalz, Geschäftsführer, J.Schmalz GMBH, Gewinner des europäischen „Green-Blue Energy Factory Award", Glatten, Schwarzwald

Notes
-Man hat nicht erwartet wie schnell die erneuerbaren Energien so schnell ausgebaut wurden, und wie weit die Umlage gestiegen ist.
-Die Energiewende ist nicht nur eine Stromwende. Es braucht eine gesellschaftliche Lösung und nicht nur eine technische Lösung. Zussamenfüren ist sehr wichtig: Kommunikation. Es muss in eineem europäischen Kontext wahrgenommen werden, i.e. Energieaustausch
-Die Energiewende wird beeinträchtigt, ausgebremst. Wir sehen die alte Stromwirtschaft wieder, „Alte Hersteller der Wirtschaft haben an Einfluss gewonnen. „Kosten, Kosten, Kosten" ist in die Köpfen der Bürger gestellt worden. (Interessenkonflikte)
-Wir hätten einen grosseren Erfolg haben können
-Problem der Kommunickation: wir haben die Kosten in Griff
-Grosse Energiekonzerne haben „Existenz-Angst": wegen der Dezentralisierung der Energieerzeugung
-Energiewende 2.0: von der Verbaruacherseite, die flexibel reagiert.
-Die Geschäftswelt ist noch zu kurzfristig: „Manager werden an den Quartalbilanzen gemessen"
-Die Gebäudesanierung ist mit der Kostendiskussion verbunden (Energieeffizientere Häuser führen zu einem niedrigen Energieverbrauch – ich vermute das)
-Sanierung der öffentlicher Gebäude: Vorreiter: die öffentlichen Behörde sollten als Vorbild dienen
-Energieeffizienz ist die zweite Säule: „Energiebedarf der der Erzeugung entspricht"
-Verbaruchsstrafe (i.e. Eigenverbrauchsteuer): „Signal: Wir haben ein anderes Interesse als der Mittelstand"
-Angesichts der Verknappung fossiler Enerige wären die Subventionen vielleicht nicht so wichtig

Wärmewende/Wärmetechnik Session

-„Oettinger sagt, dass die Ukraine Krise zeigt, dass die Wärmewende eine politische Frage ist. Ich finde das relativ dramatisch"
-Suffizienz: „Wie, als Verbraucher, wir ein bisschen zurückhalten können"
-Solare Haustechnik als Basis der Wärmewende

Helmut Jäger (Solvis GmbH)
-„Politik ist die grösste Bremse": „negative Diskussion", „Wir gehen in das Steinalter zurück"
-„Negative Berichterstattung: Energiepreisen", „Die Politiker erwähnen Problemen ohne Lösungen vorzuschlagen"
-„Das sorgt für Verunsicherung: wohin geht die EW"
-„Wir müssen darauf warten, dass die Energiepreisen wieder ansteigen, wil wir ein bisschen wie Froschen im heissen Wasser sind", d.H: die Verbraucher werden an höhere Öl-und Gaspreisen gewöhnt und diese tolerieren statt sich an erneuerbare Energien zu wenden.
-„Es gibt so viele alter Kessler hier in Deutschland"

Jörn Leuschner (Richter GMBH)
-„gestiegener Ölpreis war dem Geschäft wichtig: zwischen 2008 und 2011 war der Ölpreis deutlich höher"
-„Komplizierte Anlagen fordern hohe Investitionen. Es gab negative Pressemeldungen darüber."
-„Fördermittel: eine Kesselprämie, wie die Kassenprämie für Autos während der Finanzkrise würde das Geschäft vorantreiben"
-„Es fehlt an Informationen: einfacthen, richtigen und verständlichen Informationen"
-„Die Förderung des Handwerks ist dringend nötig"
-„Internet, gut-informierte Nachbarn sind wie man Informationen herausfindet"
-„Gute Beratug ist nötig"

Workshop Podium
-„Ja, wir wollen effizienter und unabhängiger werden, aber es fehlt bei der Öffentlichkeit"
-„Putin Problem: Wir müssen in Deutschland unabhängiger werden"
-„Wir müssen in den Schulen sagen, dass Handwerk wichtige Arbeit ist"
-„Politik ist ungerecht, weil die Politiker permanent über Problemen reden"
-„Nur 1,7% der Bevölkerung in Deutschland kennen die Förderung"
-„Die Möglichkeit aber das Personal fehlt"
-„Im Gebäudebereich sind wir Meilen hinterher: Sanierung nötig um die Klimaziele für 2020 einzuhalten"
-„Aktuelles Programm ist ruckwärts obwohl die Energiewende politisch verkündet worden ist"

Workshop on EEG Reform

Professor Thomas Schomerus (Uni Lüneburg)
-„Je mehr man die Grenze (durch Korridore) überschreitet, desto steigt die Degression“
-„Diese Mengesteuerung fing mit Solar an, jetzt haben wir eine Mengensteuerung für Wind, für Biogas.“
-„Im nächsten Jahr (Wind), wird wir die Grenze überschreiten und wird die Degression steigen.“
-„Bei der Biomasse....haben wir dei Zubaugrenze um 100MW....das ist „nichts“....“
-„Vorher war es so, egal wieviel wir bauen, es wird gefördert. Das ist jetzt anders...“
-„Die Eigenverbrauchsteuer: das ist ein bisschen wie, wenn man Gürken im Garten anbaut und die wird versteuert....“
-„Man kann eine neue Strategie bezeichnen: diese Strategie: Wende der Energiewende. Es wird nicht merh von den Bürgern getrieben werden, das wird die Bürgerenergie sehr stark belasten“
-„Mindestqualifikationen bei Ausschreibungen? Das ist nicht geklärt. Das grosse Thema ist die Sicherheit.“
-„Wer nicht einen Zuschlag in der Ausschreibung bekommt, er bekommt keine Förderung. Wer kann sich das leisten? Das ist im Wesentlichen die Grossen. Das ist genau dieses Thema. Die Grossen werden wieder zurück im Geschäft.“
-„Wer wird ungleich behandelt? Die grosse Kohlenkraftwerke, grosse Firmen werden befreit. Die Mittelständischen müssen bezahlen während die Grossen befreit werden.“

Dr. Julia Verlinden (Politikerin, Bündnis 90/ Die Grünen)
-„Diese Debatte um Energiekosten überrascht mich immer, dass die Fokussierung so eng ist“
-„Die Tempo wird durch was die Bundesregierung entschieden hat ausgebremst“ (See Folie 3)
-„Die zentrale Frage ist:
-„Wollen wir eine dezentrale kostengünstiger Versorgung, die auf die Bürger angewiesen ist?“

Appendix 3 NVivo coding sample[2]

Coded at: Credibility of Government targets node, nested within Government Reliability category and Perceptions of Credibility of Government Action to Accelerate the Deployment of Eco-innovation thematic node

<Internals\\INTERVIEW TRANSCRIPTS\\Interview Transcripts UK\\ > - § 1 reference coded [2.50% Coverage]

Ehm…..I think that the government had the right intentions in making those commitments, I do think that they are being completely undermined by the actions of the Americans who are showing absolutely no signs of taking any commitment like that seriously and other nations are also not taking those actions and that makes…that means that they are not burdening themselves with the costs of developing these renewable technologies….and, therefore, the Americans, in particular, are taking the lead and, to a certain extent, the UK Government now appear to be backing off those commitments. They're legally-binding, but the parliament can always change the law and, amongst the investors that we would talk to, they're basically do not see any imperative behind this now and are now concerned that there's no market for renewable energy and, therefore, why should they invest in it?

<Internals\\INTERVIEW TRANSCRIPTS\\Interview Transcripts UK\\ > - § 5 references coded [6.90% Coverage]

although it has its legally-binding targets up to 2050, ehm…credibility comes when….I think it's really called into question when the government can't seem to look beyond 2020 and I think that's the concern really is what about the next thirty years? The government is so focused on getting to 2020 and, even within our sector, saying: "We'll we've got enough in the system up to 2020, therefore we don't need anymore…" There seems to be no forward thinking. That's my gut feeling on the act. There may be legally-binding targets there, but there seems to be no will to meet them.

Originally, it did. So, back in 2006, when…ehm…we started out the business, when we saw the Climate Change coming through, we saw it as a real opportunity to, you know, set

[2] Full interview transcripts are available upon request.

up a business…within the renewable sector and the act certainly was a cornerstone of that credibility. I have to admit that's been worn down over the years slightly….

The fact that the act is there no longer gives the security that it should for I think businesses wanting to invest in the sector…..

Again, there was a great launch: the Greenest Government ever, brining in the feed-in tariff. There was a big launch, a feeling that we were going to have an industry in the sector…the small-medium renewable sector, fitting within the feed-in tariff bandings and, ehm…that was supported by the government…, but, as time has gone on, and, we've seen what's happened with….we don't to solar PV, but, first of all, it was the solar PV cuts and, then, the drastic cuts to feed-in tariff rates within our banding, have again questioned the government's commitment to the feed-in tariff and the concern is that the feed-in tariff hasn't got long for this world…

However, ehm…the capping at £18 sends a strong signal that they're not expecting or want renewables to compete on a laissez-faire, free-market playing field, which is extraordinary really, that it hasn't been more ambitious and, yet again, it's putting into question the government's commitment to the renewables sector.

<Internals\\INTERVIEW TRANSCRIPTS\\Interview Transcripts UK\\ Interview Transcript> - § 1 reference coded [0.23% Coverage]

> the bottom line is I'm pretty sceptical about government commitments….That's a real shame is that there's a lack of leadership

<Internals\\INTERVIEW TRANSCRIPTS\\Interview Transcripts UK\\ Interview Transcript> - § 2 references coded [3.16% Coverage]

I think it's a reasonable policy…I've been mostly guided by Scottish Government policy which is to increase renewables even further by 2020, so I think their policy has been very credible…I'm not sure the UK government has put as much effort behind theirs as the Scottish Government has…I don't know if you've factored that into my study….

Appendix 4 Ethical procedures

ANNEX B: ETHICS REVIEW FORM – STUDENT DISSERTATIONS/PROJECTS

Name: CHRISTOPHER BALL **Student Number:** 1521407

Programme: PhD

Dissertation/Project Title: POLICY AND GREEN ENTREPRENEURSHIP IN FRANCE, GERMANY AND BRITAIN

I confirm that this project **DOES NOT** include any of the following:

	TICK
Research involving vulnerable groups (e.g. children, young people, those with a learning disability or cognitive impairment, or individuals in a dependent or unequal relationship)	✓
Research involving sensitive topics (e.g. participants' sexual behaviour, their illegal or political behaviour, their experience of violence, their abuse or exploitation, their mental health, their gender or ethnic status); instruments required for initial access to members (e.g. ethnic or cultural groups, native peoples or indigenous communities)	✓
Research involving deception which is conducted without participants' full and informed consent	✓
Research involving access to records of personal or confidential information concerning identifiable individuals	✓
Research which would induce psychological stress, anxiety or humiliation or cause more than minimal pain	✓
Research involving intrusive interventions which participants would not encounter in the course of their everyday lives	✓
Research where there is a possibility that the safety of the researcher may be in question (e.g. in international research; locally employed research assistants)?	✓
I confirm that I have completed procedures required by any secondary data provider (please attach any relevant documentation)	✓

I understand that:

If my research **includes** any of the above aspects, I will need to describe more fully how I plan to deal with the ethics issues raised by my research. **My research proposal will be subject to a full ethics review.** In such cases, the following information is required to be submitted (along with this form) to the Ethics Committee for approval:

- A copy of my dissertation proposal
- A summary statement, highlighting the ethical aspects and how they will be addressed

It is my responsibility to follow the University's Code of Practice on Ethical Standards and any relevant academic or professional guidelines in the conduct of my study. **This includes providing appropriate information sheets and consent forms, and ensuring confidentiality in the storage and use of data.** Any significant change in the question, design or conduct over the course of the research should be notified to the School's Research Ethics Committee Secretary and may require a new application for ethics approval.

Student's Signature: Christopher Ball **Date:** 07/02/2014

I confirm discussion of the above statements and that the student understands their responsibilities.

Supervisor's Signature: **Date:** 18/02/2014

REVISED OCTOBER 2012