Managing (Im)Permanence: end-of-life challenges for the wind and solar energy sectors

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Abstract

In the context of the global energy transition there is a need to consider the future contribution of wind and solar farms. Given tightening restrictions on new infrastructure, the dynamics of future expansion will likely depend on companies' ability to retain their licence to operate in existing sites, including potentially increasing output through repowering. However, this raises questions regarding perceptions of original siting decisions and how decisions should be made regarding their future. Impacting the urgency of such considerations are the dominance of time-limited planning consents that have often been used to promote sites as 'reversible' or 'temporary'. Through mixed-method research involving cases in England, Wales and Scotland, this thesis aims to understand how end-of-life decisions for wind and solar farms are considered, constructed and revisited. The research firstly reveals the scale of the issue and national government responses. Qualitative interviews reveal how the actors involved approach end-of-life decisions and whose time preferences tend to dominate. With publics' views of time widely invoked, surveys provide a deeper insight into local perspectives. To better conceptualise the issues at stake, this thesis applies a Deleuzian approach to exploring planning regulation and temporality using Barbara Adam's idea of time as multiple.

The findings reveal how multiple temporalities permeate end-of-life processes, influencing the context of sites and decisions. Notionally time-limited consents are often renegotiated. The complex reality of 'temporariness' is evident through discussions of wind farm removal and potential abandonment alongside widespread assumptions that decommissioning will be unproblematic. Although temporal preferences can be seen to vary amongst actors, the priorities of developers often dominate, although their decisions are shaped by wider economic factors. While most end-of-life applications get consented, community acceptance varies. This thesis thus reveals a need for future researchers to consider multiple temporalities when making sense of the interface between planning and energy.

Dedication

This thesis is dedicated to the memory of my Grandmother, Joyce Windemer. She will always be my inspiration.

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I would firstly like to thank my two fantastic supervisors, Professor Richard Cowell and Dr Neil Harris for their guidance, motivation and enthusiasm. Their insightful discussions and immense knowledge have been central in shaping this thesis. I left each of our meetings feeling motivated and enthusiastic about this research. I could not have imagined having better supervisors. I would also like to thank my reviewer, Oleg Golubchikov, for his thorough questioning and insightful feedback.

A wide variety of respondents participated in this research including planning specialists, renewable energy developers, government officers and members of the public, I would like to thank each of them for taking the time to participate. I would also like to thank the funders of this research, the Economic and Social Research Council.

I would like to thank my family and friends for providing a much needed support network, helping me overcome the challenges faced during this journey and making sure that I kept a work-life balance. Special thanks need to be given to my parents for always being there to listen to me and support me in every way possible.

Finally, but by no means least, I would like to thank my partner Ryan for his patience and endless encouragement, for being there for me every step of the way and for always believing in me, even when I didn't believe in myself.

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Chapter 1: Introduction

In the context of the challenges of climate change, there have been calls for a global energy transition away from fossil fuels towards zero-carbon energy sources, for which the development of renewables plays a crucial role (IPCC 2018). Wind and solar form significant elements of the global energy transition. In 2018 the total installed capacity of global onshore wind farms was 540,370 MW and solar was 485,826 MW (IRENA 2019b). In areas with good wind resources onshore wind provides one of the lowest-cost forms of electricity generation (IRENA 2017). The cost of onshore wind energy has rapidly decreased in recent decades; for example, the global weighted average cost of electricity produced by onshore wind decreased by 18% from 2010–2016 and improvements in performance have increased yields (IRENA 2017). Similarly, the cost of solar energy has decreased rapidly, solar module prices have decreased by approximately 80% since 2010 (IRENA 2017).

However, while providing energy benefits it is necessary to consider that large-scale deployment of both new wind turbines and solar panels may also create negative impacts, primarily through visual intrusion of the environment, but also in terms of using large areas of land, impacts on birds and wildlife, shadowing and (in the case of wind) noise. Significantly, as wind and solar are often more dispersed and land-intensive than fossil fuel energy sources (MacKay 2008) - in terms of the amount of land required for the infrastructure - challenges of possible displacement may emerge from increasing competition for land for other uses such as food production (Scheidel and Sorman 2012).

It is clear, therefore, that questions of inter- and intra-generational justice apply to renewable energy expansion. In many instances, renewable energy is assumed to be inherently beneficial to inter-generational equity by mitigating climate change risks and fossil fuel depletion. Yet renewable energy expansion also raises profound concerns about intra-generational fairness, especially arising from the distribution of diverse environmental effects (Sovacool and Dworkin 2015). The continuation of particular locations as areas for renewable energy generation poses questions regarding the duration of impacts on particular communities, but continuing generation also has ramifications for the duration of decarbonisation benefits. The future longevity of such infrastructure may be impacted by several factors, including the development and popularity of other renewable energy technologies and policy changes – it is neither permanent nor a given.

The regulation of time is central to these issues. The long-term supply of energy from renewables is very much caught up in planning processes in a whole number of respects (Ellis et al. 2009), including the widespread use of time-limited planning consents. In numerous countries wind and solar farms have been granted time-limited consents with the benefits of such consents frequently emphasised in discussions of the infrastructure as reversible or temporary (see Pasqualetti et al. 2002; Corvellec 2007; Jaber 2013; Dû-blayo 2014). The regulation of wind and solar infrastructure thus contrasts with nuclear or fossil fuels where sites are usually considered as permanent, granted longer or non-time-limited consents and thus have the potential to operate within the landscape for longer, without such regulatory control. For wind and solar, therefore, end-of-life decision-making is of broad importance and wider potential public significance.

As outlined in table 1 below, at the end of the consented or operational life of a wind or solar site developers have three main options: i) to decommission the site, removing the energy infrastructure, ii) to increase the existing consent life of the infrastructure without making any material changes to the site, through asset life-extension, iii) to repower the site, involving replacing the existing infrastructure with new infrastructure (in the case of wind this is often of a different number and size of turbines), potentially involving different amounts of re-use of equipment and structures on the site. There is also the potential for a fourth category, infrastructure abandonment, where all or part of the infrastructure (potentially including elements such as concrete hardstanding, cables, and transmission equipment) may remain abandoned in the landscape without requirements on any actor for removal.

The expansion of renewable energy appears caught between several temporal dilemmas. Low carbon transition thinking tends to assume that investment should be long-term/permanent, but individual facilities are regulated as though they are temporary. The renewable energy industry presents its effects as reversible (Corvellec 2007), though this raises questions regarding how this relates to the actual unfolding of end-of-life decisions. Meanwhile, there is a lack of consideration of the impacts of how the planning system regulates time or the use of terms such as temporary and reversible. Continuing generation on existing sites through repowering or life-extension can provide many benefits, notably sustained or increased energy generation and thus income to owners, landowners and possibly communities. In development terms, such sites can benefit from existing infrastructure such as access and grid connectivity as well as existing performance data, which helps to inform design. Land is a finite resource and through installing more efficient infrastructure repowering is a way of enabling greater efficiency from the same or less land. However, a continuation of a wind or solar farm site will mean the continuation of visual impacts and other negative externalities. The decision-making process is thus multi-layered and not straight forward.

This thesis seeks to understand how decisions regarding end-of-life procedures for solar and wind farms are considered and made by developers, landowners, and planners as well as the communities in which the facilities are located. It seeks to explore the dynamics of the decision-making process, including whose interests are reflected and whose are left out when decisions are made about time. Through mixed-method research involving multiple case studies, it aims to understand how the duration of solar and wind farms are considered by the range of actors involved and how this influences end-of-life decision-making for this infrastructure. It aims to explore the practices by which the effects of development are made 'temporary' or 'reversible' by regulatory processes, how some impacts are embraced but not others, and how this influences the prospect of subsequent redevelopment. In doing so, it aims to develop understandings of the broader impacts of how the planning system considers and regulates time. (The research questions are introduced later in this chapter.)

Table 1: End-of-life options for wind and solar infrastructure

Option	Aim	What is involved
Repower	To remove the existing infrastructure and replace with new infrastructure, usually with a higher energy output. For wind farms this often involves replacing the existing turbines with a smaller number of larger turbines in a different layout.	This requires a full planning application and all associated planning reports to be submitted.
Life-extend	To extend the duration of the infrastructure's planning consent for a period of time (usually 5-10 years for wind and 15+ for solar), with no material changes to the site.	This requires the duration condition of the original permission to be altered through an application to amend the planning condition (but no other parts of the application). In England this is achieved through a Section 73 application.
Decommission	To end the operation of the infrastructure and remove infrastructure from the site.	Decommissioning and removing infrastructure from the site in accordance with what is specified in the planning conditions and legal agreements for the site.
Abandon	To abandon the infrastructure without removing it from the site.	Leaving all or parts of the infrastructure on the site once it is no longer working. This is legally possible if there are no legal requirements for removal.

1.1 Research background and rationale

This thesis is located at the intersection of a number of major overlapping debates: in energy transition, in dimensions of sustainability (particularly reversibility and justice), and in the treatment of time in planning. These elements form the context in which decisions regarding the lifespan of energy infrastructure are made. They intersect primarily on issues of time, i.e., the time taken (and time pressure) for energy transitions to occur and the treatment of time in sustainability and planning. They also reveal the range of material and non-material elements influencing end-of-life decision-making for renewable energy infrastructure.

1.1.1 Energy transition

The global energy transition provides the broader background context for this thesis. The energy transition is used to describe the global move towards sustainable energy systems in the context of the challenges of climate change and the pathologies of fossil fuel dependence (Solomon and Krishna 2011). Vital to the energy transition is its temporal dynamics due to the need for it to occur quickly to respond to the global challenges (Sovacool 2016). However, there is expected to be a limit to the speed at which new energy technologies can be implemented due to the requirements on human and industrial capacity and the time required to scale-up a technology, as well as the need for land and enabling technologies to support developing energy systems (Kramer and Haigh 2009).

In the context of such challenges, understanding the potential future of existing renewable energy generation capacity is imperative. Continuation of existing sites may be crucial as if sites are not sustained through repowering or life-extension it could reduce overall renewable energy output. However, the energy transition may bring new (more efficient) technologies that may replace existing renewable energy technologies, thus understanding the decommissioning process and the wider effects of developments on places and ecosystems may also be necessary. Moreover, the extent to which project owners are made liable for the total effects of their infrastructure could affect the economics of renewable energy, as it does all energy systems (and indeed, development more widely).

1.1.2 Questions of justice

In the context of an energy transition, there is a need to consider questions of justice, particularly how decisions are made and impacts distributed over time and space. As noted above, the topic of this thesis closely relates to questions of both intergenerational and intragenerational justice. Decisions regarding the future of sites (particularly concerning the location and longevity of infrastructure) raise questions regarding the possible impacts on future generations as well as the current generation. Of particular importance is how the future is represented and considered, especially given the well-known and seemingly deeply entrenched short-term bias in policymaking (Boston 2016).

There is a significant body of literature exploring energy justice concerns, identifying a need for energy policy to address justice through considering the distribution of negative externalities including how decisions are made regarding the siting of infrastructure (Jenkins et al. 2016). As well as considering who is winning and suffering as a result of decision-making, there needs to be consideration of procedural justice relating to how decisions are being made and who is involved in and influencing the decision-making process (Sovacool and Dworkin 2015). Both dimensions apply in various ways to this thesis topic as the first wind farm sites are often the best located in terms of wind resources (Hulshorst 2008) and thus repowering creates clear benefits in terms of increased energy generation and contributions to addressing climate change. However, questions can be raised regarding fairness for local communities in extending the life of infrastructure and thus extending the impacts, especially where facilities were consented in ways that seemed initially time-limited. In the context of end-of-life decision-making, this raises questions regarding how decisions are made, the weight given to the different actors involved, and if anyone is considering and reflecting the interests of future generations. Of particular relevance to this thesis is responsibility, particularly the recognition that current generations have a responsibility to not adversely impact future generations (see Heffron et al. 2015) and a further dimension of justice, recognition of impacts (see Schlosberg 2017).

1.1.3 Energy acceptability and perceptions

Another significant component influencing the energy transition is energy acceptability, which draws upon ideas of social acceptance regarding the perceived impacts of energy infrastructure (Devine-Wright 2007). Concerns about energy acceptability and perceptions have generated a considerable body of research with its own temporal characteristics. It has produced insights regarding the change in attitudes before and after a renewable energy development has been constructed, suggesting that familiarity with a development can lead to contentment (see Warren et al. 2005; Wolsink 2007; Eltham et al. 2008; Wilson and Dyke 2016). However, such studies are limited in scope, often solely focused on community perceptions rather than those of other relevant actors. The literature also largely lacks consideration of institutional frameworks (Wolsink 2018b). Furthermore, existing research often appears to consider the development and decision-making process in simple binary terms (i.e., the infrastructure was not there and now it is, or in the case of decommissioning, it was there and now it is not), ignoring the complex reality and scope for projects to evolve and change over time.

1.1.4 Reversibility

The term reversible has been used within planning practice and particularly by developers,[1] to highlight that renewable infrastructure can easily be decommissioned, leaving limited or minimal impact on a site with no off-site effects (Pasqualetti et al. 2002). Particularly in the case of wind, the lack of permanency of the infrastructure has been argued to enable sites to easily return to their previous condition following decommissioning (Jaber 2013). Wind farm developers have used the concept to promote the benefits of schemes by arguing that they can easily be removed at the end of their economic or technical life (Corvellec, 2007). This benefit can be contrasted with traditional fossil-fuel energy sources, which can cause long-lasting impacts through ecosystem damage or contamination (Fthenakis and Kim 2009) and nuclear energy which is often associated with long-term risks (Parkhill et al. 2014). Reversibility as a concept also links to ideas of justice and equity, particularly regarding distributive justice between the current generation and future generations. There are also justice benefits of ensuring that the infrastructure can be removed without leaving any impacts as irreversibilities impinge on the choices, and possibly welfare, of future generations.

As a concept reversibility has entered the lexicon of debate about the relative sustainability of different energy sources without being clearly conceptualised or unpacked. However, the closer one looks at reversibility, the more intricate it becomes. Adam (1998) critiques the use of the term within environmental discourse as assuming that any changes that may occur over time can be reversed. The concept can be seen as problematic in the case of renewable energy technologies as it assumes that a site can be returned to the way it was before the infrastructure was in place and, through doing so, ignores the range of physical and social changes that may occur during the lifespan of a development. The issue of reversibility can also be seen to be incorporated within broader questions of how and why particular features of the environment are valued (Owens and Cowell 1994) and thus which are replaceable and if complete replacement matters for all features. In the context of this thesis, the claims that the ability to reverse the infrastructure at the end of its operational life increases the sustainability of the infrastructure require exploration, including ideas of responsibility and agency, both for defining ‘reversibility’ and for bringing it about.

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[1] Planning applications often contain wording such as ‘All of its effects would be temporary and reversible upon decommissioning’ (Quote from Kirkby Moor repowering planning statement, 2014, 6.3.19).

1.1.5 Considerations of time within planning

Time and how it is considered and controlled is central to this research and is a crucial consideration missing from much of the existing literature on renewable energy. Time can be seen as a fundamental component of all of the above debates as well as to the physical regulation of infrastructure. In most countries regulation of energy infrastructure concentrates on the project consenting process, supported to varying degrees by wider policies. While major energy projects often entail some form of specialised permissions, the spatially extensive nature of renewable energy means that it is often governed through systems of land use planning or spatial planning (Kellett 2003; Cowell 2007).

Despite the claims of planning to be a future-orientated activity (Couclelis 2005) and the evident existence of longer-term plans, research has identified that planning often focuses on issues that are having the most significant impact on the near-future in order to achieve short-term results. This is often a result of the influence of short budget cycles and political timeframes (Myers and Kitsuse 2000; Van Der Knaap and Davidse 2010). It has been suggested that due to a focus on short-term results planning may leave certain decisions to be made in the future (Myers and Kitsuse 2000). However, there is a lack of consideration regarding how planning regulation, partially and incompletely, comes to try and organise the temporality of spatial change caused by energy developments. Indeed, other than considerations of temporary urban land uses, time-limiting planning regulation is nowhere extensively researched.

Different countries address the temporal dilemmas of renewable energy in various ways. In the electricity-generation field in Great Britain, time-limited consents apply only to wind and solar (not nuclear, fossil, or hydro) and most planning permission for built structures are granted in perpetuity – time limitations are the exception. Time-limited planning permissions for wind and solar have often been described as temporary; however, the term is open to a great deal of interpretation. Time-limited or temporary planning consents could be seen to act as a promise for the future (see Abram and Weszkalnys 2011) that the development will be removed, but there is a lack of consideration regarding if and how this happens in practice and thus if there is a potential for abandonment of all or part of the infrastructure to occur. There is a need to understand and explore how both planning literature and practice consider such notions of time in order to improve our understanding of how to treat the end-of-life of renewable infrastructure and thus how to also treat both the duration and physical impacts of its presence. Developing such an understanding will be valuable in ensuring that wind and solar can contribute to the energy transition and in developing our knowledge of how time is treated in planning regulation more widely.

1.1.6 The end-of-life of renewable infrastructure

While the terms temporary and reversible have been used within planning practice to argue in support of the sustainability benefits of wind and solar farms, there appears to be a lack of detailed consideration regarding how this occurs in practice through end-of-life decision-making. There are a small number of studies exploring issues surrounding decommissioning, repowering, and life-extension of onshore wind (for example, Möller 2010; Himpler and Madlener 2012; Ziegler et al. 2018). However, existing studies tend to be focused on specific aspects, such as economic benefits, and fail to provide details regarding what factors are being considered and controlled within regulatory systems. More comprehensive treatments of end-of-life issues are rare and of very recent parentage (see, for example, RenewableUK 2019).

While renewables are claimed to be easily removed from the land (Pasqualetti et al. 2002), there is a lack of understanding regarding if and how this occurs, how decisions surrounding duration are decided, and when. Understanding the temporal aspects of the regulation of infrastructure is likely to be important in the context of future competing land uses or changing policy or technological contexts. Such considerations are also necessary in the context of energy and procedural justice and possible changing social attitudes towards renewable infrastructure, which link to wider industry debates within planning about the distribution of the impacts of technological change (see, for example, RTPI 2016).

1.2 Adopting a Deleuzian approach

This thesis suggests that the impacts of renewable energy development on landscapes, communities, and energy transitions need to be considered less in the binary terms of presence-absence, but rather conceptualising a world in which developments, environments, and social concerns are all in flux. Questions arise as to how energy landscapes are made and remade over time and the dynamics of resistance (Nadaï and Van Der Horst 2010). To better grasp these temporal dynamics, the thesis adopts Deleuzian theory and concepts. According to such a perspective, entities (such as wind farms) need to be considered in terms of what they could become rather than simply in terms of their being (DeLanda 2006). Key to such an approach is the concept of assemblages, which refer to all entities being formed from both human and non-human elements (DeLanda 2006) and the idea of everything being a multiplicity, i.e. ‘a complex structure that does not reference a prior unity’ (Roffe 2010,181). This thesis draws upon Bonta and Protevi's (2004) development of the assemblage concept to ‘complex spaces’ which describes land as a combination of different assemblages, reflecting how at one moment in time the land can be subject to multiple different uses by different actors. The term depicts land as being formed of a combination of spaces comprising different human and non-human entities that change over time. From such a perspective wind or solar farms can be considered as complex spaces involving, for example, turbines, the community, animal grazing, habitats etc.

Deleuze and Guattari's (1987) concepts of striated and smooth spaces are also drawn upon to depict the way in which assemblages and complex spaces are formed and changed. Smoothing space involves removing existing characteristics that were formed by others, while striating refers to the process of defining and closing spaces in order for an entity to meet its operational requirements (Deleuze and Guattari, 2004). Such processes may reflect how wind farm sites change over time to accommodate or become different uses i.e. through striations such as policy changes or processes of smoothing such as the end of consent life. Such concepts facilitate consideration of the range of different factors that may result in change, rather than assuming that decisions are simply being controlled and directed by the planning process.

A Deleuzian approach facilitates an exploration of the multifaceted nature of planning through consideration of the intricate relationships between human and non-human influences, including the multiplicity of space-time dynamics (see Hillier 2008). It informed the design of the research through emphasising the importance of understanding how the multiplicity of elements influencing sites change over time, shaping the regulation of renewable energy infrastructure. It was chosen over other conceptual frameworks that address human and non-human elements as approaches such as Actor Network Theory that seek to map assemblages have been criticised for producing data that is highly descriptive (Robbins and Marks 2010). Deleuzian ideas of being and becoming (see Deleuze and Guattari 1988; 2004) were significant in the design of this research in terms of their sensitivity to flux and to understanding what drives the becomings of the various assemblages influencing renewable energy projects and research participants. The research explores the views of different actors and the multiplicities of factors influencing their considerations regarding the end-of-life of renewable energy schemes and the future of the spaces they occupy. It explores the complex spaces of wind farms and the striation and smoothing of spaces leading to changes or continuations in the use of the land. Sensitivity to a Deleuzian-inspired ontology is also reflected in the desire of the research to capture end-of-life decisions at the beginning, end and any interruption point in a facility's life (i.e., becoming) and to understand how broader changes in society, landscape, planning or the developer impact on what becomes. The approach also enables consideration of how planning policy and applications changed throughout the research.

1.3 Research aims and design

1.3.1 Providing an original contribution to knowledge

While the energy transition is recognised to be a temporal process (Sovacool 2016), remarkably little attention has been given to the temporal dynamics of renewable energy roll-out beyond initial development and to how project-level considerations relate to wider patterns of change. However, such consideration is critical both to grasping whether and how such infrastructures remain in place over time. This thesis addresses gaps in our understanding of how the duration of energy infrastructure is considered and how end-of-life decision-making for solar and wind farms occurs. It does so through exploring how the duration of the infrastructure and end-of-life options are considered by the range of actors involved in a scheme, the regulatory planning system and wider publics.

1.3.2 Research aims and methods

The main aims of the research are as follows:

- To understand how the 'temporary' and 'reversible' nature of wind and solar farms are considered, constructed, or resisted by the range of actors involved and how this influences end-of-life decision-making for the infrastructure.

- Through doing so, it aims to explore the reasons for particular temporal preferences, how end-of-life decisions are made, whose interests are included and excluded in that process, and with what consequences. It also seeks to consider if changes in the surrounding physical, social, cultural, or perceptual area, or shifting opinions of the site, developer, or technology influence considerations regarding duration and end-of-life options.

- It thereby aims to understand the challenges for planning regulation and the wider impacts of how the planning system considers time.

These aims are delivered by addressing the following three research questions:

1. How do different actors (including developers, Local Authorities, the public, and any others) prepare and plan for end-of-life decision-making for wind and solar facilities? For each actor:
   a) What end-of-life factors matter?
   b) What timeframes are sought and invoked?

2. Whose preferences most significantly shape end-of-life decision-making?

3. What are the wider consequences of how the temporalities of renewable energy infrastructure are regulated?

To answer these questions, a research strategy was developed that facilitated the exploration of multiple scales, temporalities, perspectives, and contexts. A multi-stranded research design was chosen to understand the wider policy context and experiences of the sector, supported by detailed cases and survey work that sought to access the views of diverse actors. A mixed-method methodology enabled an exploration of the perspectives of the range of actors involved and the interactions between them, the project, and its wider environment, including a consideration of what interests dominate and which get marginalised. The use of multiple cases enabled the questions to be explored from different contexts, including the stage of life and type of energy infrastructure, in order to identify common and diverging attitudes, experiences, and opinions. The research design is discussed in chapter 3.

1.4 Research boundaries

To ensure that the research was achievable within the allocated time boundaries had to be set. Wind and solar energy were chosen over other renewable energy technologies due to the scale and rate of their development at the time of writing (2016-2019) and the range of impacts they create. The International Renewable Energy Agency identified that the increase in renewable energy capacity continues to be led by new solar and wind energy installations, with figures 1 and 2 below demonstrating the global growth in capacity over time (IRENA 2019a).

Figure 1: Global Installed Capacity (MW) of onshore wind 2010-2018

Graph recreated from International Renewable Energy Agency[2]

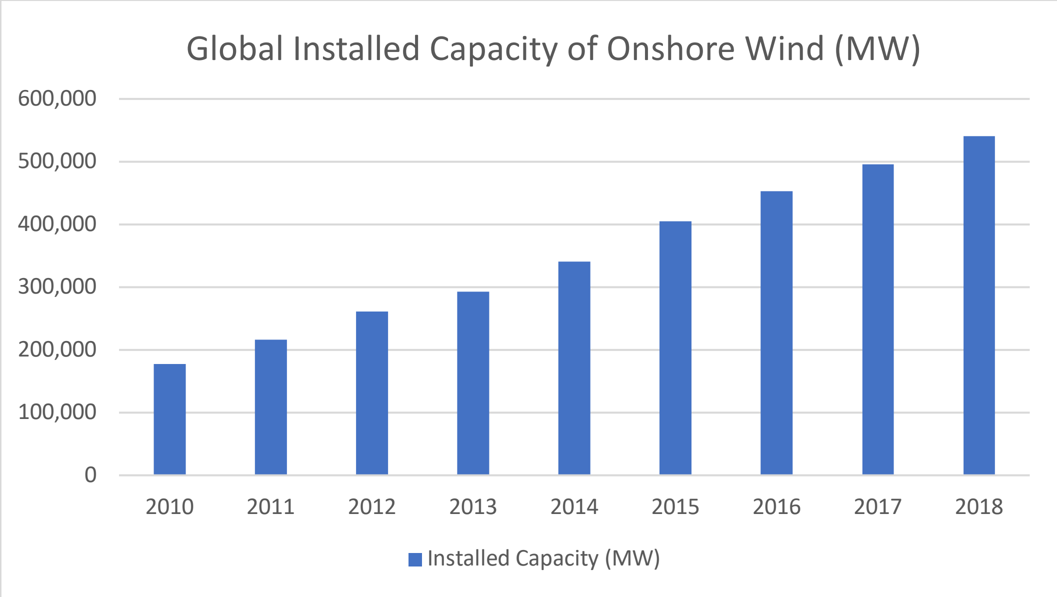
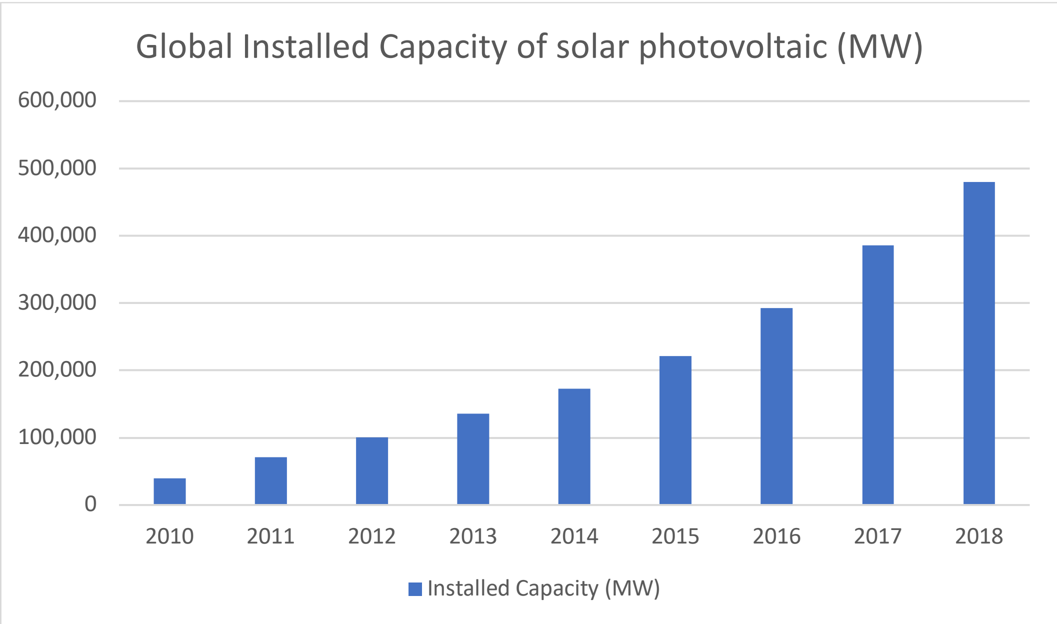


Figure 2: Global Installed Capacity (MW) of solar photovoltaic 2010-2018

Graph recreated from International Renewable Energy Agency



[2] See www.Irena.org (accessed January 2019).

Wind formed the greater element of the thesis due to the age of the infrastructure, as in numerous countries wind energy sites are starting to reach the end of their permitted or operational period, resulting in both greater need and opportunity to understand end-of-life decision-making processes. For solar, there is little existing research exploring considerations of its impacts and lifespan, thus providing another clear research gap. Certainly, the cost of solar PV (relative to 2015-2016) is expected to halve again by 2020 (IRENA 2018), driving global uptake, but its comparative recency means attention to solar is the lesser component of this research.

Since 2000, UK electricity supply from solar and wind displayed a marked upward trend through to 2018 due to generation capacity increasing each year. Onshore wind capacity increased 18.1 % from 2016-2017, while solar photovoltaic installed capacity increased by 7.3 % (GovUK 2018). England and Wales were initially chosen as the locations for the research as at the time of the research wind farms in both countries were beginning to reach the end of their operational life with repowering and life-extension having started to occur. The use of time-limited 25-year consents was also common in both countries, raising interesting questions regarding how the duration and future of the infrastructure are considered. Background research into the policy context revealed noteworthy differences in Scotland and thus it was also included in the research design. When designing research there is always a depth-breadth trade-off (Teddlie and Yu 2007) and in this case it was essential to focus on the diversity of experience between projects rather than between policy contexts – initial analysis revealed that national policy was not (yet) determinate in the treatment of end-of-life decisions. As a result Northern Ireland was not included in the study. It was also felt that issues and conditions within Great Britain reflect the situation in many other countries, meaning that the research findings have relevance to other jurisdictions.

This thesis draws upon literature and insights from a range of disciplines and covers several inter-disciplinary topics including consideration of time, landscapes, energy perceptions, energy justice, and regulation. While it would be possible to situate this research in various disciplines, it was felt that planning was the most appropriate for numerous reasons. Situating the thesis within the discipline of planning enabled an exploration of the complexity and multi-dimensional nature of decision-making, including the perspective of the range of different actors involved. Other disciplines, such as energy geographies or energy justice, tend to focus more on the public and offer few specialist insights into land use decision-making or regulation. In the end, regulatory processes are the nexus between temporal processes and diverse actors and have time signatures of their own (Marshall and Cowell 2016), so it was necessary to give centre stage to how the planning system regulates time and therefore how end-of-life decisions are considered. Although the thesis is located intellectually within planning, that is not to say that planning processes are necessarily major determinants of outcomes, whether that is so is something the research presented here set out to discover.

1.5 Structure of the thesis

This thesis is divided into eight chapters. The following chapter provides an overview of the existing literature in the field, including identification of research gaps and discussion of the theoretical perspective influencing this thesis. The research design and methodology are discussed in chapter 3 including an explanation for why mixed-method case study methodology was chosen for this research, how it reflects the epistemological and ontological position of this thesis and a discussion of each method.

The findings from the research are presented and analysed in three chapters. The policy context influencing the duration and end-of-life decision-making for onshore wind and solar is presented in chapter 4, including a discussion of how policy has changed over time and a comparison of the policy context of the three countries covered in this thesis (England, Wales and Scotland). This chapter also covers the scale of 'the problem' i.e. the age and status of British wind infrastructure including the extent of life-extension, repowering and decommissioning, and public responses to applications. Chapter 5 presents the findings of the case study research, exploring how end-of-life decision-making occurred and was considered by the various actors in each case. Chapter 6 then focuses on how the public considers the duration of infrastructure and end-of-life decision-making by providing the results of public surveys undertaken with residents living close to two wind farms.

In chapter 7 the findings from the empirical chapters are brought together and discussed, including a discussion of patterns and differences amongst the case studies. The concluding chapter presents a summary of key findings for each research question and an evaluation of the research. The implications of the research for our empirical and theoretical understanding of end-of-life issues with renewable energy and how the regulatory planning system considers time, including recommendations for future research, are provided and insights for policy and practice are discussed.

Chapter 2: Time, planning and renewable energy, a review of the literature.

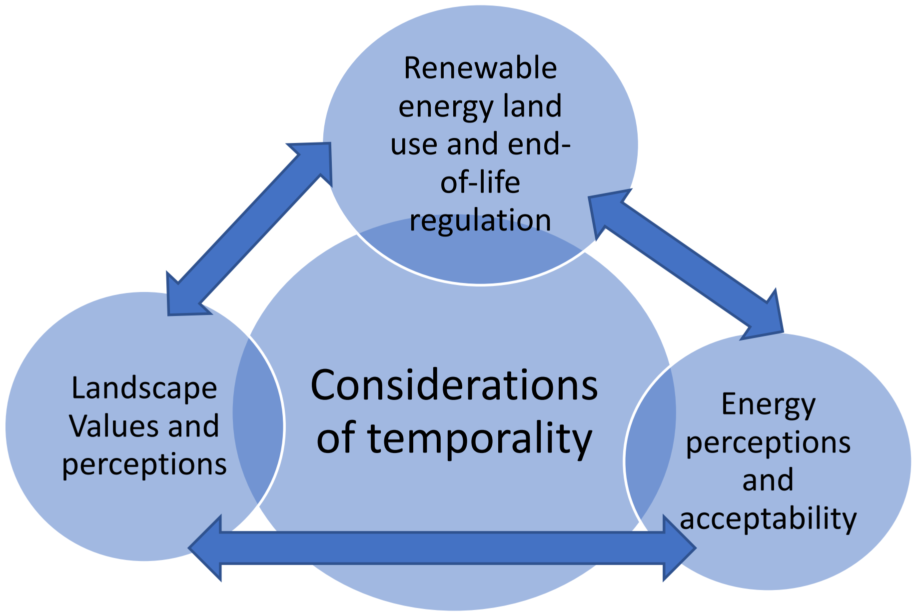
2.1 Introduction

This thesis brings together several strands of literature in order to explore how the temporal impacts of renewable energy infrastructure have been considered and contextualised. The literature reviewed includes the following: i) considerations of time in planning and theoretical considerations of time, ii) the physical regulation of energy infrastructure including land-use characteristics, end-of-life decision-making, decommissioning, and the concept of reversibility, iii) energy perception and acceptability studies, iv) landscape values and perceptions, and v) theoretical insights from Deleuze.

While the review focuses on the discipline of planning, it draws upon broader insights from geography and sociology. The bodies of literature explored within this chapter discuss the multi-dimensional concepts of landscape, time, and energy acceptability that overlap and offer fruitful lines of thinking. The concept of time and how it is considered and treated is a central theme linking the bodies of literature (see figure 3, depicting the overlapping nature of the bodies of literature). This review explores ideas and understandings of time in order to investigate how the temporary nature and impacts of renewable infrastructure might be considered from both a theoretical and practical perspective. Through doing so, it reveals the multifaceted nature of how time is considered and informs the identification of suitable conceptual approaches to the research problem and the nature of the knowledge gap.

In order to develop the insights from these bodies of literature, a conceptual approach is required that explores how the temporal aspects of development are considered in planning regulation and processes. This needs to be sensitive to the current lack of consideration of how end-of-life decision-making occurs in practice, how the regulatory notion of planning considers multiple dimensions of time and how notions of temporariness and reversibility are constructed and applied. As this review makes clear, this means considering the impacts of renewable energy development on landscapes less in the binary terms of presence-absence, but conceptualising a world in which developments, environments, and social concerns are all changing over time. In order to facilitate such an understanding, a Deleuzian perspective is applied, drawing upon the work of Deleuze and Guattari (1980; 1988; 2004) as well as those such as Jean Hillier (2008; 2011) and Bonta and Protevi (2004) who have applied Deleuzian concepts to planning and land-use regulation. Deleuzian theory can be seen to link the bodies of literature in this review by enabling an exploration of the multiplicities of human and non-human elements influencing sites over time, shaping the potentials of what sites might become in the future.

Figure 3: The overlapping bodies of literature influencing this thesis



2.2 Considerations of time

Planning is suffused with temporal considerations, both within and beyond the subject matter of this thesis. At the level of practice, within numerous planning systems solar and wind farms have been granted time-limited planning permission (often referred to as temporary), in Great Britain this period is usually 25-years. The use of such temporary permissions appears to differ from the standard use of temporary planning consents as temporary uses have often been considered as 'secondary or provisional, a stand-in or substitute for the preferred permanent option' (Németh and Langhorst 2014, 144), especially with the regeneration strategy of urban areas (Patti and Polyak 2015). However, the term temporary is open to a great deal of interpretation. To make sense of what temporary can mean and entail there is a need, first, to explore how planning literature considers time. The research literature that exists identifies several tensions surrounding conceptions of time in planning. The following section of the review explores these tensions and engages with those arguing for the need to move beyond a linear notion of time, particularly drawing upon the arguments of Barbara Adam (1994; 1995; 1998; 2003; 2004) that there are multiple co-existing temporalities.

2.2.1 Long-term aims and short-term action

How time is conceptualised can influence the focus of planning as well as how it treats and considers the future population (Moffatt 2014) and analysts have identified numerous issues here. While a pervasively name-checked aim of planning is to consider the long-term future (Couclelis 2005) there are a number of counter-theses to the view of planning as focused on the long-term (see Myers and Kitsuse 2000; Couclelis 2005; Van Der Knaap and Davidse 2010; Moffatt 2014), involving the influence of economic pressures and uncertainty about the future. Critics of contemporary planning practice have argued that it has moved away from its aim of achieving strategic long-term visions to focus on short-term managerial and operational activities (Couclelis 2005). Despite the creation of long-term plans and planning's claims to provide a longer-term perspective than many other public policies (Moffatt 2014), it can often be seen to focus on issues that are having the greatest impact on the near-future in order to achieve political gain and short-term results (Myers and Kitsuse 2000; Van Der Knaap and Davidse 2010).

The focus on shorter timeframes has been linked to the influence of short budget cycles and the timeframes of political candidates (Myers and Kitsuse 2000) as well as the prioritisation of efficiency within the development process and influences of increasing costs and decision-making that reflects the private sector at the expense of longer-term considerations (Moffatt 2014). Despite its image of being future-oriented then, planning is vulnerable to wider critiques of public policy that it is often focused on the short-term or present at the expense of longer-term considerations (see Boston 2016). Such a policy focus on the short-term has been partially explained by 'the pervasive impact of uncertainty on decision making' (Boston 2016, 95) which increases as one steps further into the future and that prospective future beneficiaries are poorly represented in decision-making processes.

Emerging from this, one can begin to see how planners often use certain notions of time as organising concepts (Davoudi 2012), resulting in a structured system, but one that is also inevitably selective. From this perspective, planning policy can be seen to favour certain notions of time that it expects communities to fit into, such notions of time often include strategies of phasing development or the time boundaries in plans. This links to critiques regarding the self-belief of planners that they are uniquely able to successfully consider the future (see Davies 1972). Graham and Healey (1999) argue that different actors involved in the planning and development process operate on diverse notions of time and through favouring certain notions of time, such as the fixed-time plan periods, the planning system may undermine and disempower certain interests. They identify that it is often the more powerful groups with clear understandings of their space-time parameters, such as corporate interests, that have the most influence (see also Raco et al. 2018). Demonstrating this, Marshall (2002) identified how changes to speed-up regional planning processes in England led to greater power and influence for groups who were the most organised, well-resourced, permanent and had the greatest expertise, particularly the government. Similarly, Marshall and Cowell (2016) in a study of major infrastructure (transport and electricity generation) projects identified the relationship between power and timeframes, noting how public decision-making processes (like public examinations) often face tight regulation of timeframes while developer-led aspects of project management (like raising finance) often do not face such tight regulation.

Further highlighting the complex relationships between planning and time, Abram and Weszkalnys (2011) portray planning as a promise between now and the future, expressing a particular intention and thus producing a set of relations that should endure over time. However, in their discussion of land-use plans, they noted that promises in planning can involve varying degrees of ‘concreteness’ and ‘institutionalization’ and thus have significant potential to break down. They emphasise that the future promised by planning is always slightly elusive and out of reach, particularly as planning has an increasing focus on managing the present, thereby leaving problems to be resolved in a postponed future.

In various respects, considerations of time within planning can be seen to echo economic ideas regarding discounting the future. In short, this contends that people discount the future as they place a higher value upon immediate rewards than future rewards, even if the future reward (or costs) may be greater in absolute magnitude (Myerson and Green 1995). This can be seen to relate to the way in which regulatory notions of time within planning leave certain decisions to be made in the future due to a focus on achieving short-term results (Myers and Kitsuse 2000). There is not space here to do justice to the extensive literature on discounting and its critics (see Pearce et al. 2013), but central concerns are that planning reflects the social rates of time preference of its political masters and the sectors that it regulates and that there are associated opportunity costs of capital i.e. when a decision is made there is a loss in potential gain from alternative decisions. The central criticism of such discounting is that it neglects the interests of future generations (raising issues of inter-generational justice).

2.2.2 Beyond a singular, linear notion of time

The current approach in planning practice is dominated by the regulatory notions of time in the sense of fixed start and end points imposed by the planning system (Davoudi 2012). Here, time has traditionally been conceptualised as a linear process that can be measured in a single dimension (Madanipour 2010) and is therefore often referred to as 'clock-time' (Ingold 1993; Adam 1998). Such a linear notion of time appears to be embedded in the planning system, such as through time-periods in development plans (Graham and Healey 1999) or the period in which a development must be commenced once granted planning permission. Linear time provides some benefits, particularly through creating a structured, measurable focus, enabling regulation of the present and, to some extent, the future too. However, the linear temporal focus of planning has been criticised for having a restricted, bounded notion of both time and space and for divorcing concepts of time from concepts of space, thereby ignoring how both time and space are produced through social action between and within places (Graham and Healey 1999). Moreover, one critique of planning practice is that it often lacks consideration of how the meanings that people associate with built development may change over time and the influence this can have on conflict and consensus (Moffatt 2014).

In the context of such critiques, planning analysts have started drawing upon insights of time developed in other disciplines. Questions have emerged regarding how time is conceptualised and treated within planning due to a recognition of the multitude of stakeholders and associated temporal connections (Madanipour 2010). Planning researchers have begun to build on the basic idea that time is not linear to explore how planning needs to understand multiple aspects of time (Del Río et al. 2011). From such a perspective planning processes can be seen to be influenced by several interconnected dynamic variables, such as laws, costs, uses of spaces etc, that are continually changing through non-linear processes. Meanwhile, the opinions of actors may also be changing over time (De Roo and Silva, 2010).

Literature looking beyond clock-time has developed ideas of time as something that is experienced rather than measured (Hicks 2016). Such an approach facilitates an exploration of the role of multiple temporal processes influencing human relationships with place. Understanding time as multiple processes also facilitates investigation of how considerations of time differ amongst actors. For example, time as expressed by those involved in enacting the regulatory function of planning, is likely to be different from time as experienced by the affected population (Moffatt 2014).

While it has been recognised that different timeframes are operating within planning and the many and various activities that planning engages with, they have not been fully considered within the planning system itself (Van Der Knaap and Davidse 2010). Contemporary planning has been identified as comprising conflicting temporal processes including different envisioned futures within planning documents, changes occurring outside planning such as demographic and ecological changes and the temporal cycles of producing planning documents (Abram 2014). Abram (2014) identified that the timeframe of a plan may be different from the lived horizon of a person impacted by the plan, suggesting that planning and planners suffer from a lack of attention to these temporal contradictions. Yet debates within planning have often lacked exploration of the influence of different notions of time and through doing so can be seen to have over-simplified the development process (Moffatt 2014). Planning can thus be seen to be a type of governmental technology that imposes a particular temporal ordering on a more complex world and that fails to emphasise the multiple conflicting temporalities (Abram 2014), instead focusing on spatial ordering.

In one of the most developed critiques of the concepts of time and space used within planning, Graham and Healey (1999) argue that there needs to be an understanding of the multiple meanings of the two concepts. Their paper draws upon a range of social theories including ‘relational theories of urban time-space, dynamic conceptualizations of “multiplex” places and cities, the “new” urban and regional socio-economics, and emerging theories of social agency and institutional order’ (Graham and Healey 1999,623) in order to explore the dynamic relationships between planning practice, action and place. They critique considerations of time within planning theory and practice as either wholly neglected or treated as a container for linear events. The problem with this, they suggest, is that the concepts of space and time have often remained divorced from one another, ignoring the idea that space and time can be constructed through social interactions amongst and within places. They argue that planning theory and practice need to consider relational non-linear notions of time that reflect the changes that occur within the contemporary world and that there needs to be an understanding of how the process and effects of planning relate to multiple space-times. From a practical perspective, they suggest that project appraisals and the development of policies need to be informed by a clear recognition of the temporalities and spatialities in which they are being inserted or may influence, thereby involving careful attention to the expression of time periods within projects and policies. They argue that where 'fixed time periods (e.g., the 5-year plan, the structure plan period) are used, clarity is needed with respect to whose space and time this is and why it is helpful to use the particular form of expression' (Graham and Healey 1999a, 642). This reflects broader considerations of time as a resource, as something that can be used strategically by actors involved (see Raco et al. 2018).

Graham and Healey (1999) draw upon the work of a range of social theorists who developed relational theories of time-space, emphasising the diversity of time-space experiences between and within cities. Such theorist include Giddens (1979), Lash and Urry (1994) and Adam (1995), as well as others who have developed relational theories of time-space, particularly Harvey (1996) and Thrift (1996). Of most relevance to this thesis is the work of Barbara Adam, who argues that 'the way time is conceptualized makes a difference' (Adam 1995,7). Adam (1998) argues that linear considerations of time transform complexity into a fixed enclosed object when in reality time is less tangible as it is constructed through interactions. She describes how the temporal relations of industrial societies are shaped by the five C's of clock time, compression, commodification, colonization, and control (Adam 2003, see table 2). She identifies that clock time became a central element of everyday life through the commodification of time; meanwhile, time has been compressed through the intensification of work, transport, and transmission. The control of time is suggested to have objectified time, reducing it to something that is externalised (Adam 2003). The externalisation of the possible future costs of actions has become easier due to the acceleration of electoral cycles, economic exchanges, and news (Adam 2004). From this she argues that we need to move beyond clock time in order to understand how time is embedded in knowledge, interactions, practices, and the environment and thus to make the diverse experiences (particularly lived experience) and conceptions of time visible, especially in relation to environmental problems (Adam 1995).

Adam (1998) introduced the concept of 'timescape' to portray the multiple dimensions of time and the complex temporalities of changes to the landscape. This perspective argues that we cannot embrace considerations of time without simultaneously its embodiment in a specific context, including the spatial material and contextual influences on how we are considering time. Timescape provides a conceptual tool that enables the previously invisible to become visible through considering 'the complex temporalities of contextual being, becoming and dwelling' (Adam 1998,11).

Similarly, Greenhouse (1996) considers time as a plural social construct with cultural representations. From such a perspective, Greenhouse argues that representations of time can be seen to articulate people's understandings of agency and that social time is inherently linked to claims to accountability made in its language. Many concepts of time may exist in any one social system or situation and institutions can be seen to regulate the contestation of multiple temporalities within situations (see Greenhouse 1989). In this context, representations of time can be seen to be manipulated in times of crises in order to legitimise certain institutions (Greenhouse 1996) such as appeals to economic urgency to expedite infrastructure decisions (see Legacy 2017). As Adam also makes clear, just because clock-time is a social construction does not mean it lacks powerful organising effects.

Table 2: Adam's 5 C's of time

(information taken from Adam, 2003)

Time	**Description**
Clock	• Time that has been created to human design, precise and invariable. • It is not context dependent as it is external to the processes that it measures and is different to the varying temporal processes and rhythms of nature. • This time, designed by humans, has become dominant and naturalized as if there are no other forms of time. • Clock time and the associated linear perspectives form a sieve through which social relations and reality are filtered. • Difficulties arise where clock time is imposed as the norm in situations that are rhythmic, variable, or highly context-dependent. • In reality all hours are not the same for people as humans are more complex than machines.
Commodification	• The economic process of charging interest means that time costs money and makes money, thus 'time is money'. • As 'time is money', calculations are made regarding the costs associated with the time spent storing and moving goods, running machines and the time that goods are on shelves before they are sold. • The value of interest and credit influences the financial value of labour time (paid employment). • Work that is not easily translated into money falls outside of this evaluation framework e.g. time spent caring for children or relatives. As money is associated with power, such uses of time tend to be associated with a lack of power. • Like clock time, the commodification of time has a linear perspective, is decontextualized and abstract.

Compression	• When 'time is money' through the commodification of clock time, time compression is associated with profit. Speed is valued as an unquestionable good and this overshadows other environmental or social considerations. • Compression is achieved through increasing the activity that occurs within the same unit of time such as through intensifying labour, using machines, or re-organising the sequence of activities. • Compression has also been achieved through technological developments such as the internet and transport developments.
Control	• The control of time involves rationalising and regulating the order, pace, and sequence of beings, organisms, institutions, and social activities based on a desired pace. • This includes controlling production, storage and delivery for a just-in-time delivery system or controlling product's shelf life. • However, attempts to control time can also lead to loss of control due to increased speed and real-time processes working across the globe that create a loss of time for reflection. • Such loss of control is global and thus impacts those on the receiving end as well as the perpetrators.
Colonization	• Temporal colonization *with* time involves the global imposition of western industrial time. Globally, clock time and the commodification of time have been imposed as the unquestionable standard regardless of their suitability. This has been achieved through the use of world time, time zones and standard time. • The economic values of time and the social relations of industrial time have been imposed globally as an unquestionable norm. • This processes has been aided by naturalised assumptions regarding the need to commodify, compress and control time. Such assumptions have been unquestioned and thus any unwilling recipients will find it very difficult to make their protests heard. • The second form of temporal colonization is colonization *of* time. This involves the contemporary reach into and use / abuse of the past and future.

2.2.3 Conclusion

The literature has revealed how temporalities are plural and planning is selective and partial in its treatment of time. The limited planning literature on time identifies the uneven distributive consequences of elevating specific temporalities, revealing how regulation is inevitably partial / selective in the ways it reflects and seeks to organise social affairs through time (see Graham and Healey 1999b; Myers and Kitsuse 2000; Moffatt 2014; Boston 2016, amongst others). Planning's focus on achieving short-term results has resulted in a lack of detailed consideration of the various temporalities and the relationships between them (Graham and Healey 1999) and the gap in our knowledge is especially wide in development control. While there has been a failure to emphasise the multiple temporal processes occurring within planning, particularly in much planning literature, multiple temporal processes are clearly evident in planning practice and in the worlds in which it intervenes. Planning can thus be seen to be selective in the temporalities that it prioritises, particularly economic and political aspects of time. It can thus be argued that there needs to be greater consideration of the impacts and relations between multiple temporalities, including consideration of the elements that currently fall outside of the regulatory system (in the case of the regulation of energy infrastructure this may involve elements that change over the duration of the facility or site, including relations to local communities). This is necessary in order to obtain a deeper understanding of regulatory and decision-making processes and the potential implications of planning decisions.

This review has begun to reveal the multi-layered nature of the term temporary and the impacts of different ways of considering time. While the regulatory notion of time used within planning can be seen to provide some benefits, it can also be seen to draw attention away from other temporal processes such as (but not limited to) long-term preferences, intergenerational perspectives and longer-term sustainability (see, for example, Graham and Healey 1999; Myers and Kitsuse 2000; Moffatt 2014). There is thus a recognition from numerous perspectives that planning and the worlds it regulates are more complicated than how the regulatory notion views them (Scott 1998; Abram 2014). It is evident that conceptualising time as a range of multiple temporal processes (as suggested by Adam 1998, amongst others) that occur in parallel and are operating on different timescales, can provide insights for both planning practice and academic research through enabling a greater exploration of the variety of physical and social changes that may occur over time. While planning literature has begun to develop notions of multiple temporalities, it often fails to bring together practical and theoretical critiques and consequently lacks recommendations for planning theory and practice (see for example Myers and Kitsuse 2000; Van Der Knaap and Davidse 2010; Madanipour 2010). There has therefore been a recognition of the need for greater consideration of the multiple temporalities influencing both planning research and practice (Moffatt 2014).

The review now turns to consider how ideas of temporality are expressed in the land use and end-of-life regulation of renewable energy projects, exploring how such understandings of multiple temporal processes become evident through problematising 'the object' that planning is regulating.

2.3 Renewable energy: land use, end-of-life regulation and reversibility

As section 2.2 introduced, renewable energy developments are often promoted as temporary and reversible, the following section aims to uncover the evidence and problem framings (see Rein and Schön 1996) behind such claims. It explores the impermanency and permanency of renewable energy infrastructure, how time and the object are regulated and how this is influenced by pervasive social constructions, particularly specific conceptions of time or the object under consideration – wind or solar energy facilities. In doing so the following bodies of literature are reviewed: i) how claims of reversibility are used in studies of the land use impacts of renewables, ii) how end-of-life factors are considered in Life Cycle Assessments, iii) how decommissioning, repowering and life-extension have been considered in existing literature, iv) a critique of the concept of reversibility. Through doing so, it reveals how claims of temporariness also reflect selective conceptions of time, starts to reveal the temporal complexities of the objects of regulation and argues that complete reversibility is not possible.

2.3.1 Land use characteristics and reversibility of renewable energy

Reversibility and land use efficiency have been identified as crucial land use characteristics of energy systems (Hernandez et al. 2014). Understanding the extent of land use requirements of energy has been identified as necessary in the context of competing requirements for land from other uses such as agriculture and in terms of balancing social, economic and environmental impacts (Evans et al. 2009). Although the term reversibility does not have direct regulatory status, it is a concept that has been used in planning (such as in decision notices and application documents) to argue in favour of renewable energy developments. The concept has been used to highlight a fundamental benefit of renewables over traditional energy sources, that at the end of its life the infrastructure can easily be removed, leaving limited or minimal impact on the site (Pasqualetti et al. 2002).

Numerous analysts have contrasted renewable energy with other forms of energy where the extent of impact, long-term effects on the land and ecosystems, and clear-up costs are far greater (Dale et al. 2011). A central benefit of renewables has been identified as their ability to use land statically, i.e., impacting one area of land in comparison to traditional energy sources that transform land through secondary land use impacts such as contamination and ecosystem disruption of adjacent or more distant lands from the supply or combustion produces of the fuel (Fthenakis and Kim 2009). A further benefit of renewables has been identified as their lack of direct waste produce (redundant turbines are often recycled or stripped) and decentralised pattern of distribution, enabling them to often be situated in remote areas (Karakosta et al. 2013). For renewables, reversibility is thus presented as entirely a matter of what happens on site since the lack of a tangible fuel means there are minimal off-site or distant effects (turbine production creates off-site effects and impacts on birds and habitats can occur, but this is rarely discussed in such studies). Meanwhile, off-site effects for other energy technologies are often greater, more visible, and tend to be a big part of what is long-lasting.

The potential benefits of reversibility have been considered to the greatest extent in the case of wind energy with studies identifying the ability to easily remove wind turbine infrastructure as one of its key benefits (see Pasqualetti et al. 2002; Corvellec 2007; Eltham et al. 2008; Jaber 2013; Dû-blayo 2014, amongst others). The reversible nature of the land use impacts of wind energy has been identified as being utilised by developers to promote the benefits of wind projects (Corvellec 2007). Such literature highlights how reversibility is often discussed in terms of impacts not being long-lasting and physical materials being removed. In one of the most detailed considerations of wind energy reversibility, Dû-blayo (2014) links the concept of reversibility to resilience, identifying that the land has the potential to return to its previous state or an enhanced state following decommissioning. However, such claims appear to lack consideration of what reversibility or an ‘enhanced’ state of land may constitute (i.e., in what ways the land may be improved and by what means) or who would be responsible for such enhancements. Such questions need addressing if reversibility is to move from a potential quality to a material practice.

The commonly made claims about reversibility can be seen to provide a surface-level consideration of reversibility without exploring the more intricate aspects of the term, most significantly what exactly it should or does constitute and how it manifests itself. Furthermore, there is an apparent lack of consideration regarding how the concept is taken into account in decision-making or how negotiations and decisions regarding reversibility take place at the point of granting permission for a scheme to be developed. These are potentially significant omissions as claims of reversibility lack evidence or experience, providing a lack of insight regarding what may actually happen as sites approach the end of their operational or consent life. Alongside these gaps, this common treatment of reversibility also reveals selectivity in concerns for time in the planning system (i.e. a focus on time-limited permissions and use of planning conditions to leave certain elements to be considered in the future), but also, as will be developed further in this review, selectivity in consideration of the materialities of development.

2.3.2 End-of-life decision-making in Life Cycle Assessments

Such claims of reversibility are perhaps better described as relative claims compared to other energy sources and raise questions regarding the impacts of renewable energy facilities. Establishing a total lifetime of renewable energy is one sphere in which analysts seek to bring 'impacts in total' into the frame, including those that could occur distantly in space and time. Through doing so, the neglect, but also importance, of technology-land-environment relations in making sense of reversibility and temporariness is revealed.

A start point for considering the 'total' impacts of energy technology options, from cradle to grave, is the use of analytical frameworks based on Life Cycle Assessment (LCA). What LCA tends to address is the non-site effects of renewables. These are deemed to be lower than for fossil fuel or nuclear, each of which cast a significant footprint. Environmental 'adders' have been developed as a regulatory method in order to evaluate the total costs of energy systems (Harrison and Nichols 1997). LCA studies are utilised in order to detect and calculate the environmental adders associated with a particular energy system (Owen 2006). In energy markets, adders involve the cost added to the resource cost in order to include the social costs associated with the provision of energy (Owen 2004).

There are numerous LCA studies providing consideration of the impacts that occur over the lifespan of renewable energy developments, revealing again that the life cycle emissions of renewable energy are comparatively much lower than conventional energy (Varun et al. 2009). Nonetheless, the dispersed and land-intensive characteristics of renewable energy developments have presented a challenge for existing LCA methods (Seager et al. 2009). Such challenges arise from the geographically dispersed nature of the technology, with lower energy yields per land area than traditional fossil fuels, the higher level of geographic variability and the potential for land quality to either be degraded or restored. It has thus been suggested that LCA studies for solar and wind require a more diverse database covering elements such as (but not limited to) the loss of ecosystem services that the land would otherwise be providing, impacts on soil and water quality, the impacts of construction and maintenance in remote areas, and impacts on regional wind patterns (Seager et al. 2009). Evidencing this, LCA studies for both wind and solar appear to vary in their scope, depth and methods (Varun et al. 2009; Davidsson et al. 2012) and in the case of wind there is a lack of consensus regarding how to quantify resource depletion and a lack of detailed consideration of non-energy resource implications (Davidsson et al. 2012).

There are several exemptions and omissions that leave LCA falling far short of a ‘total resource’ assessment. Both LCA studies and the use of environmental adders compare energy systems like products, not as contextually embedded facilities, and thus treat end-of-life simplistically rather than considering wider long-term impacts on the land. Such approaches are abstracted from time and space and lack consideration of future generations. While such studies often consider the land use impacts of renewable energy, they often only consider direct land use (e.g., the measurable space occupied by the infrastructure), thereby ignoring the intensity of the land use impact and compatibilities with other land uses (Gagnon et al. 2002). LCA studies also tend to be hypothetical. As with wider claims about the reversibility of renewable energy, there is a tendency to assume that the equipment has effects that are potentially removable without consideration of what is likely to happen in practice. Significantly, many LCA studies for wind do not include an assessment of the decommissioning stage or have lacked details through treating it as largely unpredictable (Ardente et al. 2008; Price and Kendall 2012). Through doing so they reflect some of the wider effects of time, in terms of the inability to calculate the impacts of a future event.

An LCA perspective has a tendency towards reductionist quantification and, for this reason too, tends to exclude detailed consideration of the end-of-life decision-making process or impacts on the land. There is a lack of information regarding the land in terms of how the character and nature of the previous land was documented, how it may be altered over the lifespan of the development and how it should be returned once the infrastructure is no longer working. Existing studies can be critiqued for solely focusing on the infrastructure on the site rather than broader impacts and structures in conjunction with sites that may have a greater duration. Such literature tends, therefore, to ignore how renewable energy technology such as turbines and solar panels get entangled with a site, creating a diverse ecology of changes to landscapes and natural processes, not all of which may reverse.

2.3.3 Decommissioning, repowering and life-extension

'Whole life' analytical techniques like LCA can be critiqued for providing a rather simplistic assumption regarding the reversibility of renewable infrastructure and often an assumption that full decommissioning and land restoration will occur, particularly by reducing it to equipment. However, the temporal relationship between equipment of a given technical or commercial life and a facility that uses that equipment is not straightforward, as a facility may replace its equipment several times through life-extension or repowering. The need to understand considerations surrounding repowering has been identified as necessary due to the tendency for the best-located sites (e.g., the sites with high-levels of wind) to already be occupied by older, less efficient technology (Hulshorst 2008). The rather limited literature on decommissioning, repowering and life-extension (such as Möller 2010; Himpler and Madlener 2012; Ziegler et al. 2018) reveals some of the considerations surrounding end-of-life decision-making for renewable infrastructure. From this we can begin to understand why it is a problem to treat it as an object simply occupying space, rather than as a facility that evolves over time and (as will be elaborated in later sections) with diverse relations to surrounding environment and society.

Life-extension (i.e., increasing the existing planning consent) of wind farms has been considered to a limited extent in existing literature. In one of the most detailed considerations of end-of-life decision-making for onshore wind, Ziegler et al. (2018) undertook a review of lifetime extension in Germany, Spain, Denmark, and the UK. The review focused on technical and economic considerations, including technical lifetime extension assessments, operational costs, subsidies, and legal regulations. Their findings revealed that there are uncertainties in end-of-life decision-making with a conclusion that 'the market for end-of-life solutions is still in its infancy, but is expected to grow significantly in the next five years' (Ziegler et al. 2018,1269). However, they claim that it is technical, economic, and legal aspects (such as, but not limited, to legislative changes, electricity market prices and wear-out of components) that drive the end-of-life decision-making process, lacking consideration of wider social, environmental, and land use influences. Through focusing on developer-market relations, there is a lack of insight into how decisions may be made and considered by all relevant actors (including, for example, local communities), which may prove essential in obtaining consent for such applications.

Industry consideration reflects a positive view of repowering. Writing in an industry report, Hulshorst (2008) argued that repowering wind turbines can create noise, visual, and landscape improvements as a result of a decrease in turbine numbers or the number of turbines with a high rpm. The report assumes that repowering will involve the installation of wind turbines in locations where they are ‘accepted,’ although it does not expand on whether this expected acceptance is from communities or decision-makers. Moreover, this unsupported claim assumes that all stakeholders will have accepted the permanency of the wind farms. It also relies on concepts of ‘eco-efficiency’ (Jacobs 1991) to establish repowering as a reduction in the quantity of environmental impacts per unit energy output and assumes that the trade-offs involved (fewer but taller turbines) will be widely accepted as a net gain. Current industry understanding of the process, impacts, and perceptions of repowering can thus be seen to foreground certain elements such as measurable dimensions of landscape improvement, and place others, particularly potential challenges of acceptance, outside of consideration. These framings have rarely been unpicked by academic research.

Meanwhile, research undertaken in Denmark revealed that while repowering onshore wind farms is portrayed as a lower risk and lower cost option than developing off-shore windfarms, opposition to larger wind farms creates a potential challenge (Himpler and Madlener 2012). Further research exploring the impacts of repowering campaigns in Denmark revealed that while campaigns sought to address the issue of ‘poorly located wind turbines’, ‘It was found that re-powering did not lead to lower overall visibility and density, but to higher distance for some of the inhabitants’ (Möller 2010, 240). While providing useful insights, such studies provide limited (and patchy) information regarding the complicated nature of repowering, as a reworking of the temporal evolution of a facility.

In the case of decommissioning renewable energy facilities, little consideration has been given beyond LCA studies discussed above. From a policy-orientated perspective, research undertaken by Welstead et al. (2013) on behalf of Scottish Natural Heritage explored the aims of Restoration and Decommissioning Plans (RDPs’), identifying the potential for RDPs’ to demonstrate the reversibility of wind farms in terms of removing all significant environmental impacts and visible traces. This definition of reversibility appears to be less comprehensive than other uses of the term, demonstrating a partial and specific focus through suggesting removal of significant and visible impacts rather than returning to a previous condition or considering any subsurface or less-directly material impacts such as social impacts. Again, we see value-based selectivity in reversibility claims and a lack of clarity in what decommissioning should constitute and how it should occur.

Ferrell and DeVuyst (2013) identified that while decommissioning is a policy concern for wind energy, there is little experience of decommissioning or public information on the costs. Writing from experiences in the USA, they identified a lack of standard decommissioning procedures and in some cases (particularly for the oldest wind farms) a lack of regulatory obligation for decommissioning, raising questions as to whether the wind industry will learn from the abandonment issues experienced by other sectors such as oil and gas. While there are some elements for which market incentives may be sufficient to encourage removal e.g., turbines, for which there is a recognised second-hand market (Andersen et al. 2014), it is more difficult to envisage how markets could develop for others e.g., removal of foundations, access roads or grid connections. The use of legal planning agreements can hold developers to land remediation and habitat creation actions; however, such agreements can be hampered by difficulties in valuing the natural environment (see Boucher and Whatmore 1993) and there appear not to be any studies assessing the efficacy of such planning agreements in the renewable energy sector.

If end-of-life considerations have been neglected for renewable energy, such considerations have been explored more extensively in the literature surrounding other sectors, and analogies can be drawn. The end-of-life of minerals works provides potentially useful insights regarding longer-term considerations of the land, particularly concerning decommissioning, facilitating a future land use and how social attitudes may change over time, influencing future uses of the land. McHaina (2001) identified that while many mining sites were previously abandoned, decommissioning and reclamation are now considered to be central parts of the mining life cycle. The subsequent use of mining sites is decided based on several factors including, the current surrounding land use at the time of decommissioning, environmental impacts, and the possibility of reusing site infrastructure. This links to ongoing debates regarding the possibility of creating environmental, social, and economic benefits through developing new land uses on mineral sites (Zhang et al. 2011). Bell and Genske (2000) identified that attitudes towards derelict land have changed over time with many countries developing planning acts to facilitate restoration. Such examples raise questions regarding if such measures have been considered or implemented for renewables, questions as yet unanswered.

2.3.4 Critiquing the concept of reversibility

Reversibility as a concept has entered the lexicon of debate about the sustainability and temporary nature of renewable energy without being clearly conceptualised or unpacked. The term is used widely to describe the idea that at the end of a set period the energy infrastructure can be removed without leaving any lasting impacts (Pasqualetti et al. 2002). However, Adam (1994) resists simple dualities of 'reversible' versus 'irreversible time' arguing that 'as practice, events are fundamentally contextual, directional and irreversible' (Adam 1994, 27). When discussing machines (like wind turbines), she describes how 'they are not abstractable from their environment' as 'their development and use have consequences that become integrated into the complex web of ecological interconnections which in turn impact on social life' (Adam 1994, 167). Adam (1998) thus critiques the use of the term reversibility within environmental discourse as assuming that mistakes can be undone, arguing that achieving complete reversibility is not possible due to changes that will have occurred over time. The concept of reversibility is problematic as it assumes that impacts can be undone and, in the case of energy infrastructure, thereby ignores the range of changes such as physical changes in the surrounding landscape as well as social changes that are likely to occur over the lifespan of developments. For Adam, reversibility really only exists under the specialised, abstract temporalities of Newtonian physics (Adam 1994).

The issue of reversibility has been linked to wider questions of how and why particular features of the environment are valued. Owens and Cowell (1994) contend that it is essential to have an understanding of what aspects of the environment, both material and non-material, are valued, and why, in order to understand whether certain environments are replaceable and whether therefore complete repair or replacement matter (see also, Goodin 1992). If an environment is considered as merely having material value, such as agricultural productivity, the potential for restoring the land can be assessed through identified measures such as the grading systems of agricultural land (Cowell 1997), whether any losses can be fully reversed then becomes a technical question and one that brings in considerations such as replacement, reinstatement or reintroduction. However, non-material values such as cultural values and benefits that people experience from enjoying landscapes are more complicated (Goodin 1992). Where intrinsic value is placed in a specific landscape or ecosystem, derived from the particular process of its creation, then the prospect of reversing any losses becomes logically impossible. As a result, working out whether an impact or set of impacts can be reversed is inseparable from wider questions of working out what kinds of values are at stake and which ones matter, i.e. selectivity of values as well as how these values may alter over time.

2.3.5 Conclusion

The ideas discussed within this section explore how concerns for temporality and reversibility have been brought to bear on end-of-life considerations and considerations of the land use characteristics of renewables. The literature covered can broadly be divided into two conceptual approaches, literature providing an external analysis in terms of identifying potential benefits of the temporary nature of renewables (see, for example, Pasqualetti et al. 2002 and Hulshorst 2008) and literature looking at what actually happens on the ground from a governance perspective (see, for example, research by Möller 2010). While there are many idealised claims made, closer scrutiny reveals a more selective reality. Across the literature there is a failure to explore or define what is meant through use of the term reversibility and how such a concept can be achieved in practice. It is noteworthy that the policy-orientated perspective, focusing on visible elements of the infrastructure, differs from the broader, more theoretical notions of reversibility, thereby raising questions regarding how reversibility is defined and carried out in practice.

What is revealed by these literatures and their omissions is that the object at stake - in this case renewable energy infrastructure - makes a difference, whether it is treated as an entity like a product occupying space or as a more complex assemblage of machinery, social, and ecological relations that evolve over time. A central limitation of much of the literature is how the materiality of renewable energy is considered in terms of its relations with the physical and social landscape. The LCA literature can often be seen to provide an abstract, engineering-based perspective, that focuses on removal of the equipment and its potential disposal rather than its relationship to sites and places. Through doing so, it fails to consider the multiplicity of material and non-material elements that may influence decisions surrounding the future use of sites. The literature thus raises several contestable claims that are underexplored and cannot do justice to the more complicated effects that unfold with decision-making associated with real projects.

While there is a limited body of literature exploring life-extension, repowering, and decommissioning, existing studies tend to be focused on a small aspect of such processes such as economic benefits. Moreover, a significant proportion of the existing material has been produced by and for industry (see, for example, Hulshorst 2008;

Welstead et al. 2013). While these studies provide a useful overview of some of the factors influencing end-of-life decision-making they lack consideration of whose opinions were taken into account during the decision-making process and fail to analyse critically which factors are being considered and controlled within regulatory systems.

This body of literature raises questions that will be explored in the remainder of the literature review and in the thesis itself. This thesis agrees with Adam (1994,1998) that complete reversibility in any form is not possible, it thus suggests that we need to look beyond the concept of reversibility framed in simple material and binary terms in order to explore what the actors involved in the planning system mean through use of the terms temporary and reversible. A Deleuzian approach facilitates this through enabling consideration of the multiplicity of material and non-material effects impacting decision-making. An important part of such considerations is how wider social and ecological relations, with a more diverse set of temporalities, impact notions of what is temporary. The following section aims to explore this through literatures that have sought more directly to capture the multiplicity of relations between infrastructure, environments, and publics.

2.4 Energy perception and acceptability

It has been widely suggested that a lack of social acceptance may constrain the ability of countries to achieve renewable energy targets, particularly in the case of wind energy (Wüstenhagen et al. 2007). The sizeable body of research exploring the social acceptance of energy facilities has teased out some of the key relationships between technologies, sites, and communities, which bear upon considerations of temporariness and (ir)reversibility. These also help to indicate how end-of-life decisions for renewable energy facilities might be perceived. However, although time is implicit in much of the research presented, rarely is it given explicit attention.

2.4.1 Public perception and acceptability of renewable energy

There is a large body of literature exploring public perceptions of renewable energy from social science and environmental psychology perspectives (see Warren et al. 2005; Cohen et al. 2014; Gross 2007; Devine-Wright 2007, amongst others). Perceptions can be described as a process through which people perceive their surroundings (Johnston 1998). Many studies exploring perceptions of energy infrastructure are shaped by concerns for social acceptability, also referred to as energy acceptability (see Devine-Wright 2007). Social acceptance is a central concept within energy research; however, it needs to be understood as one part of a range of factors that influence how individuals and communities interact with renewable energy developments (Upham et al. 2015). A narrow rationalist interpretation of acceptance views it as shaped by a person's calculations of the risks and benefits of a scheme (Cohen et al. 2014), however it is often more complicated due to the influence of factors such as the value people place upon a location and their opinion of the type of development.

There is a sizable body of literature exploring the factors contributing to the social acceptance of energy projects. Devine-Wright (2007) identified three main categories of factors influencing social acceptance as personal, social-psychological, and contextual. While it is not explicit in the literature, each of these factors may have a temporal dimension. From a personal level, local involvement in a project has been linked to higher social acceptance (Gross 2007). Social-psychological factors can also influence opinions of acceptability, for example, people's reactions to wind farms have been found to occur very quickly (Pasqualetti 2004), and people's personal definition of topics including what constitutes a 'natural environment' and 'progress' can influence their opinion regarding the level of development that should occur (Hirsh and Sovacool 2013). Wider contextual factors can also be seen to influence local-level energy acceptability, for example, when developments are framed and viewed as part of a wider policy context and choice of alternatives, thereby reflecting alternative futures. Demonstrating this, research undertaken by Jobert et al. (2007) suggested that a proposed wind farm experienced a greater level of acceptance due to its position as part of an energy park development.

Perception and opinions of renewable energy appear to differ depending on the context of the technology in question. Quantitative abstract studies such as the UK surveys reviewed by McGowan and Sauter (2005) reveal widespread support for both wind and solar technology; however, opinions differ when research considers the local development context (Upham et al. 2009). Public acceptability of wind energy cannot be taken for granted as it moves from support in the abstract to local projects (Barry et al. 2008). The concept of NIMBY (Not In My Backyard) has been used to describe the difference between perceptions of wind energy as a source and perceptions of individual proposals; however, the concept has faced criticism for failing to consider the complex nature of human motives and other factors such as political or social influences impacting attitudes (Bell et al. 2005; Devine-Wright 2005; Ellis et al. 2007;

van der Horst 2007). Moreover, the site-specific, concentrated characteristics of renewable energy often leads to conflict with the existing or planned use of the land (Pasqualetti 2004). Public attitudes to wind farms are thus often strongly conditional and a key element affecting that conditionality is landscape/visual/place effects (Johansson and Laike 2007).

Expectations about positive and negative impacts, particularly perceived visual impacts, can shape local perceptions regarding the acceptability of renewable energy developments. There are apparent differences between perceptions of renewable and traditional energy infrastructure, though this is often attributed more to the different geographies at play rather than traditionalness per se. As traditional energy infrastructure is often located away from settlements, it can be seen to be removed from peoples' everyday considerations, and thus electricity arrives to the consumers as a relatively unseen product (Sovacool 2009). Developing this argument, Hirsh and Sovacool (2013) suggest that opposition to wind turbines may be linked to the visibility of the infrastructure in comparison to the relative invisibility of traditional energy infrastructure as visibility makes people confront their energy choices and usage. This is supported by research in the USA that linked the visual prominence of wind turbines to reminders of energy production, usage, and cost, highlighting that the public prefer not to see the source of energy production (Pasqualetti 2000).

People's perceptions of energy infrastructure in the environment can be seen as multifaceted and influenced by a range of factors that themselves may change over time. Sowers (2006) explained how in some contexts local people do not conceive of wind turbines as an industrial energy source or a reminder of their energy use but rather see them as representing economic prosperity and pride through bringing money into the local area through jobs and tax revenues, helping local farmers. Thus, the turbines are accepted because they fit into the dynamics of the place, which are the ongoing products of previous rounds of activity. Similarly, the development of renewable energy in rural landscapes has been conceptualised by some as part of a process of ongoing rural change that is enabling farmers to diversify their livelihoods (Fast and Mabee 2015). Drawing on such temporal arguments, renewable energy can also be framed positively through the use of a sustainability framework that highlights human adaptation and progress towards carbon-neutrality (Selman 2010).

Implicitly adopting wider temporal concerns, Klass (2012) demonstrates how public trust doctrine arguments have been used to argue for and against the development of renewables. Public trust arguments have been used in favour of projects through emphasising intergenerational benefits for future generations in terms of addressing climate change and their potential to safeguard land for future generations. However, opponents have used the concept of public trust to argue against schemes due to their intensive land use characteristics and potential impacts on space, species, and landscapes. Such research identifies the significance of representations of renewable energy as continuity or change, positively or negatively. This is an angle which ought to bring temporal concerns into focus, although there is limited explicit evidence of this in the research literature.

2.4.2 Place identity, attachment, and fit

The theoretical concept of ‘place’ provides a lens through which people view change (Upham et al. 2009; Cresswell 2014). Places are shaped by human values and can be seen to be socially constructed as they are influenced and shaped by power relations and social influences (Harvey 2001). Places can therefore be conceptualised as a process as they are continuously going through sequences of change and reproduction over time (Massey 2005). The concept of place forms a key role in understanding local energy acceptability as opinions can be influenced by place-related meanings and feelings of place attachment and identity (Devine-Wright and Howes 2010). Place attachment is used to explain people’s connections to places in terms of how they interact or have interacted with an area. The concept of place identity is also used to explain how the characteristics and attributes of particular places contribute to a person or community’s self-identity (Stedman 2002). People can form attachments to places as a result of memories, enjoyable experiences, and special meanings (Scannell and Gifford 2010), through such processes particular places can become important to a person’s self-identity (Stedman 2002).

Concepts of place identity and attachment provide useful ways of understanding how people view change, and in doing so, they have an inherent temporal dimension as processes that unfold over time. However, existing studies say little explicitly about time. The main analytical themes pursued are that people’s attachments to a place may change over time as a result of lived experience or place change, potentially impacting their responses to change (Bailey et al. 2016) and how change, such as development, can impact people’s opinions of a place (Upham et al. 2009). As a result of the attachments that they form with places, people may resist change to a place, particularly if the change poses a threat to the meanings associated with it (Stedman 2002). Disruption to place identity can lead to opposition to the cause of the place change (Jacquet and Stedman 2014). The development of renewable energy infrastructure can be viewed as a form of place change that has the potential to alter or disrupt the existing relations that people have with a place and their self-identity (Devine-Wright and Howes 2010). People may oppose plans for a particular renewable energy project due to the meanings they have formed, over time, with the location of the proposed development (Haggett 2011) and thus react with place-protective action (Devine-Wright 2009b).

Different representations of places and of renewable technology have been used to portray a development as acceptable or unacceptable in a particular location and can be seen to have influenced the responses of residents, particularly through embracing a broader temporal dimension. Illustrating this, research undertaken in Canada by Fast and Mabee (2015) compared five wind farms located within 50km of each other. The findings revealed that the projects that faced less opposition were those that considered local history and included it within the project alongside building local trust. The acceptability of a renewable energy development by a local community can be seen to be highly influenced by representations of how the new technology fits with the existing identity of the place. This idea of place-technology fit has a tacit temporal dimension as it relates pasts, present, and futures. Wind farms are often subject to contrasting symbolic representations and perceptions of their suitability within a place (Brittan 2001; Hirsh and Sovacool 2013), ideas of fit and have also been used to portray wind energy developments as either suitable or out of place in an area (Otto and Leibenath 2014). Demonstrating how place-technology fit may develop over time, Nye (1999) described how energy technology or hardware in America that was once new and innovative has, over time, become taken for granted as being there. Such insights raise significant questions regarding whether such a process will occur for renewable energy infrastructure, especially for end-of-life decisions, or if it will be different due to their visual characteristics or potentially known time-limited status.

Landscape fit is a major concern for wind farm developments (Firestone et al. 2018), wind turbines have often been perceived as out of place in rural landscapes due to values associated with such areas (McLaren Loring 2007). When considering such ideas of fit, it is also important to consider the type of sites that energy infrastructure is occupying and whether it can be represented as a break or continuity in the use of land. Cowell (2017) identified that not all energy infrastructure siting decisions become politicised or face significant opposition, and thus, it is important to understand the situations in which siting disputes have not occurred. His example of gas-fired power stations demonstrates how, through re-inhabiting space vacated by previous fossil fuel-based industry, serious siting conflicts have been largely avoided. Such an example signifies the importance of understanding the multitude of socio-economic and environmental associations influencing potential sites and their surrounding landscapes and that the reference point - or base-line - for end-of-life decisions may be constructed very differently to the status quo ex ante.

Debates about landscape or place 'fit' are essentially concerned with temporal processes of path dependence, in which inheritances from the past condition what now seems appropriate. Whereas the siting choices of gas-fired power stations reinforces the reproduction of environmentally exploited and industrialised spaces (Cowell 2017), new renewable energy projects can be seen to have a greater propensity to disrupt such continuity. A central difference for renewables is also that they are often situated on un-industrialised landscapes, thereby causing disruption and often opposition. Taking wind as an example, as the resource requirements are site-specific, they are often not able to be located in less controversial locations without reducing productivity (Pasqualetti 2011). However, repowering and life-extension may change this spatial dynamic as currently sites in Great Britain tend to be reproducing over time (see Windemer 2019).

The social acceptance literature recognises the mediating effects of public engagement practices on shaping public attitudes (see, for example, Firestone et al. 2018; Gross 2007; Hindmarsh and Matthews 2008). However, the processual dynamics of public engagement processes are less widely considered in renewable energy literature than in planning literature (such as Marshall 2002; Marshall and Cowell 2016), raising questions regarding how the time available for, and temporal sequencing of, engagement processes may have some bearing on how well support is maintained, cultivated or lost. It is also necessary to consider that social responses can be mediated by project ownership and control, which can differ significantly between locally-developed schemes and those put forward by large private companies (Warren and Mcfadyen 2010; Musall and Kuik 2011).

The concepts of place identity, attachment, and place-technology fit provide a useful understanding of why publics may oppose renewable energy projects that may be considered to disrupt the existing character of a place and thus the wider relations that are at stake when the reversibility of impacts is considered. However, while the effects of renewable energy development on a place can influence social attitudes and responses, it is important to consider that places are subject to multiple representations and in some circumstances, changes to landscape and place disruption can be viewed as positive (Manzo 2003). Demonstrating this, research undertaken by Devine-Wright

(2011) found high levels of positive response to a proposed tidal project, linked to expected impacts on the distinctiveness of the area and its visual fit with the existing character of the area as well as its potential contribution to tackling climate change. Additionally, while temporal ideas of change over time are embedded in ideas of place and the negotiation of change, existing research lacks explicit consideration of how place-related meanings may develop over time. Most social acceptance research has its own temporality, with its main empirical focus on the point of project decision, there are however some exceptions to this, as discussed in the following section.

2.4.3 Treatment of time in energy perception and acceptability research

Whereas most social acceptance research is concerned with looking at a site at one moment in time, usually the build-up to consent, there is a small body of literature adopting a wider temporal frame. There are several studies exploring changes in attitudes before and after a renewable energy development has been constructed, often reflecting a narrow consideration of change over time, but providing a more explicit consideration of temporality than the energy perception and acceptability literature discussed above. Familiarity has been identified as an influence on people's opinions of technological structures within the environment (Hirsh and Sovacool 2013) as experience is considered to often generate positive attitudes (Warren et al. 2005). Examples of this can be seen in changing opinions from those living in proximity to traditional energy infrastructure such as cooling towers and slag banks who over time have started to view them as iconic features of the local landscape (Selman 2010). Moreover, research suggests that static technological objects such as transmission towers, poles, and wires often become conceptualised together in people's minds as part of the landscape (Hirsh and Sovacool 2013).

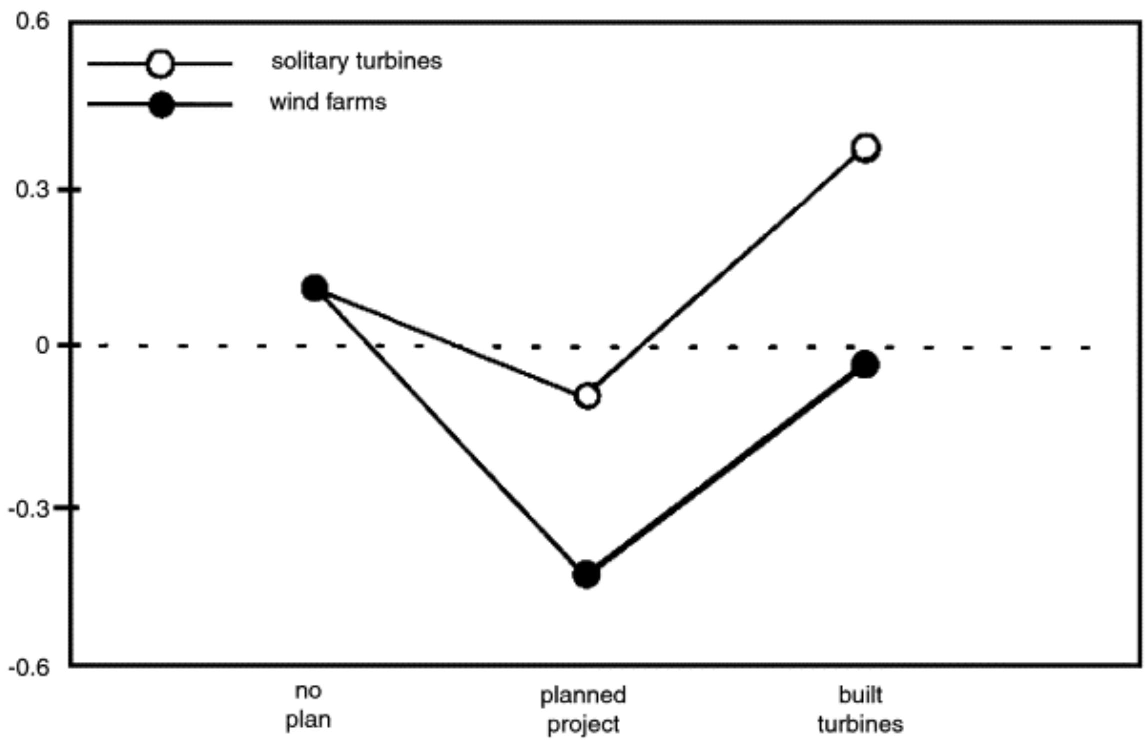
It has been suggested that people living close to wind turbines perceive them more positively after installation (Damborg and Krohn 1999; Warren et al. 2005) and that positive perceptions of wind turbines are more likely for those who see turbines daily (van der Horst 2007). Attitudes to wind power developments have been suggested to follow a U-shaped curve, ranging from very positive when people are not confronted by a local proposal, to less positive when people experience an application in an area, to more positive again following construction of the development (Wolsink 1989; Gipe 1995; Wolsink 2007), with the tacit assumption that this applies in perpetuity.

Wolsink (2007) depicts this relationship in figure 4 (U-shaped curve), which shows attitudes in standard units (z-scores) with '0' representing the average positive attitude.

However, while such research is argued to be statistically significant and to demonstrate the temporally fluid nature of attitudes to renewables, the post-construction values supporting this hypothesis appear to have been taken a short time after construction (although the exact date is not present in the paper due to the results being based on secondary data from a number of studies). There is consequently a lack of consideration regarding how values may alter over the greater lifespan of the infrastructure and what people imagine the (appropriate) duration of the development to be. Moreover, Wolsink (2007,1199) recognised that while the U-shape curve demonstrates the 'non static nature of attitudes' it is 'by no means a guarantee for improvements in attitudes after construction' as the 'effect can only be seen if the existing environmental impact is adequately dealt with in the eyes of the local population'. The U-shaped curve hypothesis also appears to consider the development and decision-making process in simple binary terms (i.e., the infrastructure was not there and now it is), ignoring the scope for projects and their contexts to evolve. Such assumptions can also be critiqued as failing to consider that there are several other contextual influencing factors that may shape community members' opinions, thus the relationship between perception and experience cannot be considered as a simple linear relationship (Devine-Wright 2005).

Figure 4: U-shaped curve

Source: Wolsink 2007 (attitudes in standard units (z-scores) with '0' representing the average positive attitude)



In one of the few detailed studies, Wilson and Dyke (2016) explored changes in community perceptions of a wind farm in Cornwall through a process of interviewing ‘affected stakeholders’ and community members about their perception of the wind farm before and after it became operational. They found that although some negative perceptions remained, attitudes generally became more favourable over time as the community became used to the turbines. In some cases a sense of place attachment had been identified by those living close to the wind farm, with the turbines forming a type of landmark. They explained that their findings supported those suggesting that concerns of living close to a wind farm decrease over time (for example Warren et al. 2005), but not that the community become highly positive following installation. They identified that the pathway of acceptance appeared more nuanced than the U-shaped curve model suggests as community responses are multi-layered and complex with different curves of acceptance relating to different areas of concern including noise, visual impact, impact on property price, environmental impact, and economic benefits. However, the generalisability of the research findings is limited by the fact that the interviews were only undertaken five years after operation and the scheme only comprised two turbines. Meanwhile, research undertaken by Eltham et al. (2008) aimed to explore whether pre-construction perceptions of a Cornish Windfarm had changed 14 years following commissioning. Although the findings revealed statistically significant changes between recalled opinions of 1991 and opinions in 2006 regarding an increase in the number of residents finding the wind turbines visually attractive and considering wind energy to be a valuable asset, the results identified no reliable change in opinion regarding residents’ general acceptance of the wind farm. As with much public-focused research, both studies gave little attention to regulators, developers, or the regulatory context, lacking consideration of the possible influence of time-limited planning permissions on preferences or how end-of-life decisions are formed.

Supporting arguments of familiarity, Wheeler (2017) researched residents’ attitudes to existing wind farm sites as part of a broader study exploring rural place identity. The findings revealed that although in some cases concerns regarding the impact of wind farms remain, for many people they have become a familiar and unremarkable, or in some instances valued, part of the landscape. The research identified that ‘the most prevalent attitude was one of ambivalence, where the local windfarm had become a familiar and accepted part of the landscape, simply blending into the background of everyday life’ (Wheeler 2017, 118). It identified how, through embodied experiences, wind farms can become assimilated with social memories in villages and that wind farms are starting to become incorporated into the shared meanings of place. It also identified connections between wind farms and other aspects of place, for example, in one village the wind turbines were found to have been viewed favourably as they remind people of the old windmills. However, this research was limited in scope in that it failed to explore how residents considered the future. While identifying familiarity and ambivalence with the turbines it ignores scope to act on temporality as there is no consideration of whether these feelings are related to the communities' possible knowledge and understanding that the turbines will be removed in a certain number of years' time. It therefore raises the unexplored question of whether it is change, and the scope to influence change, that motivates communities, resulting in a situation of acceptance once the change has happened and the chance to resist or make a difference has gone.

Opposing arguments of familiarity, Sovacool (2009b) argues that once values are formed regarding energy, such as familiarity, they are difficult to change, particularly if the values are transmitted between generations. Meanwhile, research undertaken by Kontogianni et al. (2014) found that experience of wind farms marginally affected positive public perceptions but significantly influenced negative public perceptions. Research in Denmark found that the growth in the number of wind turbines over time has negatively altered perceptions of acceptability, demonstrating how opinions changed from favourable to negative as a result of increases in the size of developments (Möller 2010). Such research identifies the significance of the scale of visual impact. A further deduction, especially from the work of Möller (2010), is that the impact of what is being regulated – the wind farm and wider wind farm landscapes – is in flux, creating broader contextual changes. It is thus more complicated than looking at the before and after of a wind farm in an unchanged context. To try and isolate changing public attitudes, some of the existing social psychology research has rather a laboratory-type approach, excluding wider contextual variables.

A significant weakness of many energy perception and acceptability studies is that they explore change in opinions before an energy development is built and then shortly after its completion, providing a limited snapshot of changes in opinions and lacking consideration of how and why opinions may alter over a longer period or at other points in time. Where studies have considered a longer time period (such as Eltham et al. 2008) these are focused on public perceptions. Moreover, existing energy acceptability studies appear to lack consideration of the temporal structure of regulation (e.g. time-limited consents), and there are no studies considering perceptions when infrastructure is decommissioned and removed, or considering possible repowering and life-extension and the potential consequences on people's perceptions and opinions of acceptability. There is a resulting lack of consideration regarding how long people expect the development to stay in place, including whether they regard the renewable energy development as permanent. Research could provide a deeper understanding of the temporal considerations impacting the future of such sites and the impacts of how the regulatory planning system controls duration.

There is a body of literature providing deeper temporal insights on the longer-term experiences of communities living with energy facilities, albeit such literature is focused on traditional energy forms rather than renewables. Bickerstaff (2012) argues that events that are temporally distant can remain very salient from a cultural perspective and are thus critical in moulding the pathway of controversial planning processes - in her case, deep disposal of nuclear waste. It is thus suggested that we need to look beyond the characteristics of the local communities in which infrastructure proposals are located to explore the historical responses influencing impacted populations. In the case of nuclear, Venables et al. (2009) identified that it is commonly assumed that communities with existing nuclear facilities will be more accepting of new facilities due to the benefits, such as economic benefits, that the existing scheme provides. However, they argue that beliefs about nuclear power in communities that have lived with facilities is more complicated than simply those being for and against. In this context, there is an identified need to consider the public's perception of environmental risks and the local context of public fears (Macgill 1987). Meanwhile, Parkhill et al. (2014) suggest that the impact that a new development may have should not be underestimated, particularly in cases of nuclear and coal where there are historical associations of risk and pollution. They identified that effects associated with stigma may occur in situations where people feel that they do not have a choice. History is thus part of the conditionalities of public – and probably regulator and developer – responses.

While the social acceptance literature has developed a detailed understanding of how infrastructure-developer-environment-community relations condition public responses to renewable energy development, there has been a call for studies to look beyond local-level social acceptance. Such considerations are important as there are factors beyond the public's view that may influence renewable energy development such as funding and the planning system. Procedural aspects and institutional factors, such as regulations, have been identified as having a significant impact on the outcome of energy projects. Friedl and Reichl (2016) suggest that both political and institutional conditions (such as economic regulations, stakeholders, and the consenting process) and local conditions (such as local politics, actors, geographical conditions, and planning) can have a decisive impact on planning for energy projects. Meanwhile, Wolsink (2000) identified that while most social acceptance studies focus on public opinion, there are factors that curtail renewable energy development beyond local acceptance. The paper draws upon research in the Netherlands to demonstrate how institutional factors including the style of planning system, the dominance of the utilities sector, and the strategic motives of stakeholders, have a more significant impact on the siting of wind farms. Again, it is the treatment of time within institutional arrangements – with their propensity to be selective and partial – which may be the greater determinant of project outcomes.

2.4.4 Conclusion

Energy acceptability and perception studies provide useful insights for this thesis by demonstrating how renewable energy facilities impact relationships between technology, place, and landscapes, and through doing so, implicitly reveal ideas of temporality. However, empirically, those using a place perspective have tended not to explicitly embrace the temporal aspects of renewable infrastructure development, such as discussions of temporariness or permanence or how social attitudes evolve over time. Moreover, the literature can be seen to have its own temporality, studies exploring attitudes to wind energy can be critiqued as generally front-loaded (i.e. focused on the build-up to decisions) and framed by crises as most studies focus on opposition to proposed schemes (Ellis et al. 2007). A focus on proposed projects has resulted in a lack of consideration regarding the result of lived experience in a place following change (Bailey et al. 2016) as well as wider considerations regarding the future of the infrastructure. There is a lack of literature exploring opinions of existing developments and where this does occur the research is usually undertaken after a relatively short period or is subject to methodological limitations, either way falling short of end-of-life decisions. Significantly, much of the social acceptability literature (and public perceptions research more widely) ignores the institutionally-structured nature of actual choices. While the way in which developer-public interactions shape trust has received some academic attention (see Devine-Wright 2007; Walker et al. 2010), existing research tends to focus on public opinion as the most important viewpoint, providing little consideration regarding how the interaction between the public and other social actors such as developers, planners, and the media can influence responses to renewable energy changes (Batel and Devine-Wright 2015). Through doing so, it fails to link social attitudes with the regulatory context that mediates between perspectives and the temporalities that each may mobilise.

What does begin to emerge from this body of research is that renewable energy comprises more than just the infrastructure, it is a knot of relationships between machinery, publics, other actors, and wider contexts, all of which are evolving, but with their own temporalities. In this context, the following section of the literature review looks beyond place to the broader concept of landscape. This is important in the context of this thesis as it helps foreground the relations between technologies, people, and contexts that are omitted from simplistic talk about impact reversibility.

2.5 Landscape values and perception

Landscape is a crucial concept within this thesis due to its ability to embrace the temporal relationships between society and its surroundings, alongside concerns regarding appropriateness of environmental change, and because the siting of renewable energy developments within landscapes is often a point of contention and objection. Landscapes have their own temporalities, often as longer term, to which temporary insertions into the landscape may be contrasted. Drawing upon landscape studies enables a broader perspective on the siting and evolution of energy facilities in relation to other elements of the locality. A landscape perspective widens the frame of reference beyond the narrow dimensions of site and land ‘used up’ by the development as seen in LCA studies (see section 2.3.2). It also enables a broader consideration of the context of the energy development than many energy perception studies (see section 2.4). Consideration of the landscapes of energy infrastructure also reveals how much they are in flux. The issue of landscape is paramount in decision-making for energy infrastructure, particularly for wind farms but also field-scale solar, and is thus likely to be a key component of end-of-life decision-making.

Landscapes have multiple characteristics (Nijnik et al. 2008) and uses (Antrop 2000). Landscape values involve the aesthetic, cultural, or natural (in terms of benefits associated with the physical element of the natural environment) values that people associate with a landscape and can be influenced by particular memories associated with the landscape (Antrop 2000). In this way, landscape values, such as visual and cultural preferences, have been seen to influence perceptions of landscapes (see Svobodova et al. 2011), and people often attribute significant value to local landscapes that are viewed as unexceptional by outsiders (Selman 2010). Landscape preferences demonstrate significant variations (Hanley et al. 2009), they can be influenced by a multitude of factors as people place value on the benefits and services which they obtain from the landscape (Termorshuizen and Opdam 2009). Terkenli's (2001) aspect of landscape model identifies three connected characteristics of landscape, the visual aspects, the meanings people associate with the landscape, and the experiences of the landscape, thus demonstrating the multifaceted nature of people's relationship with landscapes. This section of the literature review explores the temporal nature of values, perceptions, and relationships with landscapes, and the implications for renewable energy development.

2.5.1 Perception of landscape change

The term 'landscape' can be seen to reflect the interaction of the physical elements of a place and human experiences and perceptions, implicitly over time (Hanley et al. 2009), and consequently there has been recognition of the multifunctional character of landscapes and the links between landscape and sustainability (Termorshuizen and Opdam 2009). People's perception of a landscape can influence their opinion of how change should occur and vice versa, such considerations are thus useful for exploring the first research question of this thesis regarding how actors consider end-of-life factors and timeframes with renewables, including the significant landscape changes that occur from repowering and decommissioning. Reactions to landscape change are influenced by human experiences and meanings associated with the particular landscape (Stedman 2002). As landscapes often reflect how people define themselves, events or technological changes can impact how people view landscapes through altering meanings or associations (Greider and Garkovitch 1994). Historically, there has been an ongoing tension between arguments supporting development and those favouring landscape protection (Warren et al. 2005). This links to the wider challenge within planning of balancing the goals of equality, growth, and preservation (Campbell 1996).

Landscape change occurs at different scales and rates, some changes to landscape may occur naturally over time, causing smaller, less noticeable changes in comparison to larger scale disruptive change such as the development or removal of energy infrastructure. From such a perspective, some changes to landscape may not be interpreted as disruptive where they occur incrementally over a longer period. This can be seen to relate to ideas discussed in the previous section of this review on social acceptance, regarding perceptions of how technology is considered to fit in a particular location. The meaning that people give to a landscape can be impacted by their perception of the past, present, and expected future use of the landscape as well as their relationship with the environment (Hanley et al. 2009). Similarly, Bender (2002) explored the relationship between landscape and time, depicting landscapes as being in a continuous temporal process. Landscapes are dynamic as they change over time due to both natural and human influences (Hanley et al. 2009) and consequently can be conceptualised as always evolving (Antrop 2000). Through conceptualising time as life process, Ingold (1993) provides a useful understanding of human relations with landscapes. Landscapes are viewed as continuously under construction and thus as a permanent work in progress. This is facilitated by the idea that as well as people being part of the landscape, the landscape can also be seen to be part of us (Ingold 1993). From such a perspective, landscapes need to be understood as continuously evolving and in relation to the processes that are shaping them (Massey 2006). Adopting such a view undermines views that a landscape is to be preserved or fixed to a point in time, contrasting with the industry descriptions of renewable energy as a reversible land use. From this point of view, renewables should be considered as part of the evolution of human-impacted landscapes.

This temporal flux also shapes how landscape values are formed and changed over time and how people consider the temporal aspects of landscape. In this context, familiarity with a landscape has been found to influence perceptions of landscape and landscape change. Illustrating this, Svobodova et al. (2011) undertook research exploring the relationship between landscape familiarity and visual preferences of landscapes using a method of evaluating photographs. The results demonstrated that respondents were influenced by familiarity with the type of landscape, place attachment, and the influence of the character of the area they were born in or that they currently resided. Thus, history and temporality can be seen to be bound into many conceptions of what makes landscapes valuable or not. Case study research undertaken by Hanley et al. (2009) regarding changes in woodland cover in UK national parks revealed that people were more likely to favour changes to the current landscape if they were aware that the landscape, or perceptions of the landscape, had changed over time. Meanwhile, Pasqualetti (2000) used the example of traditional windmills to demonstrate how over time features of the landscape become accepted and even favoured by some. Such studies link landscape perception to historical notions of time, changes that have occurred over time, and their representation. A recurring policy question is whether we are trying to preserve the current appearance of a landscape or a past ideal (Hanley et al. 2009).

2.5.2 The importance of institutional as well as social factors

There are a range of social and cultural factors that can be seen to influence people's perception of a landscape, including how they use the landscape such as duration and nature of their interaction (Swanwick 2009) as well as cultural significance (Ingold 2000). Within the social sciences, landscapes are often conceptualised as social constructions resulting from both individual and societal processes. Such an approach aims to explore the social process of meanings attached to landscapes and the process through which landscapes become symbolic and identifies landscapes, and symbolic representations of them, as reflecting power relations and politics (Gailing and Leibenath 2013). The insights emerging from this body of literature are supported by the conceptual approach of Social Representations Theory (SRT) (see Devine-Wright 2009; Buijs et al. 2012; Devine-Wright and Devine-Wright 2009; Batel and Devine-Wright 2015).

From an SRT perspective, shared realities and experiences, including collective perceptions on the nature and causes of events, can shape people's attitudes. Consequently, the way in which people view and explain things can be seen to be influenced by what is familiar to them and through their reference group representing a particular social representation of the world (see Batel and Devine-Wright 2015). Such considerations can be seen to have a temporal dimension in terms of how familiarity over time influences attitudes. Taking a more explicit temporal perspective, the concept of anchoring reveals how meanings and ideas of past events can be used to reduce uncertainty and understand current risks (Pidgeon et al. 2008). Through connecting new events or ideas to familiar ideas and knowledge, the unfamiliar is made to seem more familiar (Devine-Wright and Devine-Wright 2009). Existing research has explored the occurrence of anchoring in relation to renewable energy, for example, through people associating wind turbines with landscape change (Fast et al. 2015). Anchoring has relevance to planning governance as well as public attitudes, where precedence and existing policies and rules designed to persist provide a basis for authoritative judgements, for acting selectively, and/or justifying drawing lines within otherwise seamless flows of change over time.

Thus, while the landscape perceptions literature provides a useful insight into social, cultural, and temporal considerations influencing landscape perceptions, it is vital to consider that landscapes are shaped by institutional as well as cultural factors. Landscapes can be viewed as inherently political (Bender 2002) and institutions such as the planning system can be seen to play a decisive role in shaping landscape change. Formal institutions seek to shape or restrict landscape change by imposing regulations and rules such as through the use of policy documents (Gailing 2012) and the law.

2.5.3 Conclusion

The issue of landscape is a central factor influencing responses to energy infrastructure, particularly wind farms (Pasqualetti 2000; Johansson and Laike 2007; McLaren Loring 2007; Wolsink 2007a; Firestone et al. 2018). Broadly, the expansion of renewable energy has driven a variety of societal concerns for landscape impacts research, with studies identifying the following (i) the land-intensive nature of renewable energy (see for example, Seager et al. 2009), (ii) renewable energy as a method of landscape organisation that reflects control, ownership and a reflection of certain attitudes (Pasqualetti et al. 2002), iii) how renewable infrastructure can impact the characteristics and identity of the place where it is located, interrupting the 'permanence' of a landscape that some expect (Pasqualetti 2000). However, while there is a body of literature considering energy landscapes, it tends not to deal with time or landscape in any fundamental, conceptual way.

Considering landscapes alongside the ideas and concepts of energy perception and acceptability facilitates a wider consideration of the range of material and non-material aspects and temporalities influencing schemes. The landscape literature has i) developed a notion of contexts in flux over time, (ii) helped improve our grasp of public concerns with change/fit with what's there, and (iii) emphasised the significance of institutional as well as social and cultural changes. As with the energy attitudes literature, the existing landscape literature appears to have been more deeply concerned with public attitudes rather than with how developers and planners negotiate issues of appropriateness of developments in particular landscapes. When considering the landscape impacts of energy infrastructure, there is often a lack of consideration of the institutionalised nature of landscape conservation in terms of the formal values enshrined in the planning system and how certain landscapes have protective designations reflecting values that are formalised within law and policy. Such considerations may have powerful effects when deciding on the future of renewable energy sites (see also Lee 2017).

Existing literature has revealed how a range of material and non-material changes may occur over time, influencing the nature of renewable energy sites and thus the context in which decisions are made. To date there has been limited consideration of how the multiplicity of factors shaping renewable energy sites influence decisions regarding their duration or future. In response to this gap this thesis adopts a Deleuzian approach that facilitates consideration of the non-static nature of renewable energy sites. The following section of the review discusses how insights from Deleuze provide a useful framework for exploring the multiplicity of factors changing and shaping renewable energy sites and landscapes as well as considerations of impermanency and the treatment of time, and for conceiving the way that state actions intervene in this multiplicity.

2.6 Deleuzian insights

The literature review has revealed that end-of-life decision-making for solar and wind farms is an underexplored, complex issue, but that contours of the issues at stake can be elucidated by opening up wider social science debates about time. While the review has identified that the perceived reversibility and temporary nature of developments are widely presented as central benefits of solar and wind energy, there is a lack of detailed consideration regarding what these terms mean and how they are considered and achieved, or even how end-of-life decision-making occurs in practice. There is also a lack of detailed consideration regarding how the regulatory aspects of the planning system considers time and mediates between the multiple temporalities impacting energy infrastructure. Such gaps relate to the multifaceted nature of planning and the range of human and non-human factors influencing the issue (such as changes in landscapes, perceptions, regulation etc), that are all in flux, each with different temporalities. In response to such gaps, a Deleuzian perspective facilitates an analysis of the wide range of influencing factors, temporalities, and relationships identified in this review and thus helps to chart and assess the range of perceptions, power relations, and representations influencing considerations surrounding the duration of renewable infrastructure.

2.6.1 Why a Deleuzian approach was chosen for this thesis

A Deleuzian approach was chosen for this thesis in order to provide a means of conceptualising and investigating the network of human and non-human influences shaping the evolution of renewable energy, over time and the treatment of time. Such an approach facilitates an exploration of the factors influencing the context in which planning makes decisions and for understanding the flux and partiality of interventions in temporalities identified earlier in this review. Through taking into consideration multiple dimensions of time, it provides the opportunity to explore how time is struggled over in planning and why certain notions of time endure whilst others are left outside regulation. Hillier (2008,27) argues that the emergence of ‘temporary fixities’ and boundaries within plans, policies, and decisions is part of the continuous flows of reality. Drawing upon these ideas of time and space within planning involves considering the world as a series of possible future scenarios. While to date this has been more applied to plan making than planning regulation, development control can be seen to be shaped by the pursuit of fixities such as rules, norms and conventions around what can go into a planning permission and associated conditions, but also at the same time deliberately (or unintentionally) accommodating some unexpected eventualities as there are always gaps and ambiguities in efforts to control (i.e. it is incomplete).

As well as adopting an overall Deleuzian framing to the thesis, involving considering how the world works rather than simply what it is or means (Deleuze and Guattari 2004; Hillier 2008; Wood 2009; Purcell 2013), there are several Deleuzian concepts that have particular traction. In accordance with the pragmatic recommendations of Deleuze (see Deleuze and Guattari 1980; Foucault and Deleuze 1997), the most useful concepts for this research were selected to influence the research design. Firstly, the concept of assemblage which was developed by Deleuze and Guattari in their book 'A Thousand Plateaus' (Deleuze and Guattari 1988) to emphasise the non-fixity and emergent nature of entities. The concept refers to understanding entities by the way they function in combination with other entities rather than simply understanding them according to their individual properties (DeLanda 2006). All entities in this research are considered as assemblages, as unique, formed of different individual material and non-material entities, and forming a part of other assemblages (DeLanda 2006). Such a concept provides a useful method of looking beyond wind turbines as an abstract product to consider their complex, embedded nature - simultaneously part of energy supply systems, commercial revenue streams, community relations, and wider landscapes and ecosystems. The term multiplicity is used to refer to 'a complex structure that does not reference a prior unity' (Roffe 2010, 181), reflecting the potential for assemblages to develop.

Of particular significance to this research are Deleuze and Guattari's concepts of emergence and becoming which are used to describe the potential (or multiple different potentials) for an entity to develop in the future (Hillier 2008; Nyseth et al. 2010). This implies a critical focus on this potential or emergent stage i.e., in the context of this thesis the potential for a site to become a renewable energy development, to become a larger project, or to become removed entirely, as well as the role of policy and other factors in facilitating potentials. Deleuze suggests that rather than considering what an assemblage is in terms of its being, we should consider what it may potentially become (i.e. its' becoming) (DeLanda 2002). Such a concept is particularly useful for considering multiple temporalities swirling through end-of-life decisions as it captures aspects of present and future flux. In the case of renewable infrastructure, this involves an exploration of the role of planning permission and conditions in managing what may become at some point in the future and the potential for wind farm abandonment. Wind farm sites have the potential to continue to be wind farms into the future, potentially in different formats, or alternatively to become something different.

The concepts of smoothing and striating are also particularly useful to this research in terms of understanding how changes occur over time, particularly changes in the organisation of space and time. Entities are considered to smooth the striations formed by other assemblages in order to meet their operational requirements. Smoothing space involves removing existing characteristics that were formed by others, while striating space refers to the process of defining and closing spaces (Deleuze and Guattari 2004). Processes of striating and smoothing spaces can be seen to change, form, re-form, or adapt assemblages (Bonta and Protevi 2004). The concepts thus enable a deeper insight into how changes occur than simply identifying who is steering change as they facilitate consideration of the circumstances that enable change to take place. Illustrating these concepts in the context of this research, end-of-life moments can be seen as an opportunity that smooth space, opening up a range of future potentials while planning conditions can be considered a striation, managing potentials and what may become in the future.

A Deleuzian approach facilitates an exploration of the research questions and an understanding of the multiplicities of temporal dynamics influencing planning, a central element of this research. It provides a useful way of making sense of Adam's view of time and reversibility in that the concern for becoming reflects Adam's (1994,1998) view that events are irreversible and her emphasis on considering the range of changes occurring overtime. This thesis provides a wider use of Deleuze than other planning researchers such as Hillier (see below for a discussion of Hillier's work) as it is used to unpack and problematise the nature of the entity being planned, not just the planning process. The research considers wind farm sites as complex spaces (see Bonta and Protevi 2004, discussed below), facilitating consideration of how they may change over time through the striation and smoothing of space and how a multiplicity of non-human and human factors may change over the lifespan of the wind farm, influencing the characteristics of the site and shaping end-of-life decisions. Drawing upon ideas of becoming involves viewing planning as an inherently experimental process that enables change to occur (Nyseth et al. 2010), but without guarantees. The very idea of 'becoming' also has an implicit temporal dimension, highlighting the significance of multiple potentials, i.e. becoming a wind farm, becoming a wind farm with continued agricultural use, becoming a repowered site etc, and is thus also useful for exploring the use of temporary consents.

The literature review revealed a lack of studies theorising the regulatory and development control side of planning, but elements of the theoretical ideas discussed above can help support the broad Deleuzian orientation. In this context, numerous theoretical perspectives were considered and dismissed for framing this thesis, including Social Representations Theory (SRT) and Institutionalist theory. Studies exploring perceptions of renewable energy infrastructure have tended to adopt social theories as a conceptual approach, most notably social constructivism and SRT. While providing useful insights regarding the ways in which shared realities and opinions are formed (Batel and Devine-Wright 2015), such perspectives lack detailed consideration of the connections between social actors and material aspects such as the landscape, development projects and planning policies, or considerations of time, which are key to this thesis. However, while a lot of the literature is closely focused on publics, there are elements of SRT that may have relevance in understanding judgement-making, especially about time, in the context of multiple fluid temporalities. A key example is the concept of anchoring discussed above i.e. faced with the need to rationalise regulatory decisions in the face of multiple, intertwining, possibly contested temporalities, on what do planners base/anchor their decisions?

An institutional perspective was also explored, providing a useful consideration of how institutions facilitate the promotion of certain norms and practices (see Alexander 2005). However, such an approach does not facilitate exploration of how the power relations of other actors and influencing factors may shape the fluid nature of perceptions. In comparison, a Deleuzian approach provides a way of exploring the multiplicities of space and time and the complexities of dynamic relations (Hillier 2008). While other approaches drawing upon assemblages may offer the benefits of exploring relationships between material and non-material actors, particularly Actor-Network Theory (ANT), such approaches have been critiqued for their descriptive style (see, for example, Allen 2011). In comparison, as a Deleuzian approach does not rely on the mapping of networks, it enables a deeper exploration of the multiplicity of factors influencing the research questions.

2.6.2 Deleuzian Insights for planning

Within the academic discipline of planning, a small number of studies have begun to draw upon Deleuzian philosophy (see, for example, Hillier 2008; Van Wezemael 2008; Wood 2009; Nyseth et al. 2010; Hillier 2011; Purcell 2013). However, it has been argued that the influence of Deleuze and Guattari's work has been less extensive in planning than in the related discipline of geography (Wood 2009), thus suggesting that a more extensive engagement could prove beneficial (Purcell 2013). Wood (2009) argued that Deleuze and Guattari's concepts facilitate comprehension of how the world works, particularly in terms of understanding power in planning and the relationship between urban planning and capital as well as how discourses of planning have developed over time, and that from such an understanding more effective planning interventions can be developed. Similarly, Van Wezemael (2008) identified that the concept of assemblage can increase understandings of the workings of democratic governance through facilitating an exploration of the contingent relations of different groups, recognising unpredictability and non-linear relationships, and preventing over-simplifications of governance settings. Meanwhile, Nyseth et al. (2010) applied Deleuzian insights based on Hillier's (2008; 2011) multiplanar approach to analyse a case study of urban planning in Norway called 'the Tromsø experiment'. The study highlights the complexity of the city and the idea that places constitute a range of different processes of becoming, demonstrating the benefit of approaching planning from a Deleuzian-inspired perspective. However, Purcell (2013) criticised most existing considerations of Deleuze in planning for relying too heavily on secondary sources and not fully engaging with the theory. Thus, this thesis engages with the work of Deleuze, drawing upon key Deleuzian concepts, as well as insights from interpretative work. The research strategy has also been designed from a Deleuzian perspective i.e. through seeking to explore what sites become over time and what influences such becomings (see chapter 3).

A useful direct application of Deleuzian ideas is provided by Bonta (2001) and subsequently Bonta and Protevi (2004). They applied Deleuzian concepts and ideas to land use regulation, providing a useful application of Deleuzian concepts for spatial theory. In their study of changing land use in Olancho Honduras the concept of assemblage is developed to provide the concept of a 'complex space', which is used to refer to the idea of an area of land being used for a range of different uses by different actors at the same time and thus the space being formed from a combination of different assemblages, in their case coffee production, ranching etc. They suggest that we should not try to consider such complex spaces in simple terms but instead should understand them as a combination of different spaces and human and non-human entities that change over time. The complex space concept thus facilitates consideration of how one area of land may be subject to different uses and in a stage of transition, reflecting the dynamic nature of land use. Through looking at the history of assemblages within complex spaces of the region, Bonta and Protevi (2004) reveal how spaces or assemblages are re-formed through processes of removing existing striations (smoothing) and creating new striations. Illustrating this, an example they discuss is the development of fences to protect coffee-growing land from the potential smoothing impact of cattle. This is important because it shows how interventions affect future trajectories of change. One can thus begin to conceive of how the regulation of renewable energy development forms particular striations, shaping future trajectories, but so too do the developments themselves.

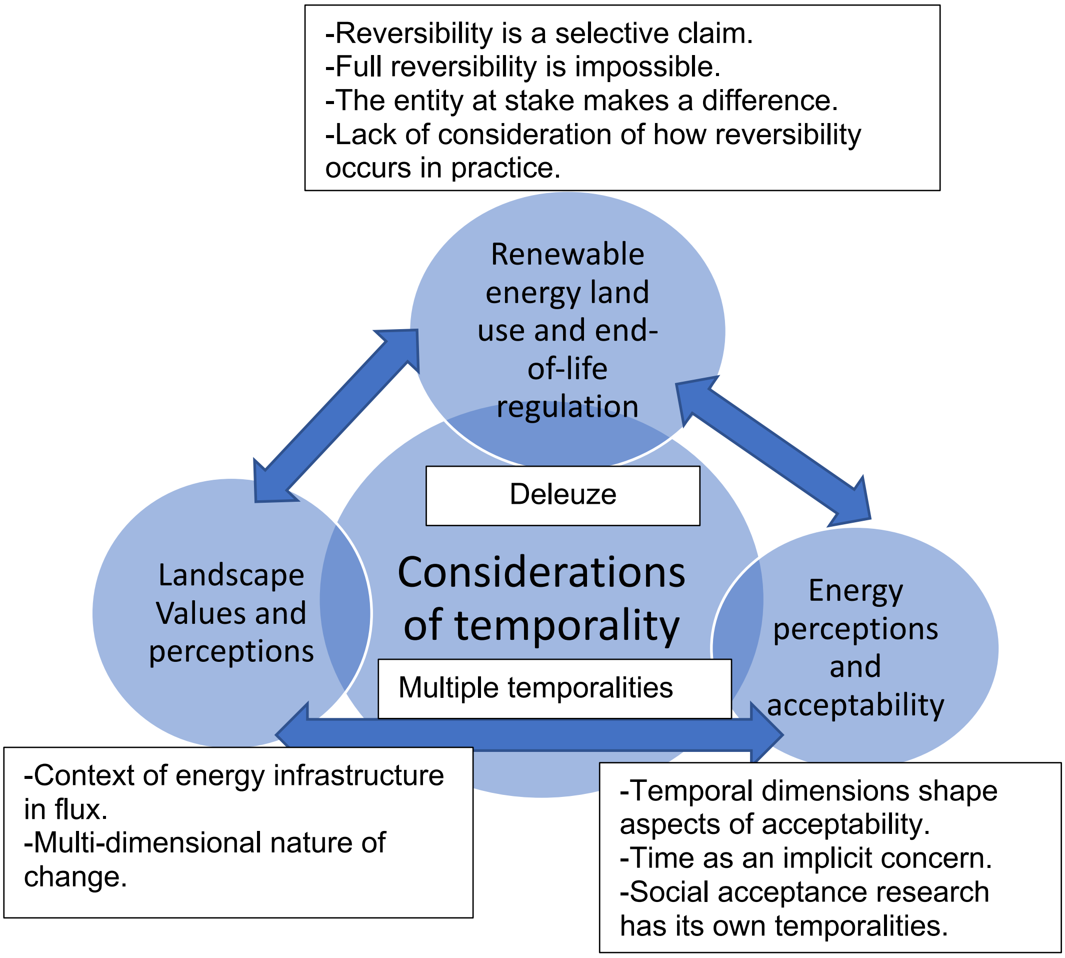
In one of the most developed considerations of Deleuze in planning, Hillier (2008; 2011) proposes a Deleuze-inspired approach to strategic planning which she labelled a multiplanar approach. This was developed to overcome the lack of planning theories considering the world as changing. Hillier (2008, 26) describes the approach as a 'post representational approach' as it is reframing time and space in a way that is focused on exclusion, connections, and communications as opposed to exact measurements. Through doing so, it provides a greater consideration of temporary periods than has been considered in the literature on time discussed above. From such a perspective time is considered not as a process of moving from a fixed 'a' to a fixed 'b' but as a fluid process of facilitating temporary fixities (these can include plans, planning policies, planning decisions, or other texts) from a range of possibilities which may then influence the emergence of new temporary fixities (Hillier 2008). Hillier (2008) considers planning and planners as experiments entwined in a number of conditional networked relationships. She identifies the becomings that form strategic plans, noting that the circumstances that planning occurs in include both legally constrained circumstances as well as more flexible circumstances in which problems are recast throughout the duration of a strategic plan due to changes in preferences and situations. From this perspective, planning can be seen as an attempt to hold together the spheres of various actors while also providing the benefit of creating space for unexpected eventualities to occur (Hillier 2008). A multiplanar approach argues that planning should explore tensions and conflicts rather than suppressing them in order to enable new trajectories to be identified (Hillier 2011). Drawing upon Healey (2006), Hillier (2008) recognises the importance of identifying who does the adding up of such tensions. Such a consideration of powerful actors forms a significant part of this research in the sense of research question two which seeks to understand whose preferences are most significantly shaping end-of-life decision-making.

Drawing upon Deleuzian concepts provides a framework for exploring the complex relationships between human and non-human influences including the multiplicity of space-time dynamics and the role of networks of power through which actors influence the development of space (see Hillier 2008). While Hillier provides the most comprehensive consideration of a Deleuzian inspired approach to planning, her work, as with other considerations of Deleuze in planning (see for example Wood 2009; Nyseth et al. 2010), focuses on the context of strategic planning. This thesis suggests that such ideas of connections, fixities, becomings, and striations can be usefully applied to the context of the regulatory aspects of planning, including the practice of development management, in order to explore questions of responsibility and decision-making. Moreover, the use of Deleuze in planning has been critiqued for lacking information about the viability of a Deleuzian insight for planning practice (Abrahams 2016). Through applying Deleuze to planning regulation this thesis aims to demonstrate how such considerations can provide useful insights for practice as well as for planning research.

2.7 Conclusion

This chapter has provided an overview and critique of the principal bodies of literature surrounding end-of-life decision-making and the temporary and reversible nature of renewable energy infrastructure. Three central conceptual topics have been explored within this review: time/temporality, energy acceptability, and landscape, all of which are multifaceted constructs with contested meanings. Energy acceptability and landscape studies have touched on, but not always engaged explicitly with, issues of temporality. The central issues raised by each body of literature are depicted in figure 5 below.

Figure 5: Contributions from the overlapping bodies of literature influencing this thesis



Energy acceptability studies have identified copiously how social factors can influence people's relationship with infrastructure and how different representations and framings of the infrastructure can impact perceived acceptability. Meanwhile, the landscape literature increased the frame of reference to reveal how the wider context of the energy infrastructure is in flux and subject to multiple perceptions. Reviewing the more limited literature on reversibility and temporality revealed the multifaceted nature of these concepts and the need to look beyond reversibility framed in simple binary terms to consider the multiplicity of material and non-material elements that may influence the flow of change and thus end-of-life decisions. Existing studies that have engaged with the 'lifetime effects' of renewable energy infrastructure treat the concept of (ir)reversibility rather simplistically with a lack of consideration regarding what it should constitute or how the reversibility of renewable energy may occur in practice and in a continual process of emergence/becoming. Claims of reversibility thus appear abstracted from a world in which multiple temporalities are in play and in their selectiveness may have adverse consequences. Such a gap raises unexplored questions regarding how place change and identity are considered and taken into account during decision-making and also during the life of the development.

The pervasiveness of limited temporal framings has been widely illustrated by this review. The literature revealed how, through focusing on strict regulatory notions of time, the planning system may push other considerations beyond regulation, creating uneven distributive consequences. While the benefits of considering multiple temporalities have been demonstrated for planning, it has not been applied to the context of planning regulation. Meanwhile, end-of-life processes lack detailed consideration. What is evident from the literature is the inherent selectiveness of any claim that impacts are reversible (often by drawing different boundaries around what is considered), just as the treatment of time in planning is also selective i.e. what is controlled, for how long, and to what ends? There is thus a need for research that recognises this selectiveness, seeks to grasp how choices are made, how they interact, and what the consequences are. Such gaps reveal the significance of the research questions shaping this thesis and also reveal that in order to answer the questions an approach needs to be taken that facilitates consideration of the multiplicity of material and non-material elements influencing sites over time and how intervention is shaped.

Drawing upon Deleuzian insights and concepts, such as assemblages and Bonta and Protevi's (2004) development of the concept to 'complex spaces', enables this thesis to explore the human and non-human factors and their multiple temporalities influencing the duration of solar and wind farms. Through doing so, it enables greater consideration of the connections between material aspects and social actors than many other conceptual approaches. Considering sites as what they may become rather than merely in terms of their being (DeLanda 2006) enables an exploration of the dynamic nature of sites and how they may change over time through processes of smoothing and striating of space e.g. through policy development or changes in the context of the site, affecting what they become. Such an approach facilitates consideration of the selectiveness of how the planning system manages change, providing the opportunity to explore how time is struggled over in planning and why certain notions of time endure while others are left outside regulation. A Deleuzian-inspired ontology is also reflected in the desire of the research to understand how wider changes in society, landscape, planning, policy, or the developer impact on how sites may change over time, as well as facilitating an exploration of the multiplicities of space and time and the complicated network of relationships influencing planning (Hillier 2008).

As stated in chapter 1, this thesis aims to respond to important gaps in the literature to understand how and whether the effects of solar and wind infrastructure are made temporary and reversible, how that is reflected in regulatory practices including end-of-life decision-making, whose interests are included and excluded in that process, and with what consequences. This thesis argues that we need to explore the impacts of a range of temporal processes, including social and physical changes and the influence they have on the context and perceptions of end-of-life decision-making for energy infrastructure. It will also build upon the limited literature exploring familiarity with renewable energy developments in order to understand how perceptions of the infrastructure and its lifespan may change over time. It will do so through considering the perspective of the range of actors it impacts (including developers, planners, and publics). It thereby provides the opportunity to link social attitudes research with the regulatory context, thus moving beyond traditional 'social acceptance' literature.

Chapter 3: Methodology

The literature review revealed a range of concepts influencing this research, broadly relating to landscape, perceptions of renewable energy, considerations of time and temporality, and dimensions of sustainability, particularly reversibility. Three central research questions were subsequently formulated to provide a basis for exploring such concepts in the context of the research aims. Due to the nature of the research questions, it was necessary to design a research strategy that enabled multiple scales, temporalities, perspectives, and contexts to be investigated. Adopting a Deleuzian framework helped to facilitate the research by sensitising data gathering to the multiple material and non-material factors at play.

This chapter explains the research design including the justification for the methodological choices that were made, how potential limitations were minimised, and a discussion of the measures put in place to ensure reliability, validity, and adherence to accepted standards of ethical research conduct. This thesis uses a mixed-method approach, drawing upon multiple studies to explore the temporal considerations surrounding end-of-life decision-making, primarily for wind farms but also for solar. The approach was chosen to facilitate an in-depth investigation of the multiplicities of values, attitudes, and perceptions from a range of actors involved, their reciprocal influence and relationships, and how far these interact and become institutionalised in decisions. It aims to move beyond the existing public-focused energy acceptability and perception literature and provide a broader consideration than existing studies that have explored end-of-life options for renewables. In so doing, it aims to understand how renewable energy sites and thus the context for end-of-life decisions may alter over time.

3.1 Research questions

The overall aim of this thesis is to understand how the temporary and reversible nature of wind and solar farms are considered, constructed or resisted by the range of actors involved, how this influences end-of-life decision-making for this infrastructure and broader insights regarding how planning regulates time.

As explained in the introduction chapter, the research has a greater focus on wind due to the age of the infrastructure – more facilities have been in place for longer and have confronted end-of-life issues – and the often more considerable controversy surrounding wind farms. The literature review identified several practical and conceptual gaps, including a lack of consideration of what happens when planning permission for this infrastructure expires (a moment when a sites' potentials re-open) or how decisions are made. While studies have begun to consider end-of-life options, such research has been limited in scope, focusing on one element such as economics (for example, Ziegler et al. 2018). Furthermore, the review revealed a lack of consideration regarding the multifaceted nature of the terms reversible and temporary and how they are considered, constructed, and utilised in end-of-life decision-making and indeed in earlier stages too, e.g. the original point of decision.

From a conceptual perspective, gaps were identified regarding how the duration of renewable energy infrastructure is considered, whether and how the effects of the infrastructure are made temporary and reversible, how that is reflected in regulatory practices, whose desires are included and excluded in that process, and with what broader consequences. To explore these gaps, the following three research questions were proposed and used to design the research strategy:

1. How do different actors (including developers, Local Authorities, the public, and any others) prepare and plan for end-of-life decision-making for wind and solar facilities? For each actor:
   a) What end-of-life factors matter?
   b) What timeframes are sought and invoked?

This question aims to understand how end-of-life decision-making is considered by the range of actors interested in the site. Such actors are expected to include, but not be limited to, developers, Local Authority planners and local community members. It seeks to understand how these actors, alongside other non-material elements, came together in preparing and planning for the end-of-life of sites, including how this may have been negotiated between them and if end-of-life plans changed at any point.

Part a) of this question seeks to understand what end-of-life factors matter to each actor and why. Through the use of the term 'factors,' this question is referring to elements that may have been controlled through the use of planning conditions/legal agreements such as site maintenance, land improvements, decommissioning requirements, identification of certain project components for removal, and any other factors considered significant by participants.

Part b) aims to explore preferences regarding the timespan of the infrastructure and use of the land in terms of how long the infrastructure will be in place as well as the duration and legacy of its impacts.

2. Whose preferences most significantly shape end-of-life decision-making?

This question aims to explore how the perceptions and actions of various actors' influence the end-of-life decision-making process in terms of how, why, and what decisions are made. It seeks an understanding of the consequences of this process in terms of whose preferences are reflected in the overall outcome and what interests are set aside.

It aims to explore the influence of different actors at potential end-of-life decision-making moments including (i) before projects are consented, (ii) when projects are consented and in any conditionalities, (iii) at end-of-life, and (iv) at any intermediate point where repowering or life-extension is considered. In cases where repowering, life-extension, or decommissioning has not yet occurred, this question seeks to understand what actors anticipate will happen and if they feel that they could influence the process.

3. What are the wider consequences of how the temporalities of renewable energy infrastructure are regulated?

This question pertains both to substantive consequences of decisions and potential outcomes, but also wider theoretical consequences taken from this research for how planning considers time. It aims to provide a deeper theoretical understanding of the impacts of how regulatory and development control aspects of the planning system consider and regulate time. Through doing so, it aims to understand if the way in which the planning system considers or prioritises particular temporal dimensions impacts the outcome of planning regulation, in ways both intended and unintended.

3.2 Epistemology and Ontology

Devine-Wright (2005) suggests that most research into public acceptance of wind farms has been undertaken without reference to a more in-depth theoretical framework and as such lacks conceptual foundation, resulting in what he believes to be a somewhat incoherent body of research that has struggled to develop a cumulative understanding of this issue. Ellis et al. (2007) identified that this might also be due to much research being conceived within a positivist frame. It has been identified that adopting a post-positive approach to exploring wind farm conflicts provides the benefit of facilitating an exploration of the narratives of those supporting and opposing wind energy (Barry et al. 2008) and an exploration of the complexity of the issue (Ellis et al. 2007). There is an identified need for research to explore the broader institutional and cultural contexts and values influencing relations to wind farms, and adopting a post-positive approach enables consideration of such complexity, fragmentation, and interpretation (Allmendinger 2002). Consistent with this, the Deleuzian approach adopted in this thesis enables a more in-depth insight and explanation of the multiplicity of factors influencing decision-making.

In ontological terms, a Deleuzian approach recognises the multiplicities of material and non-material entities that constitute the world and thus, in this context, may influence the duration of energy developments. A Deleuzian perspective goes against social constructivist ontologies; however, also rejects the notion that research can lead to the uncovering of a ‘true’ knowledge of the reality of the world (DeLanda 2006). Deleuze’s ontological approach can thus be described as non-essentialist (DeLanda 2006). Key to this approach is considering entities in terms of what they could become, rather than solely in terms of their being and comprising them as assemblages formed of human and non-human elements (DeLanda 2006). A Deleuzian approach is reflected in the multiple methods used in this research to explore how both material and non-material elements come together and change, influencing the decision-making scenario for sites. Unlike other approaches such as Actor-Network Theory that focus on mapping assemblages, a Deleuzian approach enables an exploration of how entities are formed and changed.

Deleuzian philosophy facilitates various interpretations of research methods as a result of the various possible readings of the philosophy (Foroughmand Araabi 2014). A Deleuzian ontology is thus reflected in the design of the research in terms of what it seeks to explore and understand rather than in the application of any specific method (as suggested by Abrahams 2014). In this context, the research strategy was designed to facilitate an exploration of the becomings of different assemblages involving the research participants, cases, and questions. From such a perspective a wind farm can be conceptualised as an evolving assemblage combining material and human elements or, drawing upon Bonta and Protevi's (2004) term, a ‘complex space’ that constitutes more than solely a static, complete wind farm. The concept of becoming and understanding what drives becomings was significant in the design of this research in exploring how decisions regarding the temporality of infrastructure come into being as well as how the infrastructure and its surrounding area may change over time.

Rather than considering sites as fixed entities, a Deleuzian ontology facilitates consideration of how wider changes in society, landscape, planning, or the developer, impact on what becomes.

Sensitivity to a Deleuzian-inspired ontology is also reflected in the desire to capture end-of-life decisions at the beginning (i.e., in the pre-consent and application stage), end, and any interruption point in a facility's life (i.e., becomings) and to potentially question the very idea of an end (an end can also be considered as a point at which new potentials start to form). The concepts of 'striated' and 'smooth' spaces (Deleuze and Guattari,1987) are drawn upon to explore how complex spaces form and change over the lifespan of sites and infrastructure and to depict efforts to steer or constrain certain becomings.

3.3 Methodology

A mixed-methods approach, involving multiple case studies, was chosen as the most suitable approach for exploring the research questions. Combining quantitative and qualitative methods provided the benefits of a greater depth of insights and corroboration of findings, thus reducing the limitations associated with each method (Johnson and Onwuegbuzie 2004). It also enabled different methods to be used to answer different elements of the research questions (see table 1).

3.3.1 Mixed-method research

The mixed-method approach involved the following methods:

- Cross-sectional research, reviewing data on the age of all wind farms in England, Wales, and Scotland, including identification of whether life-extension / repowering / decommissioning had occurred. Involving bringing together data from the UK Government[3] and RenewableUK[4] databases, identifying and filling gaps, and undertaking descriptive statistics.

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[3]UK Government Department for Business, Energy and Industrial Strategy (BEIS) Renewable Energy Planning Database quarterly extract, April 2018. Available online at Gov.UK. (Accessed May 2018).
[4]RenewableUK Project intelligence hub (data received via email from Renewable UK).

- Textual analysis and thematic coding of:
    I. All relevant planning and energy policy and guidance documents relating to wind and solar energy in England, Wales, and Scotland.
    II. Planning documents and public comments submitted to applications for all repowering and life-extension applications in England, Wales, and Scotland.
    III. Local-level policy in five case study locations.
    IV. Planning documents and public comments for the original and subsequent planning applications in five case study locations.

- 24 in-depth interviews (semi-structured) with relevant actors (including communities, Local Authority planners, planning consultants and opposition groups) in five case study locations (four wind farms and one solar farm) and with governments and trade associations.

- Quantitative surveys delivered to 710 residents living within 3.5km of two wind farms.

These methods were chosen to complement and inform each other and thus to provide an effective, comprehensive, and detailed investigation of each case, alongside an overview of the wider policy context and status of the sector. A mixed-methods approach suited the nature of the research questions and the overall research topic as a complex issue with multiple influencing factors and enabled a more in-depth exploration of the research topic (Jick 1979). Within the discipline of planning the use of mixed-methods has been recommended to gain a more holistic understanding of the research topic (Gaber and Gaber 1997). Moreover, there has been a recognition that the most common method for researching wind energy, opinion polls, has resulted in limited data that has been focused on public opinions (Ellis et al. 2007) and there has been a call for increased use of mixed-methods within energy research (Devine-Wright 2005). The Deleuzian perspective adopted by this research also tempers risks of oversimplification through facilitating an exploration of the multifaceted nature of planning (Hillier 2008).

The relationship between the research questions and methods is illustrated in the following table:

Table 3: The relationship between the research questions and methods

X = main methods x =supporting methods

	Q 1 How do different actors prepare and plan for end-of-life decision-making for wind and solar facilities?	Q 2 Whose preferences most significantly shape end-of-life decision-making?	Q3 What are the wider consequences of how the temporalities of renewable energy infrastructure are regulated?
Research on the age and status of all wind farms and analysis of national policy and guidance documents.	**X**	x	
Analysis of planning documents and public comments for all repowering and life-extension applications.	**X**	x	x
Analysis of policies, planning documents and public comments for five case studies.	**X**	x	x
In-depth interviews in five cases.	**X**	**X**	**X**
Two quantitative surveys.	**X**	x	**X**

3.3.2 Multiple case studies

Case study research has been identified as a particularly useful method within the discipline of planning due to its ability to explore phenomenon with unclear boundaries, to draw upon multiple sources of data and provide a detailed narrative (Campbell 2003). In the context of this research, case studies provided the opportunity to observe the multiplicities of actors and the relations between them, a project, and its wider environment. Using multiple cases rather than a singular case enabled the data to be analysed across situations as well as within each case situation (Yin 2003). Criticisms of case studies for having a lack of reliability and validity can be seen to be based on a misconception regarding how generalisations can be made. The ability to generalise from a case study is linked to the underlying theory and related knowledge influencing the analysis of the case and is based upon logical connections and inference rather than the particular context of the case (Clyde Mitchell 1983). Furthermore, the use of multiple case studies increases the explanatory power and validity of the research (Miles and Huberman 1994).

The cases that were chosen for this research (see 3.4) represent schemes at various life stages and contexts and thus can be described as divergent case studies as they are expected to have differences in outcome (Campbell 2003). The literature review identified the significance of temporal considerations; however, due to the time-constrained nature of doctoral research, it was not straightforward to track cases over a long period aside from backcasting through tracing the historical elements and decisions of the cases. While some elements of the research can easily be tracked over time, such as those leaving documentary traces, issues of meaning and effect are more difficult. Thus, multiple case studies were chosen to reflect cases of different ages and with different experiences of repowering or life-extension in order to identify common and diverging attitudes, experiences and perceptions, and to explore whether different life stages, landscape contexts or energy types influence end-of-life decision-making.

3.4 Case study selection

The selection process involved an inductive method of selecting divergent case studies to enable an exploration of multiple factors (Yin 1993) (see criteria below). Clyde Mitchell (1985) argued that it is important to choose cases based on their explanatory power rather than selecting typical, representative cases as the necessary validity of the research depends on the theoretical reasoning behind the case study analysis. Selecting case studies strategically is also believed to increase the generalisation of the research findings by enabling an exploration of the deeper causes and consequences of an issue and thus providing richer information (Flyvbjerg 2006). Each case was selected with the expectation of potentially producing contrasting results, but due to predictable reasons, described by Yin (2003) as theoretical, rather than literal, replication. The aim being that the results could facilitate an exploration of whether there is any difference in considerations and feelings towards the different site contexts or energy types, or if considerations appear to change at different life stages of the technology. The selection also aimed to include controversial sites such as where repowering or life-extension had been contested due to the potential explanatory power of such cases. The cases all addressed the same research questions and used the same methods so that results could be compared. Two of the cases also formed the basis for an additional, more detailed, exploration of public perceptions through the use of surveys.

Initial quantitative research using UK Government and RenewableUK data provided information regarding the characteristics, age, and life stage of all wind farms in Great Britain (see chapter 4), providing a basis for selecting cases based on the above criteria (as elaborated below). Where possible, the cases were chosen to be similar in several dimensions including size, proximity to a settlement, and willingness of both the developer and Local Authority to participate in the research. All cases were owned by developers as community-owned cases form a small minority of all, and particularly of the older, wind schemes. The cases were chosen to consist of at least five turbines in order to limit the number of variables influencing the research and to ensure that all sites were in an open and diversely claimed space.

The cases were selected to be different based on three main criteria, listed in order of importance:

1. Life stage (to explore the potential that key moments matter).
2. Local response to repowering / life-extension (to explore how and why responses and decision-making differ).
3. Policy context (to explore how policies may influence decision-making).

A solar case study was included to investigate the idea that technologies create different material, social, and regulatory issues and as after wind, field-scale solar is the new, emergent energy technology which is being pursued in Great Britain and elsewhere (see growth statistics in chapter 1) and facing land-use challenges (see Palmer et al. 2019).

A summary of the cases and their key characteristics are outlined below alongside a map showing their locations:

Table 4: Wind farm case studies

Name and location	Age and life stage in 2018	Details	Developer	Turbine #
St. Breock England (Cornwall)	Repowered scheme 3 years (granted in 2012, operational 2015). Original scheme operated for 18 years.	Significant public support for repowering. Original permission granted in perpetuity.	REG & Blackrock	Original:11 Repower:5
Taff Ely Wales (Rhondda Cynon Taff)	25 years. (repowering permission granted but not yet implemented).	Not located in an area allocated for wind energy. Mixed response to repowering application (greater levels of support than opposition). Original permission granted in perpetuity.	RWE Npower Renewables / Innogy	Original:20 Repowered:7
Kirkby Moor England (Cumbria)	25 years. Permission was due to expire in 2018. (At appeal in 2019.)	High levels of local opposition to the original application, refused life-extension and repowering applications. Original permission granted for 25 years.	RWE Renewables	Original:12
Windy Standard (Brockloch Rig) Scotland (Dumfries and Galloway)	22 years (phase i). Phase i life-extended in 2018. Phase ii under construction. Phase iii in the planning process.	The area around the wind farm is within an agricultural designation, designated as an Environmentally Sensitive Area. Original permission granted for 25 years.	Fred Olsen Renewables	Phase i:36 Phase ii:30 Phase iii: 25

Table 5: Solar farm case study

Name and location	Age and life stage in 2018	Details	Developer	Size
Pitworthy Solar farm England (Devon)	4 years – granted Life-extension of extra 15 years in 2017.	Became operational in 2014 with 25-year permission, extended to 40 years. Spurred local discussion about 'temporary' durations and 'precedent.'	Hive Energy Foresight	109 acres

Table 6: Case study community characteristics

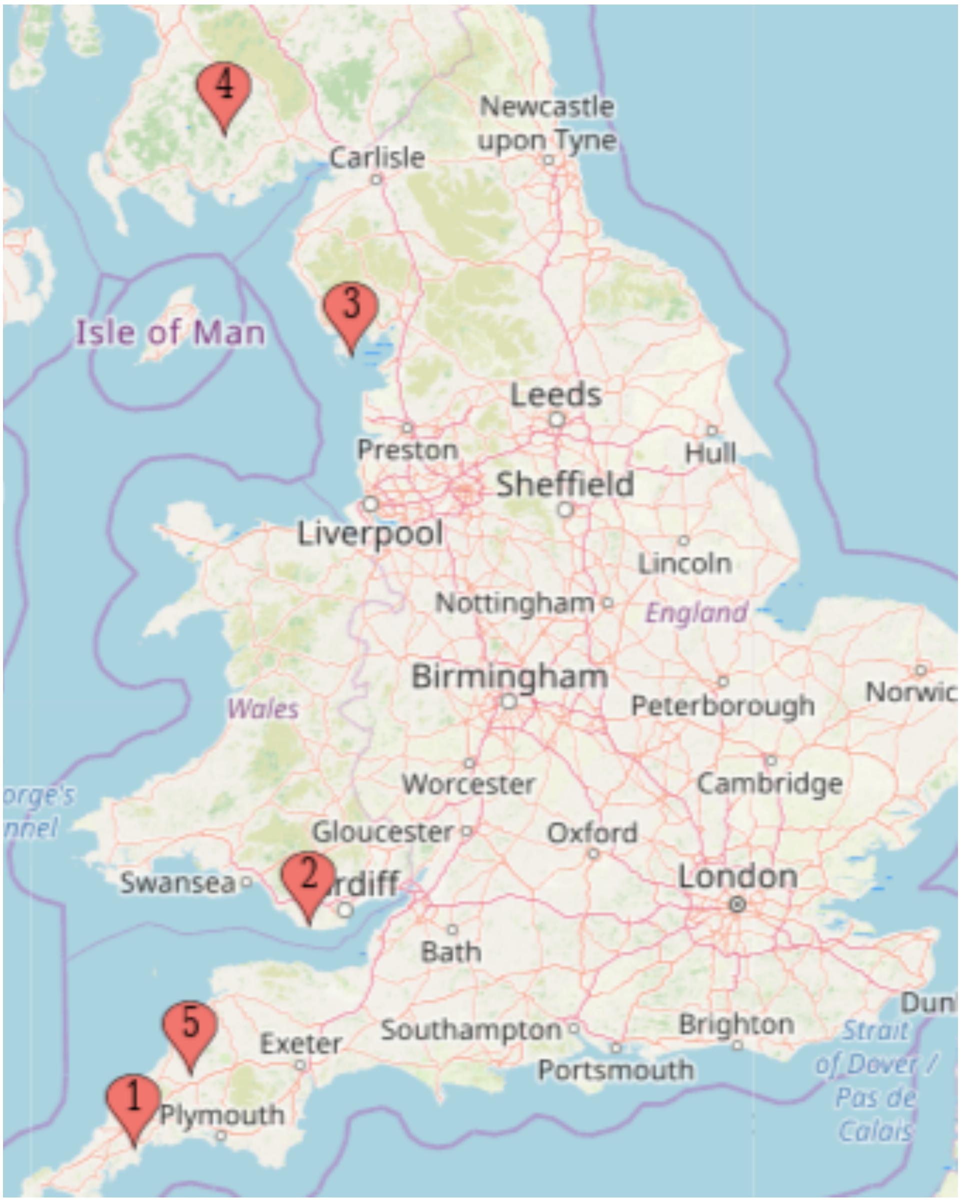
Case study	Community characteristics
St Breock	St Breock is a village in North Cornwall, one mile from Wadebridge. The 2011 census population was 725, with 31% of the population aged 60 or over. It is a rural community with approximately 30 farms situated within the parishes of St Breock and nearby Egloshayle. In 2011 70.1% of the population were economically active with 26.3% in full-time employment. In the wider Wadebridge Census area the most common occupation categories in 2011 were as follows: 1. Skilled trades occupations (19.4%) 2. Managers, directors and senior officials (13.3%) 3. Elementary occupations (13.2%) 4. Professional occupations (12.7%). The most common local occupations in the Wadebridge & Padstow Community Network Area in 2011 were as follows: 1. Agriculture, Forestry & Fishing (17.3%) 2. Retail (15.7%) 3. Accommodation & Food Services (13.3%) 4. Construction (12.9%)
Taff Ely	The Wind Farm lies immediately south of the villages of Hendreforgan and Gilfach Goch. The population of the 'Hendreforgan / Gilfach Goch built up area' in the 2011 census was 4,395. The average age of residents was 38.6 years. In 2011 57.6% of the population were economically active with 33.2% in full-time employment, 44.4% had no qualifications. In 2011 the majority of the population worked in the following industries: 1. Manufacturing (20%) 2. Human health and social work activities (15.6%) 3. Wholesale and retail trade; repair of motor vehicles and motor cycles (15.5%) 4. Construction (11.4%). The most common occupation categories were as follows: 1. Routine occupations (24.5%) 2. Semi-routine occupations (21%) 3. Lower managerial, administrative and professional occupations (10.4%).

Kirkby Moor	Kirkby Moor wind farm is situated on an upland area of moor land 2km from the villages of Grizebeck, Kirkby in Furness and Broughton Beck. It is also located close to the smaller settlements of Gawthwaite, the Netherhouses, Chapels and Beck Side. There are also some rural and farm properties within 1km of the site. While the surrounding population is rural in character, 2011 census data was available for Kirkby-in-Furness, revealing a population of 554 with an average age of 48.6 years. In 2011 69.3% of the population were economically active with 34.8% in full-time employment. 22.2% of the population had no qualifications In 2011 the majority of the Kirkby-in-Furness population worked in the following industries: 1. Manufacturing (17.1%) 2. Wholesale and retail trade; repair of motor vehicles and motor cycles (13.5%) 3. Human health and social work activities (12.7%) 4.Education (11.3%). The most common occupation categories were as follows: 1. Lower managerial, administrative and professional occupations (24.9%) 2. Semi-routine occupations (15.7%) 3. Small employers and own account workers (12.6%).
Windy Standard	The wind farm is located within Carsphairn Forest in Dumfries and Galloway. The closest settlements are the rural village of Carsphairn (with approximately 115 residents) and the very small, rural settlement of Brockloch. Due to the size and rural nature of the settlements there is no further information available about the communities.
Pitworthy solar	The solar farm is located in Holsworthy, a small market town in Devon. The 2011 census for Holsworthy Parish reported a population of 2,641 with the mean age of residents as 45.1 years. 69.3% of the population were economically active with 31.1% in full-time employment. 31.8% of the population had no qualifications. In 2011 the majority of the population worked in the following industries: 1. Wholesale and retail trade; repair of motor vehicles and motor cycles (23.2%) 2. Human health and social work activities (14.2%) 3. Construction (10.3%). The most common occupation categories were as follows: 1. Semi-routine occupations (22.1%) 2. Routine occupations (15.1%) 3. Small employers and own account workers (15.0%) 4. Lower managerial, administrative and professional occupations (14.5%).

Figure 6: Map of all case study locations

Map created using mapcustomizer.com

1. St Breock wind farm
2. Taff Ely wind farm
3. Kirkby Moor wind farm
4. Windy Standard wind farm
5. Pitworthy solar farm



3.5 Research methods and analysis

As discussed in section 3.31, the research methods were chosen to complement and inform each other and to ensure that the research questions could be fully explored and answered.

3.5.1 Quantitative overview research

The research firstly sought to obtain an overview of the age of infrastructure and rates and experiences of end-of-life procedures. Doing so enabled an examination of the scale of the problem and what wind farm sites are becoming as well as a preliminary view of what developers are seeking and - by looking at planning responses - whether they are getting it. The UK Government Renewable Energy Planning Database[5] provided the initial data including the age of infrastructure and details of repowering and decommissioning applications. There were some gaps in the database regarding decommissioning and life-extension, reflecting the possible lack of priority given to such data. The gaps were addressed through a more detailed search of the status of the oldest wind farms using Local Planning Authority online planning records. The data was also supplemented by the RenewableUK database,[6] providing more detailed information regarding the age of all wind farms.

The wind farm data was summarised to provide descriptive statistics regarding the percentage and MW capacity of infrastructure of different age categories. It was also used to calculate the number of sites expected to be making end-of-life decisions within the next ten years (see chapter 4). For solar energy, as the technology is relatively younger, sites are not reaching the end-of-life stage and thus at the time of the research there had not been any cases of repowering or decommissioning. While life-extension has been occurring this data was not available, descriptive statistics were thus not produced for solar.

Further research was then undertaken to explore the details associated with each category of end-of-life process for wind. This involved a review and comparison of the planning documents to identify consent conditions, public responses, and aspects that

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[5]UK Government Department for Business, Energy and Industrial Strategy (BEIS) Renewable Energy Planning Database quarterly extract, April 2018. Available online at Gov.UK. (Accessed May 2018).
[6]RenewableUK Project intelligence hub (data received via email from Renewable UK).

prove conflictual. The characteristics of repowering applications were obtained through calculating the change in size, capacity, and turbine height between sites granted repowering permission and their original planning consent.

The categories explored included the following:
-Asset life-extension (involving an increase in the consent duration. The physical characteristics of the infrastructure remain the same, but parts may be replaced on a like-for-like basis - 3 sites).
- Repowering (involving new planning permission, usually involving the replacement of existing turbines with new turbines, often of larger capacity, often involving a change in the number of turbines - 22 sites).
- Decommissioning (removal of the infrastructure from the site - 2 sites).

3.5.2 Policy analysis

Before undertaking the in-depth case study research, the national policy context for onshore wind and solar was examined. An analysis of national-level planning and energy policy and guidance was undertaken for England, Wales, and Scotland to investigate when and how duration and end-of-life considerations have been reflected in policy as it has evolved, and how the issue has been navigated and policy refined over time. The analysis comprised an exploration of all policy documents from the earliest policies on solar and wind until the end of 2018, including, where possible, looking at drafts and consultation responses (43 documents in total). The analysis involved the identification of any relevant policies through searching for any terms related to repowering, life-extension, decommissioning, or site duration. The analysis text was coded according to themes of end-of-life decision-making and the policy excerpts were recorded in a table so that policy change over time and between countries could be examined (see table 10 for summary of relevant policy). The policy analysis was supplemented with interviews with policymakers in each country (three in total) to provide further detail regarding what policymakers had and had not considered.

3.5.3 Document and policy analysis of cases

Textual and thematic analysis were undertaken for each case to understand how information and requirements regarding decommissioning, repowering, and any other temporal or end-of-life considerations had been represented within policy, planning application and decision documents. Analysing documents offers the benefits of providing insight into the case study, can reveal areas that require further investigation, trace change over time, and provide data on aspects that cannot be observed through other research methods (Bowen 2009). Moreover, documents contain text that was written without the intervention of a researcher (Bowen 2009) and often also provide the benefit of broad coverage, such as over a long period of time or numerous settings, providing exactness through details and references (Yin 1994). However, documents were unlikely to provide all of the information needed to answer the research questions (Bowen 2009). Bias may also occur both from the researcher and the document as documents are written for a particular purpose (Krippendorff 2004). These limitations were minimised through having a clear strategy for thematic analysis and through evaluating the documents.

For each case, the relevant planning policies including any policies referred to in the application, decision notice, or appeal documents were identified, providing the policy context. All planning application and decision documents, including public comments, were then compiled. The analysis firstly involved looking for key themes, identifying what was covered and what they appeared to be lacking consideration of, as well as considering the purpose of the document. A process of thematic coding (see Gibbs 2018) was then undertaken, with codes based on different elements relating to end-of-life decisions and interpretations of reversibility and temporality, informed by the previous stage of research and the literature (see appendix A for codes). The NVivo software package was used, producing sections of text organised into categories. The categories also later facilitated the integration of the results with the data provided from the interviews, as suggested by Bowen (2009).

A further stage of analysis involved comparing the final decision notice with the other documents, particularly those revealing the perspective of the developer and public (individuals, groups, NGO's, etc.), to explore differences in rationales and whose preferences appeared to be reflected or excluded in the outcome of each case. The document analysis also considered the use and function of the document and how it came into being, as suggested by Prior (2003). Additionally, the reasons for opposition and support for each application from the public and other actors, and the frequency with which they were raised, were explored in order to understand the levels of and reasons for written responses.

During the analysis, the main issue explored was how decisions were constructed compared to how different parties might have liked them to have been constructed and the material and non-material elements that shaped decisions. The analysis revealed the written arguments and perspectives of the various actors at the time of the application, providing insight into how views were formed and decisions made by each actor. It also facilitated exploration of how the public and other interested actors reacted to applications and how far their considerations appeared to have been included in the planning process. The analysis provided an insight into how the terms temporary and reversible as well as other descriptors that capture similar themes such as ‘impermanent’, ‘fixed-term’, and ‘restored’ had been used to both support and oppose applications.

3.5.4 In-depth semi-structured interviews.

While documents provide a static representation of formal, public-facing views, interviews enable a discussion of different perspectives and facilitate an understanding of how experiences and perceptions of energy developments may have altered over time (Aitken 2010). Qualitative in-depth interviews were used to obtain the perspective of developers, planners, communities, local pressure groups, and other key actors regarding end-of-life decision-making as well as the perspective of governments. They provide a suitable method for addressing complex issues (Qu and Dumay 2011) and for exploring the judgements (perhaps including those that are value-based or tactical) on issues that cannot be fully captured by documents, including the decisions and intentions that lie behind documents. The interviews were semi-structured with open-ended questions. Question guides, informed by the review of planning files and the literature, were prepared to ensure that all areas were covered and that all participants were asked the same core set of questions (see appendix B), but the open-ended nature of the questions enabled interviewees to converse (Esterberg 2002) and for follow-up questions to be asked. Such an approach provided participants with the freedom to expand on their responses (Longhurst 2009; Krogh 2011), facilitating a relatively open conversation (Longhurst 2003).

Twenty-four interviews were undertaken between March-September 2018 (see Appendix C for list of interviewees). Participants were identified through contacting the planning officer, developer, planning agent, and community opposition or support groups listed on the online planning application file. Before commencing the research, a pilot interview was undertaken to identify any weaknesses in the interview design (Kvale 2007). The pilot study ensured that the questions were not worded in a way as to be leading and was used to approximate how much time interviews would take.

The interviews were undertaken in locations suggested by the interviewees to ensure that they felt comfortable enough to talk freely (Elwood and Martin 2000), most (18) opted for their offices or local community building while three chose a coffee shop. Three interviews were undertaken as phone interviews at the request of the participants, the rest face-to-face. Interviews were recorded using a digital voice recorder with permission of the participant (in all except 2 cases where notes were made instead). The transcripts were subsequently typed. While the use of a voice recorder has been criticised for potentially resulting in participants being less open in their responses (Hoggart et al. 2002), it facilitated more natural engagement in the interview (Opdenakker 2006) and ensured that the interview could be listened to numerous times for analysis (Belisle 1998).

As introduced above, analysis of the qualitative interviews involved a process of developing themes and coding to organise the data and recognise patterns. The interviews were transcribed in full and before beginning the analysis a process of familiarisation was undertaken involving reading through the data to gain a feel for the research findings as a whole before trying to pick out key concepts (Ritchie and Spencer 2002). The codes used for analysis were identified through an inductive process of progressively narrowing the focus to identify key themes and patterns as suggested by Corbin (2008) and using a codebook to develop the codes. The development of categories was also influenced by the findings of the earlier stages of the research and the literature review. The inductive, open-coding approach was taken to draw out the themes emerging from the interviews and produce a set of codes and sub-codes. The qualitative transcripts were analysed through the use of the software package NVivo to collate all examples of sentences relating to the identified coding categories. The software enabled an analysis of common themes, trends, and associations to be undertaken. Segments of text of the same category were compared to identify patterns. Cases that did not fit the patterns were also explored to provide potentially useful insights, as suggested by Gläser and Laudel (2013).

Coding provides the benefit of organising the data and enabling patterns to be identified (Gläser and Laudel 2013). However, a limitation of taking an open-coding approach is its subjective nature and reliance on the researcher's interpretation of the interviews (Cope 2010). To overcome such limitations, codes were developed using a codebook to ensure that there were clear definitions for each coding category (Campbell et al. 2013), use of the coding scheme was also practiced during pilot interviews and was discussed with the two research supervisors, enabling additional reflection.

3.5.5 Survey of public perceptions

While written responses to planning applications provide insight into public perceptions, they are likely to reflect the responses of a particular group, i.e., those engaged in the planning process, and reflect their perceptions at a time when they are attempting to influence a decision. Similarly, those participating in interviews as part of the case study research reflected those in clear support or opposition to the developments. This research also sought to obtain the perspectives of members of the community who were less engaged with the topic to obtain a broader understanding of how the local community considers the duration and end-of-life options for wind farms. To understand the perceptions of local publics, a public survey was undertaken for two of the cases. The chosen cases were Kirkby Moor, due to the significant level of public opposition to the repowering and life-extension applications, and St Breock due to the high level of public support for repowering. While it may have been useful to undertake a public survey for all five cases, this was not possible due to time and financial constraints. The survey was designed to explore the perceptions of residents regarding the temporal nature of the infrastructure and the impacts and issues surrounding end-of-life considerations.

Both surveys were administered in June 2018 via an envelope hand-delivered to each house within the research boundary (see chapter 6 for boundaries). 710 surveys were delivered in total and 202 completed surveys were received. The envelope contained a cover letter providing information about the research, a copy of the survey, and a free-post return envelope. Additionally, the link to an online version of the survey was provided on the cover letter, giving participants the option to complete the survey online and thereby make participation as easy and convenient as possible. Postal surveys have been criticised for being more resource-intensive and expensive than solely web-based surveys (Yun and Trumbo 2000); however, accessing the email addresses of residents was not possible and would have led to a bias in favour of those with computers. Participants completing the survey had the option to be entered into a draw to win a £25 Amazon voucher, this was used as an incentive to increase the response rate as suggested by Bosnjak and Tuten (2003) and it was confirmed that personal details would not be stored or associated with responses. In the case of Kirkby Moor, a reminder was placed in the local church magazine.

The surveys were administered within a 3.5km circumference around each wind farm to capture the main settlements expected to experience visual impact. The Landscape and Visual Impact Assessment (LVIA) submitted as part of the St Breock repowering application stated that the significant visual impact of the original scheme was 2.0-2.5 km from the site and the significant visual impact from the repowered scheme was expected to be up to 3.5-4km. Similarly, the LVIA for the Kirkby Moor life-extension stated that open access lands, rights, and ways at 3-4km from the site might face significant visual impact. A survey question asked for the respondents' postcode to ensure that people outside the sample zone did not complete it.

The survey was designed to explore attitudes towards the temporal nature of the infrastructure, repowering, relations with place, and energy attitudes. Researching existing wind farms enabled consideration of potential changes in perceptions before and after the development of projects (Kontogianni et al. 2014). The questions were mostly closed-ended followed by several open-ended questions, enabling both statistical data to be produced as well as a more detailed understanding of perceptions (see appendix D for the survey). To maximise the response rate, the number of questions was limited (Burchell and Marsh 1992) while ensuring that responses would contribute to answering the research questions.

The survey firstly provided background information about the repowering and life-extension applications to ensure that respondents understood the terms and to refresh their memories of the applications. The questions began with overview questions regarding how long the respondent had lived in the area, how often they see the wind farm, age, and postcode. It then used Likert scales to explore energy attitudes as well as attitudes towards wind energy in general and in their local area. Likert scales were then used to explore place attachment, covering two main types of place attachment, place identity and place dependence as outlined by Williams and Vaske (2003) and Raymond et al. (2010). The subsequent set of questions aimed to understand perceptions of the existing windfarm including if people who were living in the area at the time of the original application wrote a letter of support or objection and if perceptions changed following the building of the wind farm. The survey included open-ended questions about the positive and negative impacts of the wind farm to ensure that residents were not prompted with examples, as suggested by Eltham et al. (2008). A similar set of questions were then asked for the repowering application and in the case of Kirkby Moor, the life-extension application. The final Likert scale questions sought to explore views on the main research questions, including if respondents felt involved in the decision-making process and how they considered the temporal nature of the site. When designing the Likert scale questions, those that were designed to measure different but related factors were mixed to prevent anchoring bias (Gehlbach and Barge, 2012).

Both surveys were piloted in a two-stage process in order to check for potential errors, leading questions (Adams and Cox 2008), and the use of technical language, to ensure that the questions were not too complicated (van Teijlingen and Hundley 2001) and to ensure that the survey met the aims of data collection. Firstly, the surveys were tested by colleagues to ensure that questions were clear, unbiased, and that the online survey software worked smoothly, this led to minor changes in the wording of some questions and minor formatting changes. The survey was then piloted on a small sample of each population to test the design and length of the survey. After completing the survey, these respondents were asked questions regarding the survey content, difficulty, time, and satisfaction. The overall response was positive regarding user experience, and a minor change was made to the question regarding how often people see the wind farm, identifying the need to add an option for 'every day'. For both stages, the pilot results were analysed to ensure that the plan for analysis was suitable for providing the desired type of data.

Couper (2000) identified four common sources of bias that occur in surveys: coverage, sampling, non-response, and measurement errors. Taking each source of bias in turn, coverage errors occur when the population that the sample is taken from (the frame population) does not represent the target population, this was minimised through sending the invitation to participate to all houses within the settlement area. Sampling error occurs when the sample selected is not representative of the frame population; however, sampling errors are less common in mail surveys and can be minimised by increasing the sample size (Dillman 1991). Non-response errors occur when there are stark differences between the interests of those who respond to the survey and those who do not, this was taken into consideration when analysing the results; however, it is generally assumed that the higher the response rate, the lower the non-response bias (Dillman 1991). The survey was worded in such a way as to encourage those without a strong opinion on the topic to respond and it was delivered door-to-door, providing the opportunity to encourage participants to respond. Additionally, the use of a prize draw for survey completion helped to increase the response rate. Measurement error arises when there is a difference between the survey responses and underlying unobserved variables, this was minimised through ensuring that the questions were worded in a way which allowed respondents to provide the necessary information (Groves 2004), i.e., the use of Likert scales and using simple, specific sentences in open-ended questions.

The quantitative closed questions were analysed through collating the results in a spreadsheet and undertaking statistical tests using SPSS. Descriptive statistics were used to provide an overview of the trends in the data (Weiss and Weiss 2015), while inferential tests provided a more detailed analysis. The open-ended questions were analysed through coding the answers into key themes, using the codes developed in earlier stages of the research.

3.6 Analysis and integration

The research methods were designed to complement each other through triangulation. Denzin (1978,291) described triangulation as 'the combination of methodologies in the study of the same phenomenon', it provides the benefit of overcoming the weaknesses or limitations of a single method (Adams and Cox 2008). It has been suggested that triangulation should involve at least one method for exploring the structural elements of an issue (in this case the data overview and textual analysis of policy and planning documents) and at least one that explores its meaning to people involved (in this case the in-depth interviews and surveys) (Fielding and Fielding 1985). The analysis aimed to answer the research questions by exploring the themes and patterns emerging from the data. When undertaking analysis, it was important to be reflexive and aware of any underlying assumptions (Mauthner and Doucet 2003). An inductive approach was chosen due to the complex nature of the research topic and questions; however, it is vital to consider that planning research cannot be purely inductive (Campbell 2003), thus questions and insights from the literature review helped to shape the analysis. The concept of 'temporalities' and exploring different temporal considerations also formed a central dimension of the analysis. The approach taken involved an initial analysis of detailed observations followed by the identification of patterns within the data and more abstract generalisations (Neuman 2011; Rydin 2013), this enabled themes to emerge from the data without restrictions (Corbin 2008).

Data collection and analysis were undertaken concurrently in a reflexive manner, integrating the data obtained from different methods. The research was carried out in a particular order so that the structural elements of the research (i.e., the review of policy and status of the sector) could inform the design and analysis of the interviews and surveys. Many of the same categories of analysis were used for both the documents and interviews, enabling the data to be analysed together in order to answer the research questions. The full data from each case was analysed together to obtain a comprehensive, detailed understanding of each case rather than treating each data source separately. Corroborating results across the sets of data from different methods can provide the benefit of reducing potential bias (Bryman 2006), however it cannot be assumed that the findings of different methods will support each other, thus the findings were brought together to explore contradictions as well as corroboration and elaborations, as suggested by Brannen (2005). Combining the data during analysis enabled the research questions to be explored and answered. However, both the policy and data overview and the public survey element had their own integrity and contribution to answering the research question so were also analysed and discussed separately as well as contributing to the discussion of overall findings.

3.7 Ethical considerations

Ensuring that research is undertaken in accordance with ethical guidelines is vital for ensuring the reliability of data, mutual trust and respect between the researcher and participants, and for promoting social and moral values throughout the research process (Resnik 2011). Ethical approval for this project was received from Cardiff University. The research was carried out in accordance with Cardiff University's ethics guidance and the advice provided by the Economic and Social Research Council (ESRC) Research Ethics Framework. Accordingly, a wide variety of ethical considerations covering research design, researcher positionality, data analysis and storage, and future use of the data were taken into account in the design of the research as well as throughout the research process.

It can be difficult to anticipate or quantify all possible ethical implications before the commencement of research (ESRC 2018), therefore several measures were undertaken to ensure preparedness. Familiarity with the regulations, guidelines, and best practice advice, as suggested by Hopkins (2007) ensured awareness of possible ethical issues and situations before, during, and after the research. Furthermore, adopting a reflective approach ensured that the overall purpose of the research as well as the interaction with research participants was ethically appropriate as well as ensuring ongoing critical scrutiny of the methods, data, positionality of myself as the researcher and the research context (Guillemin and Gillam 2004). A reflective research journal was used throughout the research to facilitate an ongoing reflection of ethical considerations and of my position as a researcher, as suggested by Ortlipp (2008).

Ethical considerations were taken into account when deciding if the case studies should be named as it is essential to ensure the anonymity of research participants to help protect their confidentiality (Wiles et al. 2008). The decision was taken to name the cases but anonymise the participants in order to allow a more detailed, specific picture of the research context and allow future researchers to add to understanding them, whilst protecting the anonymity of respondents as much as possible. However, as many respondents have professional roles, with much of their position being in the public realm, it was not possible to guarantee that people would not be identifiable. The decision to name the cases was explained to participants before the interviews.

3.7.1 Positionality of the researcher

Researcher positionality was reflected upon throughout the research. Alongside this, I reflected on the type of knowledge that was being generated and how it was being produced, as suggested by Guillemin and Gillam (2004). Ongoing reflection helped to guard against the effect of personal subjectivity (Ortlipp 2008) and was facilitated by the use of a research journal. My reflections included my position as a researcher, as someone who has been employed as a planner, as a renewable energy supporter, as an ‘outsider’ from the case study locations, and as someone who has not experienced living close to renewable energy infrastructure. It was also essential to reflect on my work placement with a renewables trade association and how this may have influenced my perceptions of the need for increased renewable energy development. Acknowledging and reflecting on these elements in my research diary enabled me to recognise their potential influence (for example, potential bias in interview wording) and try to minimise the potential impact on the nature of my interviews and data analysis.

In order to address potential power imbalances both from my position interviewing participants and from the influence of interviewing elite actors, the interviews were semi-structured, enabling participants to talk in their terms. Participants were also given the opportunity to choose the location of the interview to ensure that they felt comfortable to speak freely (Elwood and Martin 2000). It was also imperative to consider positionality during data analysis as a researcher makes choices regarding how the data is interpreted and which extracts to include, consideration was thus given to the influence of any pre-existing ideas, epistemological and ontological assumptions and institutional and interpersonal contexts of the research and methods (Mauthner and Doucet 2003). Throughout the process of analysis I consciously considered the influence of my perceptions and outlook as suggested by Stoecker (1991) and Mauthner and Doucet (2003), most significantly I took care not to be influenced by my positive perceptions of onshore wind and solar.

3.7.2 Research participation

It is vital to ensure that participants understand the nature of the research, their participation, and that participation is voluntary (Longhurst 2003). An information sheet accompanying the invitation for participation explained the purpose of the study as well as data storage, to provide transparency (see appendix E). The information sheet ensured that participants understood the purpose of the research, the nature of their involvement, and how the research findings may be used in both academic and non-academic contexts. As suggested by ESRC (2018), participants were given time to consider their decision and had the opportunity to ask questions before agreeing to participate.

Each participant signed a consent form before the interviews (see appendix F). The consent form and the information provided at the start of the public survey informed participants that participation was voluntary and that they were free to withdraw at any time without questions or repercussions. Participants were asked at the start of the interview if they were comfortable being recorded and if they did not agree (two participants) detailed notes were made.

3.7.3 Data storage

Following transcription of the qualitative surveys, all files were stored on a secure password-protected computer and deleted from the Dictaphone. The identity of respondents remained anonymous by using a system of number coding rather than names. The data storage procedure was explained to participants so they understood how their responses were being protected. Data will be stored longer-term and destroyed in accordance with the UK data service recommendations.

3.8 Limitations

Each research method had limitations (as discussed in section 3.5). As well as identifying and trying to minimise the limitations of each method, the use of multiple methods enabled corroboration of research findings (Bazeley 2004). As the research contained several qualitative methods, there was potential for researcher bias to occur in numerous stages, particularly when coding and choosing which elements of the data to discuss in detail. The potential impact of such bias was reduced through undertaking a process of reflection, acknowledging my perspectives and ensuring that any assumptions taken within the research were made transparent (Mauthner and Doucet

2003). Moreover, physical and intellectual audit trails were used, documenting all stages of the research including how methodological decisions were made and how my thought process as a researcher developed throughout the study, thereby increasing the transparency of the research process, enabling readers to judge or confirm the findings (Carcary 2009). As suggested by Yin (2003), a protocol was developed and followed for each case to ensure that they followed the same research procedure. A database was kept to organise data and to ensure that it could be retrieved if requested for further investigation (Yin 1994).

3.9 Structure of the empirical chapters

This mixed-method approach provided a wealth of data and research findings, which will be presented and discussed in the following chapters. Chapter 4 provides an overview of the age and life stage of wind farm infrastructure, including experiences of repowering, life-extension, and decommissioning. The chapter also provides a comparison of the development of relevant solar and wind policy in each country. The document analysis and interview data from the five case studies is presented in chapter 5 with the results of the two public surveys in chapter 6. In chapter 7, the findings from each of the empirical chapters are brought together, forming a discussion of emerging themes and insights for answering the research questions.

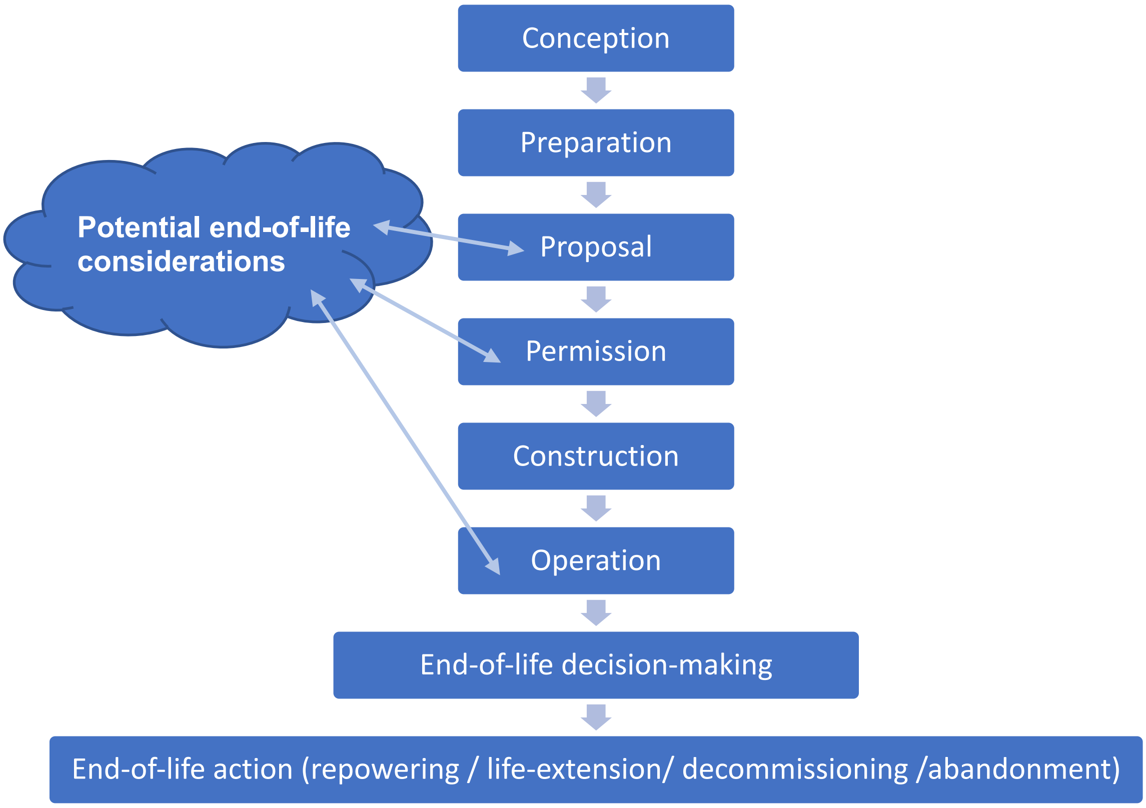
Chapter 4: Age of infrastructure, end-of-life experiences and policy context.

This chapter considers the policy context and status of the wind and solar sectors in Great Britain. It firstly outlines the status, age, and characteristics of wind farms in England, Wales, and Scotland, including an overview of end-of-life experiences. Forecasting is provided regarding the expected timing of end-of-life decisions and the estimated potential for future repowering. It then provides the results of an analysis and comparison of planning and energy policy and guidance in the three devolved planning systems. In so doing it begins to address the first research question through providing an understanding of how national governments, Local Planning Authorities (LPAs) and to a lesser extent developers, prepare and plan for end-of-life decision-making for wind and solar facilities, including what end-of-life factors appear to matter and the timeframes being sought and invoked. From a Deleuzian perspective, wind capacity is considered not as a fixed stock but as more fluid. The following data reveals how the extent of that fluidity might become problematic and how states are responding – or not – to try and steer what becomes.

In order to assess the status of onshore wind and solar, it is necessary to understand the life stages of a development as outlined in Figure 7.

Figure 7: Life stages of a renewable energy development

The diagram reflects how end-of-life considerations may also occur during the proposal, permission, and operation of the site.



This chapter discusses three[7] sets of end-of-life options:

i) Repowering.
Comprising a material change to the site. Repowering has not yet occurred for solar; however, for wind farms it usually involves removing the existing turbines on a site and replacing them with new turbines, either on the existing towers with larger rotors/blades (sometimes referred to as replanting, see RenewableUK 2019) or new turbines often in a different location or layout. Because this entails a change to the form or dimensions of the project, it involves a full planning application.

[7] In an industry report, RenewableUK (2019) identified an additional category of 'refurbishment' as involving the replacement of equipment without changing the size or layout of the infrastructure or changing the planning permission. While it is important to consider that such repairs or upgrades may be part of managing the operational life of the site, it is considered in this thesis to be maintenance rather than an end-of-life option (granted that the categories are blurred).

ii) Asset life-extension.
Involving extending the consent life of the infrastructure for a period (usually 5-10 years for wind and 15+ for solar) with no material changes to the site, this is achieved through altering the duration condition of the original planning permission. For wind, during this process, some components of the existing turbines may be replaced, but the overall height and layout of the site remain the same.[8]

iii) Decommissioning.
Involving ending the operation of the infrastructure and removing the turbines and possibly other associated infrastructure. What is removed from the site may depend on the requirements specified in planning conditions and legal agreements and may also depend on what developers do in practice.

As this chapter will discuss, there is potential for a further end-of-life category to occur - site abandonment, where part or all of the infrastructure may be left in place with no requirement for removal by any actor.

4.1 Status of the sector

While policy provides the framework for how decisions should be made regarding the end-of-life of this infrastructure, it can be seen as merely envisioning and trying to shape what might become. The first stage of the research thus sought to explore what has been happening in practice in terms of the age of infrastructure and the extent and nature of repowering, life-extension and decommissioning.

4.1.1 Current status of the onshore wind sector

In considering wind energy developments in Great Britain, it is crucial to first reflect upon the use of time-limited planning consents. In Great Britain, as with most other countries, most development is granted planning consent in perpetuity. Wind and solar are thus distinctive, even when compared to other energy sources such as hydro and

[8]In some sense, the lines between repowering and life-extension may appear blurred, particularly in cases where life-extension leads to increased efficiency and as repowering extends the life of a site.

nuclear, in having been regularly granted time-limited consent periods, often of 25-years.[9] While the research revealed a lack of consensus as to the reasons for the time-limited consents, it is likely to have emerged as a way of managing concerns associated with new, highly visible technology and then remained the norm. The use of time-limited consents provides one basis - rooted in the temporalities of planning regulation - for gauging how the overall ‘stock’ of wind energy infrastructure is approaching end-of-life.

4.1.1.1 Age of infrastructure

A review of the age and status of current windfarms revealed the extent to which end-of-life is becoming an increasingly prominent issue. In 2018 in England, Wales, and Scotland there were 462 wind farms aged 5-14 years (42 % of wind farms), 40 (4%) aged 15-20 years and 22 (2%) over 20 years old. The oldest wind farms usually have a lower installed capacity (hence, repowering provides the opportunity to significantly increase the installed capacity of sites). Table 7 reveals that end-of-life considerations are an issue that is creeping forward steadily in Great Britain rather than reaching a sharp tipping-point, at least until 2025 (see also Ziegler et al. 2018). Notably, a more significant proportion of the capacity in Wales, an early ‘leader’ in UK wind power development (McKenzie Hedger 1995), has entered the final few years of expected life.

[9]The wording of planning conditions limiting consent duration is usually as follows: ‘The permission hereby granted shall endure for a period of 25 years from the date when electricity is first exported.’

Table 7: Age and installed capacity of wind farms in England, Wales, and Scotland

(Based on 2018 data from Gov.UK and RenewableUK, supplemented with authors research)

Age of wind farms (Years)	**England**		**Wales**		**Scotland**		**Total**	
	Number and % of all turbines	Installed capacity (MW) and %	Number and % of all turbines	Installed capacity (MW) and %	Number and % of all turbines	Installed capacity (MW) and %	Number and % of all turbines	Installed capacity (MW) and %
5-14	836 (48.7%)	1473 (52.9%)	238 (30.6%)	430 (35.3%)	2066 (59.4%)	4770 (61.9%)	31403140 (52.6%)	66746674 (57.0%)
15-19	71 (4.1%)	5656 (2.0%)	43 (5.5%)	38 (3.1%)	150 (4.3%)	142 (1.8%)	264264 (4.4%)	237237 (2.3%)
20+	82 (4.8%)	35 (1.26%)	312 (40.1%)	135 (11.1%)	96 (2.8%)	54 (0.7%)	490 (8.2%)	224 (1.9%)

4.1.1.2 Characteristics of repowering

At the time of writing in 2018, in England, Wales, and Scotland, 22 wind farms had been granted permission to repower of which 17 had been implemented. Two permissions remained valid with the developers not confirming if they will implement the permissions. Interviews revealed that such decisions regarding implementation are often linked to the economics of repowering (further explained in chapter 7). One permission was granted but not implemented, one was unknown, and the developer was amending one application. Additionally, one wind farm (Castle Pill) was considered to be a site-extension rather than repowering. Two schemes had been refused permission to repower, with one (Chelker Reservoir, discussed below) refused on two occasions. There was also one application awaiting decision. The situation revealed a high success rate for repowering applications, revealing a changing nature of the permission period and demonstrating that wind farms are continuing to exist for longer than initial time-limited permissions would suggest, albeit often in different formations. Due to the small number of applications, it is not possible to compare experiences between countries; however, it is worth highlighting that the two refused applications were in England. While the number of repowered schemes is currently low, the data in tables 9 and 10 demonstrates the potential future increase.

Repowering provides an opportunity to increase the efficiency of existing sites through upgrading the infrastructure with new, more efficient, turbines, particularly as many of the older wind farms are located in sites with the best wind resource (Mitchell 1996), albeit also visually prominent. Repowering generally changes the characteristics of the site as, in most cases, it involves replacing turbines with a smaller number of taller, higher capacity, turbines, thus there are effects other than changes in duration. Exploring the 22 sites that had been granted repowering permission in Great Britain revealed that on average repowering has decreased the number of turbines on a site by 39% but increased the height of turbines by 90.4%. Significantly, the average increase in installed capacity (MW) of the site is 155 %, or when the one turbine scheme (Ramsey) is removed from the equation, 121% (see table 8). It is worth considering that despite the significant increases noted here, in some locations land restrictions may create potential barriers to repowering due to the increased space requirements of larger, more efficient turbines with greater rotor diameters. Moreover, the greatest increases in installed capacity are likely to occur from upgrading the earliest sites due to improvements in turbine technology. Nevertheless, we can see wind farms potentially becoming larger and more economically and energetically efficient.

Table 8: Characteristics of sites granted permission to repower in England ,Wales, and Scotland

Sites granted repowering permission (Country and County)	**Change in turbine numbers (Original = O, Repower = R) and (%)**	**Height change to turbine blade tip (Original= O, Repower=R) and (%)**	**Change in installed capacity (MW)(Original = O, Repower = R) and (%)**
Blood Hill (England Norfolk)	O= 10 R= 2 **-80%**	O=43 R=45.5 **5.8%**	O= 2.25 R= 0.8 **-64%**
Camas Nan Geall (Scotland Highlands)	O= 2 R= 2 **0%**	O=27 R=45 **66.7%**	O= 0.1 R= 0.45 **350%**
Carland Cross (England Cornwall)	O= 15 R= 10 **-33%**	O= 49 R=100 **104.1%**	O= 6 R= 20 **233%**
Caton Moor (England Lancashire)	O=10 R= 8 **-20%**	O=48.4 R=90 **86.0%**	O= 3 R= 16 **433%**
Cemmaes (Wales Powys)	O= 24 R= 18 **-25%**	O=42 R=76 **81.0%**	O= 7.2 R= 15.3 **113%**
Coal Clough (England Lancashire)	O= 24 R= 8 **-67%**	O=49 R=110 **124.5%**	O= 9.6 R= 16 **67%**
Delabole (England Cornwall)	O= 10 R= 4 **-60%**	O=49.5 R=110 **122.2%**	O= 4 R= 9.2 **130%**
Goonhilly Downs (England Cornwall)	O=14 R=6 **-57%**	O=49 R=107 **118.4%**	O=5.6 R=12 **114%**
Great Eppleton (England Tyne and Wear)	O= 4 R= 4 **0%**	O=71 R=115 **62.0%**	O= 3 R= 8.2 **173%**
Great Orton II (England Cumbria)	O= 10 R= 6 **-40%**	O=60 R=68.5 **14.2%**	O=3 R= 3.96 **32%**
Harlock Hill/Furness (England Cumbria)	O= 5 R= 2 **-60%**	O=53 R=99.5 **87.7%**	O= 2.5 R= 4.6 **84%**
Haverigg (England Cumbria)	O=5 R= 4 **-20%**	O=45 R=76 **68.9%**	O= 1.125 R= 3.4 **202%**
Llandinam (Wales Powys)	O= 103 R=34 **-67%**	O=45.5 R=122 **168.1%**	O= 31 R= 102 **229%**
Llangwyryfon (Wales Ceredigion)	O= 20 R=11 **-45%**	O=42 R=66 **57.1%**	O= 6 R= 9.35 **56%**
Ovenden Moor (England West Yorkshire)	O= 23 R= 9 **-61%**	O=48.9 R=115 **135.2%**	O=9.2 R= 18 **96%**
Ramsey (England Cambridgeshire)	O= 1 R= 1 **0%**	O=45 R=125 **177.8%**	O= 0.225 R= 1.8 **700%**
Rhyd-y-Groes (Wales Ceredigion)	O= 24 R= 13 **-46%**	O=46 R=79 **71.7%**	O=7.2 R= 11.7 **63%**
Spurness (Scotland Orkney)	O= 3 R= 5 **67%**	O=100 R=105 **5.0%**	O= 8.25 R= 10 **21%**
St Breock (England Cornwall)	O=11 R=5 **-55%**	O=53.5 R=100 **86.9%**	O= 4.95 R= 12.5 **153%**
Taff Ely (Wales Rhondda Cynon Taff)	O= 20 R= 7 **-65%**	O=53.5 R=110 **105.6%**	O= 9 R= 17.5 **94%**
Tangy III (Scotland Argyll and Bute)	O=22 R= 16 **-27%**	O=77 R=125 **62.3%**	O=18.7 R= 36.8 **97%**
Wansbeck Blyth Harbour (England Northumberland)	O=9 R= 1 **-89%**	O= 45 R=125 **177.8%**	O=2.7 R=3.4 **26%**

Table 8 is based on data correct as of August 2018. Not including Bu wind farm as permission lapsed and site is now decommissioned. Not including Castle Pill wind farm as it was considered to be an extension rather than repowering.

4.1.1.3 Characteristics of life-extension

In other cases, the decision has been taken to extend the consent life of the existing infrastructure, often by a period of 5-10 years, through asset life-extension. Interviews[10] revealed that this decision is taken in order to get the most out of the existing assets which can often operate, physically and economically, for longer than their 25-year permitted period, reflecting different temporalities of materials and regulation. During this process some components of the existing turbines may be replaced, but the overall height and layout of the site remain the same and thus compliant with the original consent. As well as occurring for an individual site, life-extension may also occur when a site is physically extended (e.g., an application is put in for new turbines close to an existing site) so that the new and existing consent durations align. Such site-extension is particularly common in Scotland.

As life-extension varies a condition on a planning consent, rather than requiring a new consent, it is difficult to identify such applications and no database is held. In order to get an estimate of the occurrence of life-extension, the planning history of all wind farms aged 18 or over[11] was reviewed to see if they had submitted an application to vary consent duration. This provided a figure of 3 from a possible 35 wind farms, (additionally, 5 of the 35 had been granted permission to repower). All three were successful and submitted the life-extension application in their 24th year of operation, reflecting industry discussions[12] which identified that the timing of life-extension applications is often taken at a later stage as varying a condition requires far less supporting information than a full planning application. Nonetheless, this figure is an estimate that is unlikely to cover all life-extended applications as some may have made the decision at an earlier stage. Meanwhile, there is also evidence of cases of life-extension being undertaken after a short period of operation. This has occurred in the case of the repowered Goonhilly wind farm where the developer applied to extend the duration from 25 to 30 years after seven years of operation of the repowered consent, identifying that wind farm manufacturers are now providing 30-year operating life

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[10]Interviews undertaken with UK wind farm developers between March-September 2018.
[11]Age in 2018.
[12]Interviews undertaken with UK wind farm developers between March-September 2018.

certification. In such cases, life-extension could be seen as a strategy from the developer, applying for a shorter period then attempting at an early stage to extend the permission, possibly in order to reduce risk during the main application through initially applying for the most common consent period, reflecting a tactical deployment of time (see Raco et al. 2018).

4.1.1.4 Characteristics of decommissioning

In Great Britain two wind farms have been decommissioned, Bu in Scotland and Chelker Reservoir in England. Bu, a three turbine wind farm located on the Orkney island of Stronsay, became operational in 2002 and was decommissioned in 2014, after only 12 years of operation. In 2012 permission was granted to repower the site with three turbines of a similar MW installed capacity; however, this permission was never implemented. The repowering application included a decommissioning method statement with the caveat that it would be updated in the case of the refusal of permission to repower. However, while the repowering application was not implemented, the council has no record of an updated decommissioning statement, thus suggesting a lack of LPA involvement in the decommissioning process. From speaking to those familiar with the site it appears that decommissioning was carried out in accordance with the decommissioning method statement[13] which specified removing the turbines, transformers, and breaking down the top 200mm of the foundations and replacing it with top-soil, stating that 'reinstatement of such areas will be subject to the agreement of the landowner' (i.e., it is a private, not public, matter). There was no mention of facilitating a future land use, suggesting a focus on land reversal and the features to be removed rather than what the site could become.

Chelker Reservoir provides a rare example of a refused repowering application, demonstrating how steps can be taken to redress what have come to be regarded as initially inappropriate siting decisions. The site was decommissioned in 2013, three years before planning permission was due to expire, due to reducing efficiency of the turbines. The developer tried to repower the site on two occasions, in 2008 and 2011, but the applications faced strong local opposition and were refused for the same reasons despite decreasing the proposed height from 125m in 2008 to 75m in 2011. The reasons included visual impact on the historic landscape and the national park[14] landscape and the impact on nearby residents, reflecting opposition to the changing

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[13]Bu Wind Farm Turbine Decommissioning Method Statement, 2012, 2.
[14]Site located 1.3km from the National Park boundary.

impacts of the infrastructure on a range of interests. Similarly, there appears to have been a lack of LPA involvement in the decommissioning process as while according to information provided by a local resident the site appears to have been fully decommissioned, a decommissioning plan was not held by the LPA.

The limited experience to date suggests that developers carry out decommissioning, as specified in planning conditions, without LPA involvement such as approving a decommissioning methods statement or specifying particular requirements. This suggests that LPAs carefully manage some life stages but not others, with an apparent focus on controlling decommissioning at the point of granting permission, setting parameters to striate the future that they can potentially act on if there is concern. Despite this, the two sites discussed above returned to their previous use of open agricultural land. However, there may be more considerable challenges in the future in cases where the relationship between regulation and the range of interests are not as straightforward or where the goals are more complex than returning to agricultural use. For example, some of the earliest wind farms do not have time-limited consents, instead specifying removal of the turbines when the infrastructure stops working for a specified period of time (often 6-12 months). Such consents rely on enforcement action from the council to ensure turbines are removed unless the developer decides it is in their interest to do so. A lot of enforcement activity is reactive in character and responsive to complaint as enforcement is discretionary in UK planning systems.[15] Additionally, there is potential for greater challenges to occur for some of the earliest wind farms where planning permissions failed to specify full decommissioning of the site. Such situations create the potential for infrastructure abandonment, changing the duration of some impacts to permanent rather than temporary and introducing potential bargaining over externalities.

4.1.1.5 Timing and repowering potential

In order to explore how the duration and end-of-life of the infrastructure is considered and treated, it is necessary to understand the extent to which end-of-life issues may form a problem and the potential implications of end-of-life decisions. For every repowering application, the number of years between the operation of the original scheme and the submission of the application to repower was calculated. Some sites

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[15] UK Government Guidance: Enforcement and post-permission matters. Online at https://www.gov.uk/guidance/ensuring-effective-enforcement). (Accessed June 2018).

submitted a repowering application early, within the first 14 years of operation, acting to prevent facilities becoming defective due to issues such as performance problems with the earliest infrastructure, rapid technological developments, and difficulties of obtaining replacement parts. In ‘normal’ cases, repowering is taken later in order to upgrade the infrastructure as it approaches the end of its working life and thus to maximise the installed capacity from the site. In some cases, older turbines are sold after repowering. In order to create an estimate for the age at which most schemes repower, an average was taken of all sites that repowered aged 15 or over, excluding abandoned applications or second attempt applications. The 15-year figure was chosen in order to reflect schemes repowering within the last ten years of their permitted life rather than undertaking early repowering for the reasons discussed above. This was supported through looking at planning applications of repowered schemes and from discussions with industry experts. The calculated average was 17.53 years, this was rounded to 18 to undertake calculations. Interviews with wind farm developers[16] revealed that the date of decision to repower can vary due to factors such as ownership and finance, but if a decision is made there needs to be time to get an application through the planning system. Therefore, the calculations were also repeated with a more conservative, but feasible, 20-years as the date of submitting an application.

Based on the figure of 18 years, the number of sites expected to make repowering decisions within the next five and ten years was calculated.[17] Table 9 provides the number of sites, the current energy produced from these sites and the potential energy based on the average increase in MW discussed in section 4.1.1.2. What it demonstrates is that while all wind energy capacity, especially that which is subject to 25-year consents (most schemes in Great Britain) is ultimately ‘at risk’ of approaching end-of-life processes, for a significant amount of capacity that point is now very close and the potential increase in installed capacity from repowering is significant, with knock-on effects for overall installed capacity.

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[16]Interviews undertaken with UK wind farm developers between March-September 2018.
[17]Using the RenewableUK November 2017 database (updated for 2018 figures).

Table 9: Potential sites repowering after 18-years of operation (based on 2018)

(Calculated using data from GOV.UK and RenewableUK.)

	Number of sites	**Current total MW**	**Potential MW from repowering** (155% increase)	**Potential Increase in MW**
Making decision within 5 years (aged 13-17 in 2018)	54	666	1,698	1,032
Making decision within 10 years (aged 8-17 in 2018)	215	3,225	8,224	4,999

The same calculations were completed using the 20-year figure to provide a more conservative estimate of when schemes may repower (see table 10), even with this figure, the potential MW increase from repowering in the next ten years is substantial.

Table 10: Potential sites repowering after 20-years of operation (based on 2018)

(Calculated using data from GOV.UK and RenewableUK.)

	Number of sites	**Current total MW**	**Potential MW from repowering** (155% increase)	**Potential Increase in MW**
Making decision within 5 years (aged 15-19 in 2018)	40	237	604	367
Making decision within 10 years (aged 10-19 in 2018)	144	1,917	4888	2,971

The figures in tables 9 and 10 provide an estimate in terms of potential MW increase from repowering, which may decrease as some of the early, most inefficient turbines are gradually replaced. They also provide an estimate in terms of time frames as developers may make end-of-life decisions after 18-20 years. For example, in 2018, there were 22 windfarms aged 20 or over with 15 having not applied for repowering or life-extension. There are numerous reasons for making the decision later, including policy constraints or uncertainties and a lack of financial support mechanisms. Notably, if sites do not repower or pursue life-extension, there is a potential for significant loss of MW output. Moreover, some of the earliest sites do not have time-limited consents and thus do not face the same time-pressures to submit some form of end-of-life application, such sites risk redundancy, inefficiency, and potentially abandonment. Therefore, the figures above have the potential to increase if some of the oldest sites decide to repower, which many are expected to due to their locations in areas with high wind speed. Significantly in the context of the aims of this research, the above findings reveal that a growing proportion of Great Britain's wind energy capacity will have to negotiate end-of-life decision issues, with broader implications for the energy mix and potentially, wider decarbonisation policy. Differences emerge regarding end-of-life time frames for the infrastructure, in particular between the end of consent and other temporalities. In some cases, the physical/economic life of the equipment may not be aligned with the consent, there are thus ongoing efforts to align multiple temporalities.

4.1.2 Response to repowering, life-extension and decommissioning of onshore wind

4.1.2.1 Public response to repowering

Reviewing public comments on applications – the substantive remarks made and their frequency – appeared to show that public preference often has little direct influence on the outcome of applications (see also, Aitken et al. 2008). The high success rate for repowering (as discussed above) appears to have occurred irrespective of the level and nature of public opposition. Illustrating this, the repowering of Ovenden Moor received 111 letters of opposition and two of support, but such opposition did not prevent approval. While the two refused repowering applications (Kirkby Moor and Chelker reservoir) faced high local opposition, the reasons for refusal were centred on visual impacts, impacts on historical landscapes, and proximity to National Parks. The reasons for refusal in Chelker reservoir noted the impact on nearby residents; however, the reasons in Kirkby Moor, where opposition was extremely high, did not mention the public.

Reviewing public comments also provided an overview of the most popular reasons for support and objection. Those supporting applications often did so based on supporting renewable energy, preferring wind turbines over other forms of energy and due to positive impacts created by the original scheme. Sites that had the most positive reactions to repowering appeared to be those where the local community could identify the benefits that the wind farm had provided and where it had become a recognised part of their local area. There is evidence of perceived familiarity in some locations, reflected in comments describing turbines as a 'local landmark' or part of the 'local landscape.'[18] This supports research suggesting that people are often more favourable of the infrastructure once constructed (see, for example, Warren et al. 2005). In some cases, those supporting repowering felt that the developer had listened to and involved the community during consultation processes, reflecting existing literature highlighting the importance of meaningful, responsive public consultation (Firestone et al. 2018; Gross 2007; Hindmarsh and Matthews 2008).

An analysis of comments submitted online to LPAs in response to repowering applications (full copies of all public comments were available for nine repowering applications) revealed that the most frequently reported reasons for opposition (cited as reasons across all nine cases) included visual impacts, impacts on the local economy and tourism, and noise and residential amenity, particularly due to changes in turbine size. This reflects existing literature identifying visual impact as a central reason for wind farm opposition (Wolsink 2007b). However, change to the 'temporary' nature of the development was also a common reason for objection in three of the cases, showing public disquiet that a prior agreement had been broken and, in some cases, raising concerns that approval for repowering will set a precedent for other sites. Perceived breaches of trust have been identified as undermining public attitudes elsewhere (Walker et al. 2010) and necessarily have a temporal narrative to them in terms of promising to the future (see Abram and Weszkalnys (2011) for ideas of planning promising to the future). Landscape changes that had occurred over the lifespan of sites could be seen to influence arguments of opponents, particularly in cases where the landscape had become more cherished such as where it had become part of, or close to, a designated landscape, as in the case of Kirkby Moor where land close to the site (the Lake District National Park) became designated as a World Heritage site while the turbines were in place.

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[18]Planning appeal decisions Caton Moor (2004) and Carland Cross (2010).

In most cases, it was not possible to locate the public response to the planning application for the original scheme due to records having not been retained by the LPA. However, a comparison of public comments between the original and repowering planning applications was undertaken for Caton Moor wind farm in Lancashire. In 1993 permission was granted (ten turbines) without a time limit, but a condition of removal if the turbines were not working for six months. Aside from comments from local groups, there were only three public comments of objection and four of support, with the committee report highlighting that at public meetings people were generally in favour. In comparison, in 2004 the 25-year repowering proposal (eight turbines) received 175 letters of objection and 21 of support with objections focusing on the visual impact, perceived failure of the original turbines and lack of local benefit. While this is just one case, there are wider implications that can be drawn out. It demonstrates that some of the earliest schemes may have faced less opposition due to unknown impacts and perhaps due to lower levels of public awareness and involvement, as well as being smaller in scale. For example, during the repowering, there were three separate occasions on which the public were invited to submit comments due to revisions to the scheme including public consultations and the ability to comment online. It also reveals that turbines do not become an accepted part of the landscape in all areas, particularly in places where over time they are perceived not to be working or providing local benefits, place 'fit' can thus be contested and does not emerge automatically for all wind farm sites. Moreover, for those who have accepted them, the changing impacts of repowered schemes may lead to additional opposition. There are no guarantees. The issues that matter can thus be seen to overflow the narrow, abstract calculations of relative eco-efficiency discussed in chapter 2.

4.1.2.2 Response to life-extension

Generally speaking, life-extension applications have faced low levels of opposition with relatively few public comments compared to cases of repowering. Reasons for support reflect those submitted to repowering applications, often identifying the contribution to the local area and renewable energy production as well as acceptance that visual impacts would be unchanged. Reasons for opposition have centred on the idea that the original development was granted 25-year permission, impact on views, and a lack of trust towards developers. However, in one case, Kirkby Moor, the life-extension faced considerably more opposition than most others, with 153 comments of objection and 68 of support. Significantly, opposition to the life-extension was far less than the repowering application at this site which received 532 comments of objection and 141 of support. Repowering can thus be seen to create far higher levels of public response, suggesting that material changes may be more opposed than temporal ones, something explored further in the thesis. Such differences are also reflected in public comments which discuss the benefits of being able to see the infrastructure and its impacts rather than developing new turbines, reflecting apprehension to a site becoming something different. Moreover, those opposing repowering are often concerned about larger turbines. While the Kirkby Moor site is unique due to both the location of the site and the life-extension application being submitted after a refused repowering application, the preference for life-extension over repowering is reflected in public comments submitted to many applications.

4.1.3 End-of-life challenges for ground-mounted solar

Ground-mounted solar is a comparatively younger technology than onshore wind. The first schemes in Great Britain became operational in 2011,[19] consequently no sites have repowered and this is unlikely to become a policy concern within the next ten years. However, of more prominence to the solar sector is life-extension, which is becoming increasingly common due to the nature of solar farms as investment-fund assets. Interviews revealed that solar farms are usually sold to investment firms with 25-year planning permission and the purchaser will often seek to immediately extend the permission to 40-years or longer to ensure that it provides a lower-risk, longer-term investment.[20] There are thus many situations where longer permissions are applied for just a couple of years after the original permission was granted. Such situations demonstrate the intricacy of the range of interests and purposes in the planning system influencing the permanence of a site and the duration of its impacts.

25-years has often been used as the length of permission for solar farms, paralleling established practice for onshore wind; however, interviews revealed that the duration of consents varies in the range of 20-40 years.[21] There are also circumstances where solar farms have been granted permission without a time-limited consent, instead control has a different focus, using a condition that requires the removal of all structures upon cessation of use or the removal of the panels that have ceased operation,[22] similar to some of the earliest wind farms. Such variations demonstrate the

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[19]According to UK Government renewable energy database.
[20]Interview with company managing approximately 70 solar farms.
[21]Interview with company managing approximately 70 solar farms.
[22]See, for example, the application for a solar farm at Whitehill Lane Alresford Hampshire.

different ways of treating the duration of the infrastructure and its impacts, revealing a somewhat open decision-making context.

The above findings begin to reveal how multiple temporalities come together, not always neatly, that developers' time frames appear to often 'win', in terms of having the greatest influence on end-of-life decisions, but that there are no guarantees. In doing so the wind and solar farm portfolio becomes mostly reproduced over time, long-lasting and, through repowering, more efficient. However, there is a need to navigate regulatory processes. These findings are particularly significant as the long-term supply of energy from renewables is very much caught up in time-limited processes, to a far greater extent than nuclear or fossil fuels where sites are often longer-lasting. Moreover, initial adverse public perceptions of the landscape effects of solar and wind often raise questions about permanence.

4.2 The policy context

The previous section captured outcomes to date with end-of-life decisions, focusing on three main categories: repowering, life-extension, and decommissioning. These categories may get combined (so repowering may bring life-extension) and other issues get woven into end-of-life regulatory moments (such as new time-limits or restoration commitments). While most developer efforts to seek some form of life-extension are successful, there are no guarantees, there is thus a need to consider if this is just a world of developers and individual LPAs, or whether the state seeks to striate what is becoming.

4.2.1 Policy approach for onshore wind

Approaches to spatial coordination in systems of governance are designed to have an effect in steering policy action and development, striating spaces to meet public policy objectives. Thus in considering end-of-life policy, it is firstly necessary to consider the overall attitude and approach to solar and wind in each country. Notably, in all countries planning policy on solar is minimal but positive in approach. As outlined in table 11, England, Wales and Scotland can be seen to vary in their approach to the siting of onshore wind, each with temporal implications. Scotland has a positive, proactive approach, reflected in ambitious renewable energy targets and their longstanding interest in spatial approaches to identifying suitable sites (Power and Cowell 2012). Similarly, national spatial control is key to the positive approach to wind energy in Wales (Cowell 2017). The Welsh Government's SSA (see table 11), written into national guidance, might themselves be considered a device that confers long-term presumptions in favour of wind energy in these areas. Comparatively, since 2015, England has taken an anti-wind stance, which reflects post-2010 political rhetoric of localism (i.e., the focus on local control) and a wider desire to curtail expansion of onshore wind.

Most wind farms have been granted time-limited 25-year planning consent, reflecting a desire to treat them as temporary developments, often with an assurance of removal (through use of decommissioning conditions). However, instances of repowering and life-extension have shown that such time-limits can lead to the reintroduction of a series of future potentials, thereby altering the duration of sites and temporary nature of the assets. In this context, it is necessary to explore how the duration, as well as the presence and impacts of the infrastructure, are controlled and regulated by the planning system. Doing so enables consideration of how the planning system may be striating spaces (see Deleuze and Guattari 1980), creating a policy context that facilitates certain outcomes and thus use of certain areas as long-term wind farm sites. The following section of the review compares all national planning and energy policies relating to the temporary nature, duration, and end-of-life processes for wind farms in England, Wales, and Scotland since 1990. This data is summarised in table 12. A comparison of the three countries demonstrates the different ways in which policies have developed, been interpreted and applied in the devolved planning systems.

Table 11: Approach to onshore wind in England, Wales, and Scotland

	Wales	England	Scotland
Approach to onshore wind	Positive towards the expansion of on-shore wind, coupled with a belief in the desirability of nationally-directed spatial steering.	Effective block on new onshore wind since the 2015 Written Ministerial Statement[23].	Positive towards the expansion of on-shore wind, including extension and replacement of sites and larger turbines.
Decision-making level	Applications over 10MW installed capacity - submitted to the Welsh Ministers, as Developments of National Significance Under 10MW - LPA.	Since 2016 all applications decided at LPA level.	Over 50MW - Government Consents Unit Under 50MW- LPA level.
Scale at which suitable areas are identified	7 Strategic Search Areas (SSA) with indicative MW targets identified nationally.	Advice against spatial zoning policy reversed from 2015, with all wind development now required to be in area allocated for such in local plans.	LPA's should identify the most appropriate areas for onshore wind in their development plan, using guidance issued by Scottish Government.

[23]UK Government House of Commons: Written Statement (HCWS42) Written Statement made by Secretary of State for Communities and Local Government (Greg Clark) on 18 June 2015. Available at https://www.parliament.uk/documents/commons-vote-office/June%202015/18%20June/1-DCLG-Planning.pdf (accessed June 2019).

Table 12: Policy development in England, Wales, and Scotland 1990-2018

Country	Consent duration policy	Repowering and life-extension policy	Decommissioning policy
England	Use of temporary consents first suggested in 1993. 2011 policy identified typical turbine design life of 25-years and 25-year consent as typical. Identified that applicants may seek consent for differing time-periods and suggested use of conditions. Identified the time-limited nature of wind farms as an important consideration when assessing impacts.	First mentioned in 2011 - repowering applications should be determined on their individual merits. 2018 National Planning Policy identified that repowered turbines are exempt from the planning constraints placed on new onshore wind farms, providing no further detail. No consideration of life-extension.	First considered in 2011, policy recognising the need for applicants to set out details of what will be decommissioned. 2013 guidance suggested use of conditions to ensure turbine removal and land restoration.
Wales	First mention of the use of temporary planning permissions in 1993 guidance. 25-year consent period mentioned in non-statutory guidance. No policy on consent duration.	TAN 8 (2005) set out a positive approach for repowering or life-extension of sites outside Strategic Search Areas, subject to environmental and landscape impacts (no mention of sites within SSA). Planning Policy Wales 10 (2018) set out positive approach to repowering and life-extension more broadly, including recognition that sites may change.	First mention of decommissioning in 1996. Use of decommissioning conditions suggested in various documents from 2005 onwards with lack of detail.
Scotland	1994 policy stated that temporary permissions will rarely be justified. 2007 policy identified temporary consents of 20 /25 years as common. 2014 policy stated that areas identified for wind farms should be suitable for use in perpetuity, while recognising that project consents may be time-limited. 2017 policy confirmed that there are no current statutory or legislative limits to the duration of consent.	First recognised in 2012. 2014 policy recognised benefits of repowering and identified the current use of a site as wind farm as a material consideration. 2017 policy identified the various forms of repowering including life-extension and set a position of clear support for repowering. It also recommended renegotiation of community benefits during repowering.	First mentioned as possible consideration in 1994. 2007 policy specified use of conditions to ensure decommissioning and site restoration, taking into account any proposed after use of the site.

4.2.2 How is the temporality of the assets considered and controlled in planning policy?

Policy regarding the duration of wind farm consents was compared, revealing significant differences between the three countries. In England, 2011 policy identified, for the first time, a limit of 25-years as typical with permissions described as ‘temporary’ as at the end of the period the infrastructure must be removed. There is no mention of LPAs potentially recommending different time periods although it is open to LPAs to apply conditions as they think fit. While this suggests flexibility, the policy states that ‘applicants may apply for consent for a specified period, based on the design life of the wind turbines. Such consent, where granted, is described as temporary because there is a finite period for which it exists, after which the project would cease to have consent and therefore must be decommissioned and removed.’[24] Such policy appears to reinforce the nature of the infrastructure as temporary, aligns the temporalities of consent duration with the physical design life, and marks a change from earlier policies that suggested impacts may be temporary if conditions are attached.[25] Moreover, policy also identifies the ‘time-limited’ nature as an important consideration when assessing impacts, including visual impacts and impacts on the setting of heritage assets.[26] In effect, the prospects of being temporary are presented as a factor militating in favour of consenting wind farms and finding their impacts more acceptable. Meanwhile in Wales, the only mention of the 25-year duration is in a 2008, non-statutory document. Despite this, most permissions are for 25-years with planning application documents often specifying the benefits of this ‘temporary’ period when discussing impacts of schemes. What such policies reveal is that while the 25-year period is nowhere specified in legislation, it appears to have become treated as a norm, perhaps through the impact of precedent creating an inherited fixity (see Hillier 2008).

Interviews with government officials in England and Wales revealed uncertainty regarding where the 25-year planning period originated from, but identified the benefit, particularly to local communities, of providing an opportunity to review the development and assess its impacts. This occurs at the expense of longer-term certainty for developers, owners, or investors. Some suspected that the 25-year permission might

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[24]UK Government. National Policy Statement for Renewable Energy Infrastructure (EN-3), 2011, 2.7.13.
[25]UK Government. Planning Policy Statement 22:Renewable Energy (PPS22), 2004.
[26]UK Government. National Policy Statement for Renewable Energy Infrastructure (EN-3), 2011.

have arisen as it was the expected useful life of turbines, but this has not been confirmed. While Welsh Government respondents[27] identified that time-limited consents are useful given the speed of technological change and in providing the benefits of control and the ability to return land to its previous use, they appeared open to considering arguments regarding increasing the 25-year permission. For UK Government officers, significantly, they identified that the temporary nature of original consents might cause challenges, 'we've already seen an example of it causing an issue for potential repowering and lifetime extension. Um, I can imagine it will be likely that will carry on'[28] (UK Government). While suggesting that the duration of consents should be looked at in planning guidance, they provided no certainty that it will. It was also clear that UK government officers felt that the description as 'temporary' was suitable as 'it's a long temporary period for sure, but people do have the opportunity to say no we don't want that to be repowered because it has to go through a whole new planning application'[29] (UK Government).

English and Welsh positions have come to contrast markedly with Scottish policy which, in 2017, confirmed that despite common assumptions that onshore wind consents should be for 25-years there are no statutory or legislative limits to consent duration.[30] This departs from their 2007 policy which described temporary consents of 20-25 years as 'common practice.'[31] The approach set out in Scottish Planning Policy is that 'areas identified for wind farms should be suitable for use in perpetuity,'[32] fixing the potential permanence of sites but not specifying that specific developments should operate in perpetuity. Interviews confirmed that through introducing the 'in perpetuity' policy the government aimed to provide clarification that the duration of consent does not have to be 25-years, rather than expecting developers to apply for consents in perpetuity. Part of the Scottish Government's approach is thus to shape the use of sites over time, rather than just regulating the time frame of projects. Through doing so, they can be seen to striate certain spaces as longer-term wind farm locations.

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[27]Interview with Welsh Government, May 2018.
[28]Interview with UK Government BEIS, August 2018.
[29]Interview with UK Government BEIS, August 2018.
[30]Scottish Government. Onshore wind: policy statement. 2017,41.
[31]Scottish Government. Scottish Planning Policy SPP 6 Renewable Energy. 2007,56.
[32]Scottish Government. Scottish Planning Policy. 2014, 170.

4.2.3 Policy context for repowering

While in the period up to 2018 repowering applications have experienced a high success rate, it is crucial to consider the policy context in which decisions are made, as this reveals both policy priorities and emerging issues. In England, repowering has come to be treated more guardedly, as an 'exception' from its otherwise very anti-wind policy stance. In 2018 revised National Planning Policy exempted repowering applications from the constraints on new onshore wind applications, suggesting recognition of the need to support it.[33] Government interviewees confirmed that the NPPF makes it clear that repowering is able to go ahead but identified that it needed to be looked at in more detail, confirming that 'there's a big deficit and er we er need to clarify this area quite urgently because it's obviously looming as an issue and there's a real need to clarify what the NPPF policy means', suggesting the use of more detailed planning policy guidance to provide clarity for LPAs 'because otherwise, we'll end up with a bit of a mish-mash of understandings of what to do and how to assess things and you know you might get some strange inconsistencies between authorities'[34] (UK Government).

In Wales, 2005 policy (TAN8) considered repowering as a permissible exception to their zoning policy through identifying that there may be opportunities to repower sites located outside of the areas zoned for new large-scale onshore wind;[35] however, it did not consider how applications and their impacts would be assessed. During interview in early 2018, it appeared that the Welsh Government had given little consideration to repowering, assuming that it would probably just happen.[36] However, there appears to have been a policy shift as in December 2018, Planning Policy Wales,[37] for the first time, set out a positive approach to repowering and life-extension of all wind farms, identifying the importance of such schemes to meeting decarbonisation and renewables targets. The policy explicitly states that LPAs should support schemes, recognising that viability and technological changes may result in repowering schemes having a different format. It specifies that LPAs should set broad criteria for the

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[33]UK Government. National Planning Policy Framework 2018, footnote 49.
[34]Interview with UK Government BEIS, August 2018.
[35]Wales has a policy of spatial zoning of wind energy specified through 2005 policy (TAN8), allocating Strategic Search Areas (SSA) as the most appropriate locations for new large-scale wind energy development. In accordance with this policy, wind farm development should be focused within the seven SSAs, each of which have indicative targets for installed capacity, with LPAs guiding the development within each area.
[36]Interview with Welsh Government, May 2018.
[37]Planning Policy Wales Edition 10, 2018, 5.9.23.

determination of schemes ‘based on the additional impact of the new scheme.’[38] However, while this policy sets out a recognised need to support repowering and life-extension, it lacks detail regarding assessment of applications and how applications could potentially increase community, environmental, or other benefits.

England and Wales contrast with Scottish Policy, which sets out a positive approach to repowering, identifying the benefits of repowering and explicitly classifying the current use of a site (as a wind farm) as a material consideration.[39] In this way the initial, ‘temporary’ development leaves a legacy for future decisions, militating in favour of future wind energy. Their 2017 policy built on this positive approach, confirming that the government’s position ‘remains one of clear support in principle for repowering at existing sites’[40] and identifying the different variations of repowering and the benefits of repowering, including maximising value for Scotland in terms of economic, social, and environmental benefits. Compared to similar bodies in England and Wales, Scottish Natural Heritage has a very active role in liaison with the Scottish Government. As a result they have produced draft guidance[41] on assessing the impact of repowered wind farms on nature, demonstrating how non-governmental bodies can form part of the assemblages shaping and striating spaces of energy infrastructure.

4.2.4 Policy context for life-extension

There are no specific policies relating to life-extension in England, thus decisions fall under the position on wind energy in local development plans in each area and wider government guidance. When asked about guidance for life-extension in England, the UK Government identified a knowledge gap and a need to understand the intentions and varying approaches of the sector in order to be able to help LPAs appraise different situations. Meanwhile, Scotland regards life-extension as a form of repowering,[42] thus their position is reflected in their positive approach to this activity.

At the time of interview (in early 2018), the Welsh Government did not appear to have considered what a life-extension application would involve;[43] however, support for life-extension was later included in 2018 planning policy (discussed above). This lack of

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[38]Welsh Government. Planning Policy Wales Edition 10, 2018, 5.9.2.
[39]Scottish Government. Scottish Planning Policy. 2014, 174.
[40]Scottish Government. Onshore wind: policy statement, 2017,35.
[41]Scottish Natural Heritage, Assessing the impact of repowered wind farms on nature, consultation draft, 2018.
[42]Scottish Government. Onshore wind: policy statement, 2017.
[43]Interview with Welsh Government, May 2018.

detailed consideration of life-extension and repowering reflects a lack of broader temporal outlook in planning, with policy development in England and Wales being chiefly responsive through dropping a positive signal into the planning balance, rather than engaging in future-oriented steering. Reflecting on governmentality as problematisation (Foucault 1991; Dent 2009), one might infer the government in England does not see any major problems in the likely treatment of life-extension decisions (Windemer 2019).

4.2.5 Policy context for decommissioning

In many ways, repowering and life-extension push the crux point of end-of-life regulatory action further into the future (but not without having set some parameters), but ultimately it does arrive and, for some projects, it has already been reached and passed. It is essential to consider the policy context for decommissioning in order to understand how the removal of this infrastructure is controlled and to explore how or whether changes that may have occurred over the lifespan of the infrastructure are considered.

In England, policy identifies that 'the extent to which the site will return to its original state' is a possible relevant consideration in assessing the impacts of wind farm applications,[44] reinforcing the conception of such developments as temporary. However, as sites and the land around them are always in a process of flux, this raises questions regarding the feasibility or desirability of returning to an original state. Policy lacks detail regarding the decommissioning process and guidance states that conditions should be used and the land should be restored to 'an appropriate use.'[45] There is no detail regarding what constitutes an 'appropriate use' or how this will be assessed, reflecting perhaps a desire not to be too specific and to defer to local-level decision-makers. This provides another example of issues being deferred to a future point. Significantly, UK Government policymakers recognised that cases of abandonment might occur in instances where insufficient conditions were put in place during the original permission, identifying that there is nothing that can be done in such instances, thereby suggesting that permanent impacts may occur from such temporary developments, impacting future potentials. However, they felt that this is less likely to occur in the context of the recent positive approach to repowering, 'we do hear of some

[44]UK Government. National Policy Statement for Renewable Energy Infrastructure (EN-3), 2011,2.7.17.
[45]UK Government. Guidance for renewable and low carbon energy 2015, 24.

sites being abandoned but er I would have thought that now that the NPPF is saying what it's saying, it would put a premium on those sites'[46] (UK Government), reflecting how repowering and life-extension defer the final end-of-life but provide an opportunity to tighten commitments to managing the process.

Welsh policy has long identified the role of LPAs in securing 'the decommissioning of developments and associated infrastructure and remediation of the site as soon as their use ceases.'[47] Planning conditions and legal agreements are recommended to ensure this is achieved, but it places the onus on LPAs, giving them discretion, thereby smoothing space in relation to future potentials. Interviews with Welsh Government officers revealed that bonds are something that they feel they need to consider in the context of legacy issues; however, they have only just tackled this issue with open-cast coal mines,[48] reflecting the way in which planning policy is trying to catch up. In comparison to developing policy or guidance for repowering, there appeared to be less immediate concern to develop decommissioning policy, reflecting assumptions that legacy issues will not present a problem as well as signs of discounting the future in the context of competing problems.

Scottish Policy identifies the need for decommissioning conditions as one of the considerations for energy infrastructure proposals and additionally identifies the importance of ensuring that finance is secured for site restoration. Planning guidance states that 'in many cases, wind turbines can be decommissioned and sites cleared and restored easily and rapidly,'[49] reflecting the widely shared assumption that this process will not cause difficulties. The most recent onshore wind policy confirms that a change in the operating period 'does not remove the need for decommissioning provisions, where considered appropriate'[50] but provides no further information regarding decommissioning. Speaking to the Scottish Government confirmed that there are no plans to produce further guidance and that it is between the developer and LPA to negotiate.[51] Even if it is believed that such things need governing, it is a separate judgement as to whether that governing needs to be a central state responsibility. It can thus be seen that Scottish policymakers, while open to potential future becomings, don't see a need (or possibility) for steering particular becomings into being from the

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[46]Interview with UK Government BEIS, August 2018.
[47]Welsh Government. Planning Policy Wales (Edition 9) 2016, 12.10.6.
[48]Interview with Welsh Government, May 2018.
[49]Online renewables Planning advice: onshore wind (2014 update), 2.7.17.
[50]Scottish Government. Onshore wind: policy statement, 2017,41.
[51]Interview with Scottish Government, April 2018.

centre e.g. for restoring to rurality those landscapes where windfarms have been particularly high impact.

4.2.6 Solar policy

Policy for field-scale solar appears to have been given very little consideration. England has a lack of policy regarding the temporal nature and end-of-life considerations for the infrastructure, with the only mention being in planning guidance that states ‘solar farms are normally temporary structures and planning conditions can be used to ensure that the installations are removed when no longer in use and the land is restored to its previous use.’[52] Policy thus appears to focus on functional (i.e. events that occur at some indeterminate point in the future) rather than time-limited considerations for end-of-life. During interview the UK Government was surprised to learn that some solar permissions do not have a time-limited consent, identifying it as something that needs to be looked into and recognising that ‘there’s quite a lot of guidance about solar which needs a refresh’[53] (UK Government). Again, such responses reflect the dynamism of the sector with governments trying to catch-up with what has been happening in practice in order to shape the use of spaces, revealing a somewhat open context for the future of solar sites.

Similarly, Welsh policy is supportive of solar but lacks detail regarding the duration of the infrastructure and associated impacts.[54] Practice Guidance identifies the ‘reversibility of the development’ as a factor in determining if an Environmental Impact Assessment is required[55] and suggests that the impact of the development can be mitigated through ‘taking steps to enhance the reversibility of the development.’[56] However, this provides another instance of the term reversibility being used without detailed consideration of what it constitutes or how it can be achieved. In interview the Welsh Government thought that solar farms are all permitted for 25-years but were not sure, commenting that impact on soil conditions may be a reason for their temporary nature. They indicated that they would be expecting repowering of field-scale solar in the future but highlighted that technology will have moved on and applications will need to be considered in the context of policy at the time, the availability of technology, and

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[52] UK Government. Guidance for renewable and low carbon energy 2015, 13.
[53] Interview with UK Government BEIS, August 2018.
[54] Welsh Government. Technical Advice Note 8: Planning for Renewable Energy, 2005.
[55] Welsh Government. Practice Guidance: Planning implications of renewable and low carbon energy development, 2011 8.4.16.
[56] Welsh Government. Practice Guidance: Planning implications of renewable and low carbon energy development, 2011, 8.4.17.

the impacts that have occurred from existing solar farms.[57] This reflects how a multiplicity of factors may change and re-change the complex spaces of energy sites over time. They likened temporary conditions as a stop-gap, enabling elements to be reassessed, but agreed that a condition requiring removal once the panels stop producing energy would have a similar outcome. They also identified that the market will impact decisions regarding land use, demonstrating how the use of spaces can change over time due to changing material and non-material factors. Significantly, they identified that the National Development Framework will be looking at large solar developments to help guide them into specific areas, similar to the policies for wind, and this could potentially lead to more permanent allocations for solar as a land use, reflecting the way in which policies can be used to create more heavily striated spaces for longer-term use.

Scotland has produced no guidance about the duration of solar farm permissions. The impacts of solar have been given significantly less consideration than onshore wind. This could potentially create another situation where policy will be shaped by the experience of existing sites; therefore, what is happening in current cases is significant, and the question that arises is whether the existing situation is adequate.

4.3 Discussion and conclusion

While most of the existing repowering and life-extension applications occurred at a time when policy was less developed, there is a need to consider the significance of policy issues in relation to the identified end-of-life concerns and ageing infrastructure.

4.3.1 Repowering and life-extension: policy and experience

Policy has been very open for the past 25-years and thus has not had much bearing on end-of-life experiences of existing sites. The current high success rate for repowering applications suggests that the temporal nature of the infrastructure is changing in a way that until recently was not reflected in policy. Governments are only just starting to recognise that repowering is happening and – to the extent that they are concerned about renewable energy deployment – needs to be supported. While there is evidence of an increasing recognition that policy needs to change to reflect what is beginning to happen at existing sites, there are significant differences across Great Britain in current

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[57]Interview with Welsh Government, May 2018.

progress and approaches. The approaches of all countries can be viewed conceptually as experiments, with each government taking a positive or negative view of how potential becomings should be channelled.

Scotland seems keen to act to make wind energy output permanent and striate certain areas as wind farm spaces as part of their positive approach to onshore wind, while managing flexibility on the configurations of equipment that provides it. They have thus considered what social relations need to be managed to make that the likeliest outcome. As others have noted, policies for socialising the benefits of wind were already more advanced in Scotland than other parts of the UK (Strachan et al. 2015). While providing benefits for maintaining wind energy output, it is important to consider that creating such a heavily striated space may disable those who might wish to re-think the suitability of a wind farm in a particular landscape, perhaps to make it become 'more rural'.

While policy can be seen to have significantly developed over time and become more comprehensive in Scotland, this has only happened to a very limited extent in England and Wales. Interviews with both UK and Welsh Government officers made it clear that they are in the process of trying to catch up with what is happening within the sector, demonstrating how an array of potential outcomes are not considered as a problem until they become a pressing issue for government. This can be seen to link to wider concerns regarding short-term bias in policymaking (see Boston 2016). While there are benefits of remaining open to change, as it is impossible to imagine exactly what may happen in the future, a policy absence entails risks, not least for the ongoing availability of wind energy.

4.3.2 What about solar?

Although solar is a relatively young technology, interview data revealed that life-extension is happening at a significant rate without much consideration in policy. It is evident that treatment of duration varies significantly, with some LPAs granting permissions without time constraints (but with conditions focusing on operational factors) while others strictly grant 25-year consents. In many cases, the asset changes rapidly from a 25-year development to a far longer 40-year development, raising questions regarding how the nature of the impacts may change and how this effects different interests. To date, governments have shown little interest in the strategies being pursued by developers and the possible impacts of longer permissions, resulting in a less striated space for the future of solar energy sites.

4.3.3 Decommissioning: policy and experience

Only a small proportion of sites have been decommissioned compared to those that have been repowered or life-extended, reflecting the domination of particular interests in existing regulatory arrangements. This strikes a contrast with planning documents describing the infrastructure as temporary and reversible and decision notices confirming that removal will occur at the end of the permitted life. Such trends can be seen to continue, for the next few years at least. In all nations, policy does little more than flag the salience of decommissioning and is quiet on the details, flagging up items for LPAs' and other actors' attention but mandating little. There is a lack of consideration regarding how the nature of a site may change over the lifetime of a development and how this should shape decisions. Additionally, while there is some, albeit limited, recognition that decommissioning may need to facilitate a future land use, there is a lack of discussion regarding how this could be achieved in practice, thereby focusing on the removal of impediments to an array of potential future uses, within certain limits, not about the what next.

There is a lack of guidance regarding how the decommissioning process should be carried out, leaving this domain highly open, for developers, LPAs and maybe others to argue about questions such as 'how much decommissioning,' 'to what end' and 'how secured'? In the face of future uncertainty, this may not be unreasonable. Furthermore, no one would claim that the physical legacy of renewable energy developments equates in scale and severity to that of nuclear power (Blowers 2017) or opencast mining (Ibarra and De las Heras 2005) which have left immensely costly remediation challenges. Nevertheless, wind energy does have material consequences and the spatially extensive nature of wind farms in rural areas gives the legacy issue significance. Wind farms reaching end-of-life may leave concrete foundations or other equipment, projects may shape landscape meanings and perceptions if left in situ. While a lack of detailed attention to regulating future post-wind land use may be understandable, a lack of attention to what elements of wind facilities should be removed is a different dimension and could be more problematic (e.g., potential issues of abandonment). Ironically, one might say that UK governments face a backlog of legacy issues.

Although the analysis in the first part of this chapter shows a sector that is experiencing some flux through end-of-life decisions, central governments are only beginning to seek to steer the outcomes. If government intervention is taken to be revealing of problematisation (Dent 2009), then the limited national attention given to decommissioning implies that governments see little problem here, believing perhaps that acceptable outcomes will be achieved with relative ease. One can interpret this as reflecting beliefs that decommissioning is socially unproblematic, perhaps also neo-liberal preferences against placing regulatory requirements on businesses.

4.3.4 The temporary nature of developments

The findings above reveal areas of potential difficulty in the planning systems' treatment of wind farms as temporary, or at least a gap between the narrow technical meaning and unfolding materialities-temporalities of development. Experience suggests that wind farms tend to reproduce over time. The issuing of multiple time-limited planning permissions shows something different about the way this infrastructure is treated compared to other infrastructure as it appears neither permanent nor temporary, rather temporary with an evolving duration. This raises questions regarding whether it is really appropriate to treat or consider wind farm permissions as if they will conclude and cease to exist. While 25-year consent periods are not grounded in legislation, they appear to have become treated as such, perhaps through the impact of precedent reflecting popular practices and creating an inherited fixity. In 2018, 25-year applications continue to be the norm and some of the earliest sites, that did not previously have a time-limited consent, have repowered with 25-year consents. Planning permission thus appears to operate with a time-limited bundle of specific 'use rights' with developers leasing the land and not seeking consent in perpetuity.

One can begin to see that the common 25-year consent period appears as a compromise as well as a convention, balancing competing concerns including planning control, operational life of the infrastructure, public opinion, developers' returns, and asset value. It appears, however, that this compromise is potentially becoming unstable given the recognised longer lifespan of the infrastructure. This has been recognised in Scotland and addressed in policy in order to facilitate longer permissions in a sustainable way and get the most out of existing assets. Yet some elements have not been considered, notably the implications if a community has expected a wind farm to be removed.

What makes the issue important is the way in which the 'temporariness' of wind farms has been used as a potential virtue in planning as a quality that weighs positively in consent decisions where things like landscape impacts are likely. In all countries, there are examples of the temporary and reversible nature of the impacts of the infrastructure being used to gain support through making the otherwise potentially unacceptable, acceptable due to its duration. In such a way, the consideration of time within planning can be seen as a way of achieving political gain (see Myers and Kitsuse 2000; Van Der Knaap and Davidse 2010). Planning consents for onshore wind continue to be described as temporary in much of the documentation and assessments of impacts despite the fact that the majority of sites that have reached the end of their permitted or operational life have been repowered or undertaken life-extension. This reflects literature portraying planning as a promise between now and the future that has significant potential to break down (Abram and Weszkalnys 2011), i.e., the 'promise' of 25-years followed by removal, with a lack of consideration of the consequences.

4.3.5 Conclusion

This chapter has provided a cross-cutting, comparative assessment of the dynamics to date of the three main categories of end-of-life decision: repowering, life-extension, and decommissioning. To date, most applications for repowering and life-extension in Great Britain have been successful and only two sites have been decommissioned. As a corollary, one can see that temporariness is a *potential* quality of onshore wind, but most often the duration of wind farms has been extended further into the future. The complex reality of temporariness is also becoming apparent in emerging discussions about which components of closed facilities need to be removed in decommissioning. Site abandonment, a fourth category of end-of-life decision, has yet to happen in the UK, but national regulation has done little yet to prevent it.

Deleuze is relevant to this chapter both in terms of interventions and also for capturing a renewable energy portfolio as something always in flux (through various life-extension strategies). Notably, Deleuze and Guattari's (1980) concepts of smooth and striated spaces have facilitated exploration of how, through constraining (striating) the planning policy context, governments' can steer the long-term future of wind farms into particular locations. Policy can be seen to mediate between multiple temporalities, providing a temporal and spatial fix and injecting its own dynamics. The chapter sought to understand to what extent the issue of end-of-life decision-making for renewables is problematised and regulated by national governments. The majority of existing end-of-life applications were decided when limited policy was in place. Governments are only just starting to recognise that life-extension and repowering is happening and, if they are hoping to maintain wind energy capacity, then it needs to be supported.

Notably, we see governments seeking to establish the long-term appropriateness of existing sites for wind power, to provide a conducive context for the consideration of future wind energy projects. Indeed, English, Welsh, and Scottish Governments have all moved to adopt supportive policy stances on repowering, demonstrating how the 'temporariness' of wind energy is being renegotiated. However, the findings show government policy on end-of-life issues to be limited in scope and patchy, especially in England. It highlights the elements of end-of-life decisions that states can choose to act on in order to extend control into the future. Only in Scotland, thus far, is the government encouraging end-of-life decisions to enhance the benefit flows to 'host' communities. Meanwhile, governments have been content to issue minimal advice on decommissioning, effectively passing any problem to local communities or LPAs.

The different treatment of end-of-life considerations within policy points to the divergent ways in which this issue is problematised and, indeed, the multiple problems that end-of-life decisions bring together (Dent 2009). One such problematisation is the potential contribution of repowering to energy and climate change targets and the need to secure it. Thus, differences in policy approach can be seen to relate to the emphasis given to this priority in the energy policy of each country (see tables 11 and 12). What we are seeing here is the strategic selectivity of the state (Jessop 1990), but conducted in the face of the very considerable contingency of the future, in which wind energy, projects, and landscapes may evolve in multi-various combinations. Partiality of policy is perhaps therefore inevitable. Yet it is still important to consider which kinds of future are being embraced within policy, which actor concerns, and which tend to be omitted.

While only a small number of existing schemes have reached the end-of-life stage, the number will be rising significantly within the next 5-10 years, thus it is significant that policy in Scotland and to some extent Wales appears to be starting to striate spaces for longer-term use as wind farm sites. This raises questions regarding the 'temporary' nature of the development and who treats or considers the permission as if it will expire and cease to exist. This chapter has begun to answer the research questions through identifying what has been included and neglected in current regulatory arrangements, however it does not consider how policies have been interpreted and applied by the range of actors involved, it has also made assumptions about what matters to publics. There is thus a need to more fully explore how different actors are planning and preparing for the end-of-life of sites (research question one) and whose preferences are most significantly shaping end-of-life decision-making (research question two) in order to understand how the policy context may influence decisions and the wider consequences of how the temporalities of renewable energy infrastructure are regulated (research question three). The following chapter explores these questions in far greater detail through investigating the experiences of four wind farms and a solar farm case study.

Chapter 5: End-of-life considerations in five case study contexts.

This chapter develops the broader picture gained in chapter 4 through beginning to unpick what causes or is used to justify certain outcomes and how perspectives and end-of-life preparations vary amongst different actors (research question one). While the previous chapter provided an indication of multiple temporalities being in play, this chapter begins to examine which tend to 'win' and in what circumstances (research question two). Through using the term 'win' this thesis aims to understand which temporalities and thus actor interests are dominant in terms of influencing the outcome of end-of-life decisions. Chapter 7 then brings together the findings from across the cases and the two other empirical chapters (the policy and data research and the surveys) to answer these questions and provide a discussion of the research findings, including consideration of the third research question regarding understanding the wider consequences of how the temporalities of renewable energy are regulated.

In order to understand end-of-life decision-making processes in detail, in-depth research into five case studies was undertaken. As outlined in the methods chapter, the cases were chosen to vary on several dimensions, including location, age and status of the wind farm and local response to end-of-life applications. For each case, an analysis of the policy and application documents was undertaken and in-depth semi-structured interviews were undertaken with all identifiable impacted parties to piece together how decisions were made, the arguments used, and contingencies navigated. The case studies are presented each in turn.

5.1 Repowering a wind farm with a lack of controversy, exploring the significance of duration in St Breock

5.1.1 Introduction

The case of St Breock represents a site that had significant public support during its application to repower. It was initially granted permission without any limit on the consent duration but repowered with a time-limited consent. Permission for the original St Breock wind farm, comprising 11 x 53.5m turbines, was granted at appeal in 1993 and became operational in 1994. Permission was granted in perpetuity with no requirement to decommission the turbines at the end of a fixed period. As one of the earliest wind farms, the lack of decommissioning or time condition was likely to be a result of the infancy of the sector, reflecting a lack of consideration of such aspects.

Permission was granted in 2003 to repower the site with 8 x 80m turbines, the consent was not implemented and lapsed in 2008. Permission was then granted in 2012 to repower the site with 5 x 100m turbines for a time-limited 25-year consent. The repowered site became operational in 2015 and also continues to be used for sheep grazing (reflecting the complex nature of wind farm sites, see Bonta and Protevi 2004). The 2012 repowering application received a high level of public support with 95 public communications of support and 7 objections.[58] Questions thus arise regarding how this application faced so little opposition.

Figure 8: Location of St Breock wind farm

Source: Google Map (accessed May 2019), wind farm marked by red point

[58]St Breock Repowering committee report, 2012.

5.1.2 Narratives of change

In exploring considerations of the duration and end-of-life decision-making for the site, it is firstly important to consider what changed over time and how such changes were considered. It was identified that sheep grazing continued over the life of the wind farm, reflecting a continuity in this land use and the use of the site as a complex space (see Bonta and Protevi 2004).

5.1.2.1 Policy change

Relevant planning policies did not significantly change over the lifespan of the original site. At the time of the repowering application there were no local or national policies regarding repowering.

5.1.2.2 Industry changes

Ownership of the site changed as E-ON sold the site to REG in 2010; however, this appeared to create little impact for the local community as reflected in a lack of discussion of this amongst community members.[59] Of greater significance, the developer identified how the nature of the infrastructure changed over time, most notably with the increase in size of turbines[60] (repowering involved new larger turbines).

5.1.2.3 Change in visual impact

When assessing the visual impact of the repowering, comparison to the previous scheme was central as this was affirmed as the relevant baseline. The repowering committee report identified that a smaller number of turbines with a slower rotation speed would create a less-cluttered visual impact. The report also noted that the increase in geographical extent of the Zone of Theoretical Visibility (i.e., the likely extent of visibility of the development) would be limited and that the influence would mainly be in parts of the landscape already subject to the visual influence of the existing wind farm.[61] Narratives of familiarity were expressed: the impact on a local

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[59]There was no mention of the ownership of the site changing in the research interviews undertaken with the local community.
[60]Interview with Developer A St Breock, May 2018.
[61]St Breock Repowering Committee Report, 2011, 73.

walking route was considered, noting that walkers were already subject to the visual impact of the existing wind farm and that many representations indicated that people 'see the existing turbines as interesting features in the landscape and welcome the redevelopment'[62]. It was concluded that the repowering would 'offer a balanced, controlled development which will sit well in terms of the broader scale and pattern of the landscape and, as such will not look incongruous'[63]. Such a term is loaded with interpretation regarding how larger turbines are not incongruous in the landscape. Meanwhile, amongst the public there was a preference for the repowered scheme as they felt it created less of an impact on the landscape despite the larger turbines.[64]

5.1.2.4 Familiarity

Local familiarity with the existing wind farm and LPA familiarity with repowering applications appeared to benefit the application process. The developer noted that 'the fact that there was a wind farm there meant there was a door open, the fact there was a previous consent meant that it was even more open'[65] (Developer B, St Breock). Thus, the regulatory and consenting landscape is critical – it is not just 'what is there', but what could be there under existing and as yet unimplemented permissions i.e the consent itself striates areas further into the future. The developer felt that 'people had got used to the wind farm', noting that working with a site where people understood the effects of the wind farm made it a lot easier to get support as people usually fear 'the unknown and change'[66] (Developer B, St Breock). The LPA reflected this narrative of familiarity, stating 'I assume that the original windfarm had become accepted locally, at least to a degree'[67] (LPA, St Breock). Public comments submitted to the LPA suggested that for some, the turbines had become a familiar or accepted part of the landscape[68] and comments in interviews reflected narratives of familiarity with the wind farm,[69] reflecting how perceptions of infrastructure may change over time. However, the interviews did not capture those who held opposing views regarding familiarity. Additionally on a far broader scale, interviews with community members identified longer-term familiarity with using land as a resource either through farming or mining.

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[62]St Breock Repowering Committee Report, 2011, 76.
[63]St Breock Repowering Committee Report, 2011, 72.
[64]Interviews with members of the community St Breock, June 2018.
[65]Interview with Developer B St Breock, May 2018.
[66]Interview with Developer B, St Breock, May 2018.
[67]Correspondence from Local Planning Authority, St Breock via email.
[68]Comments submitted to Local Planning Authority online, St Breock, June 2018.
[69]Interviews with members of the community St Breock, June 2018.

5.1.3 Varying narratives of duration

In order to understand how the repowering was considered, it is necessary to explore how the various actors consider the duration of the infrastructure and of the use of the land as a wind farm.

5.1.3.1 The influence of duration on Planning Authority decision-making

The repowering committee report noted that the repowering proposal was time-limited for 25-years, including confirmation that the site would be subsequently decommissioned. Confirmation of decommissioning was significant as it was absent from the original consent. It also identified that this time-limited consent would replace the original consent that was not time-limited,[70] illustrating how end-of-life applications provide an opportunity to resolve regulatory oversights – trading off an extension in time to exert greater control in the future. When discussing the landscape and visual impacts of the scheme, the committee report noted that 'any adverse impact would be temporary depending on the consented life span of the project' and again the absence of an end date for the original scheme was mentioned.[71] The benefits of controlling and limiting temporality were thus used in the assessment of the application, suggesting that despite evidence of longevity of the site, proved in repowering, the wind farm and its impacts were treated as temporary.

5.1.3.2 Public consideration of duration

Public comments submitted to the planning applications did not mention the duration of consent, suggesting that this was not a key reason for public support or opposition.

5.1.4 Strategies used

5.1.4.1 Developer's strategy for increasing the duration of the infrastructure

The developer purchased the site with the intention of repowering. Their decision-making at that time was relatively simple as there was clear support for onshore wind development in England.[72] Repowering permission had previously been granted for the

[70] St Breock Repowering committee report, 2011, 6.
[71] St Breock Repowering committee report, 71.
[72] Interview with Developer B St Breock, May 2018.

site in 2003, but for a different number and height of turbines and this precedent made it easier. They identified that another wind farm in Cornwall (Goonhilly) was repowering at the time and provided useful information regarding the application process, again demonstrating the benefits of precedent. They felt that the lack of time-limit attached to the original consent made the repowering application easier 'because we were going in saying you can either have the existing one forever or you can have the new one for 25-years, take your pick'[73] (Developer B, St Breock). While in reality it is unlikely that the existing turbine would be left in place forever, such temporal arguments can add strength to an end-of-life application through providing reassurances of removal at an identified date (although, as can be seen, future end-of-life applications may shift such a date further into the future).

5.1.4.2 Community-developer relations

The developer did a lot of PR work for the repowering and also worked with the local organisation Wadebridge Renewable Energy Network (WREN).[74] They identified that as a result of WREN (and their information provision about renewable energy) there was local support for renewables, describing how it was 'the right scheme and the right time, in the right place' (Developer B, St Breock). They did a lot of community engagement, including offering trips to look at the existing wind farm and the community was also set to benefit from community benefit payments that had not formed part of the original scheme (see figure 9). Additionally, there is evidence of public involvement in the design of the scheme. The repowering committee report discusses how comments and feedback from public exhibitions led to changes in the layout from six to five turbines,[75] this was also reflected in public comments praising the consultation.[76]

Residents identified benefits of repowering, particularly in terms of energy generation and local economic benefits[77] and explained how they trusted the assurances provided by the developer.[78] The developer identified that there was a 'combination of circumstances' that led to such high public support[79] (Developer B*,* St Breock). The circumstances included the fact that people were familiar with what a wind farm in that

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[73]Interview with Developer B St Breock*,* May 2018.
[74]Interview with Developer B St Breock, May 2018.
[75]St Breock Repowering Committee Report, 2011, 72.
[76]Public comments submitted to LPA during repowering application, St Breock.
[77]Interviews with members of the community St Breock, June 2018.
[78]Interviews with members of the community St Breock, June 2018.
[79]Interview with Developer B St Breock, May 2018.

location looked like, the good community benefits package of £4,000/MW/yr for the lifetime of the windfarm[80] and the high level of community engagement. In this way, for this application, improving public opinion can be seen as a significant element in the developers' strategy for end-of-life applications.

Figure 9: Example of community benefit fund promotion in St Breock

Source: stbreockparishcouncil.co.uk (accessed June 2019)

5.1.4.3 The promise of decommissioning

The LPA identified that the repowering application provided the opportunity to capture the decommissioning of the existing site. They explained that this provided clarity that all of the previous turbines would be removed and this clarity was a planning consideration. The repowering committee report identified that once the 25-year planning permission is reached, the site will be decommissioned, involving removing all infrastructure and restoring the site to its 'original state.'[81] Such a focus on returning to an original state (referring to the state of the land pre-wind farm) reflects the importance of specific moments of time and the idea of sites as reversible. Decommissioning was secured in a condition of the planning consent specifying that 'all related above ground structures (except those required for ongoing agricultural use of the site and agreed in writing by the LPA), shall be removed from the site' and specifying that the land should be reinstated in accordance with a restoration scheme.

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[80]St Breock Repowering Committee Report, 2011,118.
[81]St Breock Repowering Committee Report, 2011, 122.

Repowering thus provides an opportunity to redress omissions from the past, but there is selectivity here, the focus on the above-ground and retaining elements that have become more widely useful.

5.1.5 The struggle to find a working fixity

5.1.5.1 Challenges faced by the developer

While the principle of gaining repowering permission did not pose a significant challenge to the developer due to the precedent on the site, accessing land, grid capacity, and the speed of the planning system were central challenges. Access for larger turbines created perhaps the most substantial challenge.[82] The new turbines were too large to use the original access and thus required a new access track across four different landowners' land, subsequent negotiations lasted about a year, thereby creating an unexpected delay. Additionally, while selling the turbines was expected to cover the decommissioning cost, they had difficulties finding a buyer and thus had to pay for storage.[83] It can therefore be seen that during an application process, the focus is likely to be on immediate issues relevant to gaining consent rather than on longer-term considerations which can easily be deferred to the future.

5.1.5.2 Local Authority decision-making

The LPA explained that there was an expectation of repowering in light of the age of the site and as more efficient turbines had been developed over its lifetime.[84] They identified that the application was complicated by the five additional Parish/Town Councils that needed to be consulted.[85] They noted that concerns were raised by the Council's Landscape Officer and AONB Team, but the issues were 'weighed in the overall planning balance'[86] (LPA, St Breock). The repowering committee report identified the need for renewable energy at the forefront of the national and local planning system and that wind turbines could play a key role in meeting energy targets. While noting that the turbines create a visual impact upon the landscape, it was identified that this has to be balanced against their ability to generate renewable

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[82]Interview with Developer B St Breock, May 2018.
[83]Interview with Developer A St Breock, May 2018.
[84]Correspondence from LPA St Breock via email, June 2018.
[85]Correspondence from LPA St Breock via email, June 2018.
[86]Correspondence from LPA, St Breock via email, June 2018.

energy.[87] They identified the benefits of the scheme, including environmental enhancements[88] (reflecting some acceptance of the eco-efficiency arguments for repowering) and over £5million of local investment[89] (over the 25-year life of the scheme). The duration of the infrastructure did not appear to weigh heavily in decision-making compared to the expected benefits from the repowered scheme being there.

The LPA had experience of other repowering applications, reflecting the benefits of precedence. Narratives of precedence and familiarity and a preference for the continuation of existing sites over new sites were evident from the LPA, 'In my experience, the fact that a site is already established as a wind farm is a material planning consideration as a fall-back position and therefore without prejudice, a suitably designed repowering scheme can often be accepted locally as opposed to a completely new development on a greenfield site'[90] (LPA, St Breock). This echoes the findings in chapter 4 that sites that have become windfarms, by such arguments, are more readily maintained over time.

5.1.6 Conclusion

This case illustrates how certain contextual factors can increase the likelihood of a wind farm successfully repowering. Firstly, the temporal duration of the existing scheme. In this case, as the original scheme was granted in perpetuity, repowering provided the opportunity to control the duration of the site with a time-limited consent and to secure decommissioning arrangements. Significantly, the LPA described the existing use of the site as a wind farm as a material consideration, while this is not reflected in policy or all other cases, this may be because the original consent was permanent. The temporary nature of the landscape and visual impact were discussed as central reasons for support and the application was treated as temporary despite the continued use as a wind farm site. Secondly, it revealed that the level of experience of the LPA can have a significant impact on the process, Cornwall Council had previous experience of dealing with repowering applications and of assessing the visual impact of turbines. Finally, how the landscape is considered is significant, Cornwall benefits from having a tradition of working on the land and viewing the land

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[87] St Breock Repowering committee report, 2011, 80.
[88] St Breock Repowering committee report, 2011, 92.
[89] St Breock Repowering committee report, 2011, 117.
[90] Correspondence from LPA, St Breock via email, June 2018.

as a resource,[91] revealing the significance of long-term considerations of land and landscape. This case also illustrates the benefits of good community engagement and community benefits in smoothing the way to a longer presence.

5.2 A repowering permission that has not been implemented, the case of Taff Ely

5.2.1 Introduction

Like St Breock, Taff Ely wind farm was granted permission in perpetuity (without any time-limit on the consent) in 1991 for 20 x 450 kW, 53.5m (tip-height) turbines. The site became operational in 1993. The site is located within the administrative boundary of Rhondda Cynon Taff County Borough Council who are the LPA. The 180-hectare site lies immediately south of the villages of Hendreforgan and Gilfach Goch in Glamorgan. It is located within a Special Landscape Area and Site of Importance for Nature Conservation as designated by the Local Development Plan.[92]

Permission was granted in 2012 for the decommissioning and removal of the existing turbines and their replacement with 7 x 2.0–2.5 MW 110m (tip-height) turbines (see figure 10). The repowering scheme, named Headwind Taff Ely, has an expected generating capacity of 14-17.5 MW. As of February 2019, the permission had not been implemented and the original turbines were continuing to operate based on the original permission. There is no evidence that the permission was renewed and thus the repowering permission is expected to have expired.

Figure 10: News headline regarding the Taff Ely repowering

Source: walesonline.co.uk (accessed June 2019)


News ▸ Local News ▸ Rhondda Cynon Taf Council

Turbines set to double in size

TURBINES at one of Wales' oldest wind farms could be set to double in height.

[91] Interviews with community members referred to the history of agricultural and mining land-uses in Cornwall.
[92] Rhondda Cynon Taff Local Development Plan Proposals Map, March 2011.

Figure 11: Location of Taff Ely

Source: Google Map (accessed May 2019), wind farm marked by red point

5.2.2 Narratives of change

5.2.2.1 Change in the site context

The context of Taff Ely changed over time due to the development of wind farms in the surrounding area, the LPA explained how due to problems with the grid in other areas of Wales there has been a lot of development in specific locations including around Taff Ely. Such development impacts the visual context of the wind farm. Moreover, the developer identified that a barn had been converted to a dwelling near the site, adding a constraint to the developable area due to restrictions regarding the proximity of turbines to dwellings.

5.2.2.2 Policy change

National and local policy changed over time, both regarding the overall approach to onshore wind and the recognition of repowering.[93] Regarding local compliance with the Welsh Government's Strategic Search Areas (SSA) in which wind farms should be located (see chapter 4), the repowering planning statement identified that 'as the existing Taff Ely Wind Farm has existed on the site since 1993, it would have formed part of the baseline position when Policy SSA 23 was adopted. Therefore, any assessment of how the proposed development performs against Policy SSA 23 should assume that the existing Taff Ely Wind Farm already forms part of the landscape.'[94] It is significant that the wind farm was assumed to be a baseline element of the landscape, this may be due to the nature of the original consent in perpetuity.

5.2.2.3 Industry changes

Site ownership changed over time. The original owner Eastern Electric sold the site to National Wind Power in 1998 and RWE took it over in 1999, the company has since gone through different names and structures. During the repowering, they owned a third of the site but later sold their share so that they no longer own the wind farm but work as consultants for the current owners, Ventient (who have held ownership in the site since 2004). Such changes in ownership potentially impact the development of community-developer relations.

5.2.2.4 Change in visual impact

The developer explained that the visual impact of Taff Ely is intensified by the different rotation speeds of the other wind farms in the area, demonstrating how perceptions of a site can alter due to wider changes occurring over time. In assessing change in visual impact for prospective repowering the permanent nature of the existing turbines was significant, with the cumulative assessment stating that 'whilst significant cumulative effects have been identified, assuming a do nothing scenario, significant cumulative effects will already arise due primarily to the introduction of the consented wind farms and the presence of the existing Taff Ely Wind farm' and noting that the

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[93]Taff Ely Repowering committee report, 2013, 30.
[94]Taff Ely Repowering planning statement, 2012, 4.3.35.

repowering scheme would increase the prominence of the turbines but not the number of developments within the landscape.[95] The repowering committee report identified that if there was not an existing wind farm then the combined impact of the proposal and another local proposed wind farm would not be acceptable for the landscape, but the composition, spacing, and slower-moving blades of the repowering proposal created an improvement on the existing situation.[96] Such an assessment demonstrates how people anchor their judgements in different baselines, fixed to different points in time, against which to judge the acceptability of change. Meanwhile, the community representative felt that the increase in the size of turbines did not make a difference to local people as ‘the turbines on another site are quite large’,[97] again reflecting the impact of precedent and changes occurring in the surrounding area.

The repowering committee report identified the existing wind farm as ‘an established feature in the landscape which most local residents appear to have got used to’[98] and that the landscape and visual impacts would ‘be somewhat mitigated by the fact that the site is currently occupied by an operational wind farm, it is not a “green field” site,’[99] reflecting a preference for development to endure in existing rather than new locations. Additionally, when assessing the magnitude of change the committee report assessment took into account the duration of the effect and if it is reversible or not, noting the significance of the fact that the repowered permission would be time-limited with decommissioning requirements, revealing another case in which temporalities of control are bargaining chips that can be used to exert leverage. However, the committee report also noted that the turbines would be larger and more dominant in relation to local settlements and there would not be much precedent of such larger turbines near residential areas in the UK,[100] again reflecting precedence as a crucial element in LPA decision-making.

5.2.2.5 Familiarity

Narratives of community acceptance and familiarity were evident in this case. The local elected councillor felt that people are accepting of the existing turbines and repowering but would not want any more new sites, demonstrating how past siting decisions can

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[95]Taff Ely Repowering environmental statement, 2012, 18.4.4.
[96]Taff Ely Repowering committee report, 2013.
[97]Interview with community representative Taff Ely, April 2018.
[98]Taff Ely Repowering committee report, 2013, 47.
[99]Taff Ely Repowering committee report,2013, 30.
[100]Taff Ely Repowering committee report, 2013, 46.

influence the future of siting of such infrastructure, 'I think they are accepted now and of course the benefits that they've got are excellent and I think because of the environment people are more accepting that you have to do something, and they feel they're doing their bit'[101] (Community Taff Ely). This statement also demonstrates how perceptions of climate change and the need for renewables can change perceptions of renewable infrastructure. It was noted that the existing turbines have not caused problems for the community and that they had consequently accepted them. There was also evidence of familiarity amongst younger generations who had grown up with the wind farm, 'every time a child does a picture of Gilfach Goch it has a windmill in it'[102] (Community, Taff Ely). This suggests that embodied human temporalities may influence social acceptance, something explored further in the following chapter.

The local wind farm opposition group also expressed narratives of familiarity and acceptance, with acceptance being linked to the lack of possibility for change, 'there's nothing we can actually do about it. So, in a sense, it's not, not the topic of conversation anymore'[103] (Opposition group, Taff Ely). They expressed that most people are likely to have moved on as 'it is part of the scenery now and of course a lot of people who moved into the area that was already there so um it's not such an issue to them…they've accepted it, and there is actually nothing they can, in fact, do about it'[104] (Opposition group, Taff Ely*)*.

Meanwhile, the LPA described how their perception of wind farms has changed over time, 'from a decision-making point of view in that we've moved from, you know, an initial reluctance to accept them to perhaps seeing more of the positives from them'[105] (LPA, Taff Ely). They evidenced this through describing how members were not keen on the earliest applications for wind farms and the council refused most of them, then many were allowed on appeal (which itself can lead to reluctant acceptance), then recent applications, including the repowering, have had a more favourable determination from committee.

5.2.2.6 Pubic considerations of change

The LPA could not locate records regarding public response to the original application. However, they identified that there were 14 community letters of support and seven

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[101] Interview with community representative Taff Ely, April 2018.
[102] Interview with community representative Taff Ely, April 2018.
[103] Interview with local opposition group Taff Ely, April 2018.
[104] Interview with local opposition group Taff Ely, April 2018.
[105] Interview with LPA Taff Ely, April 2018.

against the repowering, contrasting this with a nearby wind farm application that had hundreds of comments. The community representative emphasised that local people would oppose any more new sites but felt that if other sites were to repower there would not be significant local objections, demonstrating how existing sites are considered differently from potential new sites. Similarly, the representative from the opposition group noted that repowering is likely to be less of an issue than new sites, 'I think people would know probably they're there and it's replacing one with another that's a bit bigger, is probably not going to be such an issue to be honest'[106] (Opposition group, Taff Ely). Such comments reiterate the legacy and significance of earlier decisions made over 20-30 years ago.

5.2.3 Varying narratives of duration

5.2.3.1 The influence of duration on Planning Authority decision-making

The committee report identified that the repowering proposal had to be considered in light of the existing wind farm as due to the lack of time-limiting condition the existing wind farm was effectively there in perpetuity. The LPA felt that if people are used to the turbines then they might as well stay there, reflecting a lack of concern regarding issues of reversibility, the tendency for most sites to be time-limited, or future removal.

5.2.3.2 Public consideration of duration

The community representative recalled that while there was opposition to the original wind farm a lot of the older members of the community would not be there in 40-years and it was vital to do something to help younger generations, reflecting wider temporal concerns of climate change and intergenerational justice. The community recognise the benefits of having an end date to provide a 'get out clause' if anything changes in the future; however, if things stay as they are the community is happy for the wind farm to be renewed. For the local community, the biggest problem was traffic congestion caused by the delivery of turbines. The community did not identify any other problems with the repowering application, suggesting that longer-term temporal dimensions were not a significant concern compared to the short-term traffic issues that may impact them in the more immediate future.

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[106] Interview with local opposition group Taff Ely, April 2018.

5.2.4 Strategies used

5.2.4.1 Developer's strategy for increasing duration of the infrastructure

Regarding tactics, the developer discussed the involvement of local school pupils, describing how a local girl spoke in favour of the repowering discussing the benefits for her generation, this can be seen as a symbol for future generational approval. They also reinforced the importance of pre-application discussions with the LPA to ensure that the benefits are put across early. Much justification in the application was based on the existing wind farm being in place with permanent planning consent. The planning statement identified that the site has the attributes to accommodate wind farm development, 'this is reflected by the 'permanent' planning permission that was granted for the existing Taff Ely Wind farm in 1993.'[107] The statement emphasised that the continued operation of the site would create a continuation of the existing landscape, visual and ecological impacts[108] and identified that repowering would lead to ecological benefits as a result of proposed habitat creation and land improvement works[109]. Such considerations can be seen as an ecological echo of the use made of repowering to extract higher levels of community benefits.

5.2.4.2 Community-developer relations

Community benefits and communication with the developer appeared to be critical to local support for repowering. It was clear that the community had trust in the developer, 'the experts say they're a good idea, who are we to argue with the experts'… 'in all fairness they've kept to their word and so we are happy with that'[110] (Community Taff Ely). The community also felt that the developer took into consideration their opinions, 'I would say they're very understanding'[111] (Community, Taff Ely). Community members identified the range of benefits that wind farm funds had created in the local area including money for the old age centre, parks, traffic calming, and the boxing club. The community representative noted that they were continuing to receive funds and explained how each member of the community benefitted or had family members that benefitted in some way from the support. There was a feeling that whatever the community council needed help for, there would be a way of achieving it. The funding

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[107]Taff Ely Repowering planning statement, 2012, 4.2.72.
[108]Taff Ely Repowering planning statement, 2012, 4.2.72.
[109]Taff Ely Repowering planning statement, 2012, 4.2.55.
[110]Interview with local community Taff Ely, April 2018.
[111]Interview with local community Taff Ely, April 2018.

appeared to be crucial in keeping local support 'because we're such a small community if there wasn't any benefits they would soon know about it too, you know as well, I mean we're not pushovers you know'[112] (Community, Taff Ely*).* The repowering proposal involved a significant increase in the value of community benefits from £2,500 to an expected £35,000[113] for each year of generation, reflecting how end-of-life applications provide an opportunity to significantly enhance benefits for communities living close to the infrastructure. The developer felt that the community fund was significant in Taff Ely as a low-income community.

5.2.4.3 The promise of decommissioning

The repowering committee report identified that the wind farm would be maintained over its 25-year life and then 'after this time unless a further planning permission is granted, the wind farm would be decommissioned, dismantled and the site reinstated.'[114] Such wording reflects recognition that the use of the site as a wind farm may continue further into the future, reflecting a broader temporal outlook than in other cases where decommissioning at the end of the consent period is presented as the definitive option. The planning statement identified that 'there is a commitment to reseed the affected areas and in the long term, bring them back into active agricultural use,'[115] providing a partial and thereby more readily measurable and achievable reassurance than other applications that use narratives of complete reversibility and returning a site to a previous condition.

5.2.4.4 Strategies used by opponents

The main concern of the opposition group (The Green Valleys Action Group) appeared to be the number of wind farms in the local area rather than consent durations. Their actions focused on objecting to applications for new wind farms, 'potentially we could eventually be surrounded or encircled'[116] (Opposition group*,* Taff Ely). They noted that the application for the original Taff Ely wind farm occurred before the opposition group had been formed but that they did oppose the repowering. During the time of the repowering application most active opposition was focused on a proposed new site to the west of the valley, reflecting the concern for new sites over repowering. The group

[112]Interview with local community Taff Ely, April 2018.
[113]Taff Ely Repowering planning statement, 2012, 4.2.43.
[114]Taff Ely Repowering committee report, 2013, 4.
[115]Taff Ely repowering planning statement, 2012, 4.2.71.
[116]Interview with local opposition group Taff Ely, April 2018.

now does not exist due to the key members moving away or dying, reflecting another temporal dimension of community relations with infrastructure.

5.2.5 The struggle to find a working fixity

5.2.5.1 Challenges faced by the developer

Deciding between implementing the repowering consent or continuing to operate the existing wind farm was a central challenge for the developer, revealing the significance of economic changes on end-of-life decision-making. The nature of the original permission being granted in perpetuity created an easy fall-back position, they thus had to decide if it would be better to run the existing site until 2027 when the existing subsidy ends or to repower without subsidy. At the time of interview they were in the process of exploring ways to make the consented project work, identifying challenges in the absence of financial support mechanisms and the significance of tip heights to the commercial position. They faced regulatory time pressures to decide before the planning consent ran out, or the grid connection was removed by the national grid.

5.2.5.2 Local Authority decision-making

The LPA described how the principle of land use was already there due to the existing wind farm, but the challenge was making the planning judgement between the larger number of smaller turbines or smaller number of larger turbines, expressing that people would likely have different preferences. They explained that they got assistance from an expert on landscape impact but that it offers no guarantees. ‘Whether we were right or wrong on that I guess time will tell, if they do it and people either throw their arms up in the air’[117] (LPA, Taff Ely). Regarding decision-making the LPA considered, ‘is the impact going to be that much more significant than what it is at the moment that we could support the refusal and ultimately we thought that that wasn’t the case’[118] (LPA, Taff Ely). The committee report[119] identified that the repowering scheme had to be considered in light of the existing operational wind farm with permanent permission and Welsh Government spatial guidance TAN8, which states ‘that opportunities to repower existing wind farms which are located outside SSAs should be encouraged provided

[117] Interview with LPA Taff Ely, April 2018.
[118] Interview with LPA Taff Ely, April 2018.
[119] Taff Ely repowering committee report, 2013, 46.

that the environmental and landscape impacts are acceptable.'[120] While finding the repowering proposal acceptable, the committee report noted that 'it is considered that any further development either in size or number of turbines would be likely to be considered unacceptable,'[121] demonstrating a sense of acceptable incrementalism, with the status quo as the benchmark. They explained how the local SSA is reaching capacity (regarding the MW targets) but did not feel that it was necessarily a reason to refuse new applications, perhaps due to an expectation that such targets may increase as the efficiency of turbines increase.

5.2.6 Conclusion

This case depicts the significance of commercial challenges shaping temporal decision-making through the decision regarding continuing to run the existing turbines or implement the repowering permission. While repowering permission was granted without much opposition and the community supported the increased value of benefits, changes in the wider economic context have created a challenging decision-making process regarding implementation. Changes in the subsidy regime and technological advances have formed a situation whereby the repowering permission is not as attractive or feasible to the developer as it was during the time of the application. Moreover, the existence of an ongoing subsidy and lack of duration condition on the existing consent further add to the complicated decision-making context. Meanwhile, there is a positive expectation from the LPA and community that the repowering will go ahead, reflecting different expectations and priorities regarding the duration and end-of-life of the site.

5.3 A multitude of temporal perspectives influencing end-of-life decisions, the case of Kirkby Moor

5.3.1 Introduction

Kirkby Moor demonstrates how high levels of local opposition can result in unsuccessful planning outcomes for repowering and life-extension at the LPA decision-making level. It also demonstrates the significance of the range of changes that alter

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[120]Welsh Government. Technical Advice Note 8: Planning for Renewable Energy, 2005, 2.14.
[121]Taff Ely repowering committee report, 2013, 47.

the context of sites over time, including but not limited to economics, physical site changes, social changes, policy changes, and ownership changes, each with their own temporality, creating a complicated end-of-life decision-making context and demonstrating how wind farms are ‘complex spaces’ subject to numerous influences and uses by different actors (see Bonta and Protevi 2004).

The wind farm is located just outside the Lake District National Park, 4km from Ulverston within South Lakeland LPA, on common land owned by the Holker Estate. The site was rather controversial from the start. The Sectary of State granted planning permission for 15 turbines in 1992. The reasons for approval have certain experimental particularities, being based on the need to proceed quickly with renewable energy developments and to develop wind farms ‘in different places to test their economic viability and environmental acceptability.’[122] The decision went against the advice of the planning Inspector who recommended refusal on terms of visual impact. These facets of the original decision resurface in later phases of the project, revealing how fixes can be reopened and issues of concern in one period of time can be resurrected.

12 x400kw, 45m turbines became operational in 1993. An application to repower the site with six larger (2MW–3MW) 115m turbines was submitted in December 2014 and refused in November 2015 (see figures 12 and 13). The reasons for refusal were as follows:

1. Visual impact, including on setting of National Park and the cumulative visual impact with other wind farms.
2. Visual impact on heritage assets.
3. Interference with Air Traffic Control radar.
4. Insufficient evidence submitted to demonstrate that the development would not have an adverse impact on archaeological interests.
5. Insufficient evidence submitted to demonstrate that the mitigation measures and long-term management proposals could be fully implemented.

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[122]Kirkby Moor Sectary of State (SOS) decision, March 1992.

Figure 12: News headline regarding the refusal of Kirkby Moor repowering (1)

Source: grough.co.uk (accessed June 2019)

Friends of Lake District welcome refusal of plans to double size of wind turbines

Bob Smith, Editor

Thursday 26 November 2015 09:51 PM GMT

Jump to comments

Figure 13: News headline regarding the refusal of Kirkby Moor repowering (2)

Source: telegraph.co.uk (accessed June 2019)

Bigger wind turbines will 'devastate' Lake District views

Cumbrian residents fight energy company plan to replace 12 old wind turbines with six much bigger ones

A visualisation of the proposed new six-turbine Kirkby Moor wind farm as seen from St John's Church, Broughton Beck. Photo: RWE

An application to extend the life of the existing scheme for 8.5 years was submitted in August 2017 and refused in December 2017 (see figure 14). Reasons for refusal included the continued duration of impacts on the landscape and the setting and character of the Lake District National Park and World Heritage Site, on designated heritage assets, and adverse impacts on the local economy. The decision noted the ‘substantial number of objections from the local community,’ identifying that the continued operation of the wind farm would be ‘contrary to local and national planning policies for renewable energy,’[123] including the 2015 Written Ministerial Statement. Indeed, there had been a policy shift towards a far tighter stance on onshore wind in England that had not, at that stage, given any exemption for repowering (see chapter 4).

Figure 14: News headline regarding Kirkby Moor life-extension

Source: tgomagazine.co.uk (accessed June 2019)


OPEN SPACES SOCIETY DELIGHTED THAT KIRKBY MOOR WIND TURBINES MUST GO

7th December 2017

In June 2018 the developer appealed the refused life-extension. The appeal was granted in July 2019 (after the completion of this research). The inspectors’ decision reads, ‘overall, the continuation of the life of this windfarm for a further limited period would provide benefits in terms of the production of renewable energy and would include decommissioning and restoration advantages. These matters outweigh the limited harm which the proposal would cause for the remainder of the life of the installation.’[124] A crucial element of the appeal was whether the category of repowering in footnote 49 of the National Planning Policy Framework (NPPF) included life-extension, as the NPPF does not provide a definition. The inspector concluded on this issue, ‘overall, in the absence of national guidance as to the meaning of the term, I consider that the proposal comprises repowering and that, accordingly, the proposal is not required to be in an area identified as suitable for wind energy development in the development plan or demonstrate that the planning impacts identified by the affected local community have been fully addressed and the proposal has their backing.’[125]

Regarding public opinion, two letters were submitted in support of the original 1992 proposal with one being from the landowner. There were also approximately 30 letters of objection with five of those from organisations.[126] In comparison, the repowering and life-extension applications faced significantly higher levels of public response. The

[123]Kirkby Moor life-extension decision notice 2017, refusal of planning permission.
[124]Kirkby Moor appeal decision, 2019, 93.
[125]Kirkby Moor appeal decision, 2019, 33.
[126]Figures from Inspectors report, 1992.

repowering received 532 public comments of objection and 141 of support. The LPA also received 755 pre-printed support cards. The life-extension received 153 comments of objection and 68 of support.

Figure 15: Location of Kirkby Moor wind farm

Source: Google Map (accessed May 2019), wind farm marked by red point

5.3.2 Narratives of change

5.3.2.1 Change in the site context

Several changes occurred to the context of the site over the 25-year life span of the development. Firstly, the Lake District was designated as a World Heritage Site (WHS) in 2017. The designation was discussed in the LPAs' life-extension report which identified that as the designation occurred with the turbines in place 'the retention of the wind turbines for a further 8 years is not considered to result in unacceptable impacts on the setting and character of the WHS,'[127] but reiterated that did not make permanent development acceptable.

[127]Kirkby Moor life-extension committee report, 2017, 203.

Secondly, at the time of the original application wind energy was a relatively new technology, the inspector for the original decision identified that 'very few windfarms have yet been built or even received planning permission. This relative scarcity of established windfarms enhances the need to have such a scheme in operation to demonstrate the technology.'[128] Comparatively, over the following 25 years, there has been substantial growth in onshore and offshore wind in the UK including in the vicinity of Kirkby Moor (particularly Furness - 3.5 km away and Askham - 6 km away). So, arguably, part of the reasons for granting permission on this site (i.e., the site as a form of demonstrator for experimentation and learning) is no longer applicable. Change in the wider setting of the site was considered in both committee reports.[129]

5.3.2.2 Policy change

Local and national policy considerably developed over the lifespan of the wind farm. National policy change was significant in terms of steering outcomes. Significantly at the time of the repowering application the 2015 Written Ministerial Statement[130] (WMS) was announced, with its restrictive stance on new wind farms and ahead of the appeal the updated NPPF exempted repowering applications from the constraints of the WMS, demonstrating the significance of policy change over time. Best-practice guidance regarding consultation with local communities[131] also emerged as well as local guidance for assessing the impacts of wind farms.[132]

Policy change was considered during both end-of-life applications. The repowering committee report discussed the application of the WMS during its transitional period, stating that the adverse planning impacts identified by the local community had not been fully addressed and concluding that 'the proposed development would not meet these transitional arrangements.'[133] Meanwhile, the life-extension committee report identified that both local and national policies had significantly changed since the

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[128]Kirkby Moor inspectors report original wind farm, 1992.
[129]Kirkby Moor life-extension committee report (2017) and repowering committee report (2015).
[130]UK Government House of Commons: Written Statement (HCWS42) Written Statement made by Secretary of State for Communities and Local Government (Greg Clark) on 18 June 2015. Available at https://www.parliament.uk/documents/commons-vote-office/June%202015/18%20June/1-DCLG-Planning.pdf (Accessed June 2019).
[131]Set out in the Department of Energy and Climate Change (DECC) document Community Engagement for Onshore Wind Developments: Best Practice Guidance published in October 2014.
[132]Including Cumbria Landscape Character Guidance and Toolkit (2011); Cumbria Wind Energy SPD (2006-8) and Cumbria Cumulative Impacts of Vertical Infrastructure Study (2014).
[133]Kirkby Moor Repowering committee report, 2015, 53.

original permission, arguing that 'the original decision taken to grant planning permission despite the opinion of the appointed Inspector carries limited weight in the current assessment.'[134] However, it also confirmed that 'the underlying planning arguments for the current application remain the same as the original decision,'[135] i.e., the need for renewable energy generation (however, this statement ignores changes such as the visual context of the site and the WHS designation as discussed above). Moreover, it identified that the updated Landscape and Visual Impact Assessment used recent guidelines and could thus 'be considered as being more rigorous when compared to the information submitted in 1991.'[136] The local opposition group also identified the significance of policy change and the WMS, speculating and arguing that the original wind farm would not be granted permission today,[137] speculations that blend the past with the present and future.

5.3.2.3 Industry changes

The nature of companies owning and managing the windfarm changed over time. Ventient owns the wind farm; however, the company was a result of a merger between Zephyr and Infinis Wind in 2017. The site was also managed by RWE who changed their name to Innogy in 2016. Such changes created a difficult situation for the public in terms of recognising the owners of the site, 'it's just always changing hands'[138] (Community, Kirkby Moor). The community identified this as an issue due to a lack of community-developer relationship and a perception that the developer was not concerned about the community.

5.3.2.4 Change in visual impact

Visual impact was a central issue for repowering, with the committee report identifying that the larger turbines would have a wider visual impact, creating 'a prominent skyline feature'.. 'eroding the undeveloped character of the area, and adversely affecting the setting of the Lake District National Park.'[139] It identified that the site would contribute to the cumulative impacts of the turbines at the Furness/Harlock Hill (consented for repowering) and Askham wind farms and would conflict with policies through creating

[134] Kirkby Moor life-extension committee report, 2017, 108.
[135] Kirkby Moor life-extension committee report, 2017, 108.
[136] Kirkby Moor life-extension committee report, 2017,111.
[137] Interview with local community opposition group representative Kirkby Moor, April 2018.
[138] Interview with local community representative Kirkby Moor, April 2018.
[139] Kirkby Moor repowering committee report, 2015, 46.

‘significant adverse impacts to the visual amenity on parts of the Lake District National Park, which do not currently exist under the baseline condition for the site.’[140] Meanwhile, a key reason for local opposition was the size of the turbines, ‘If they’d repowered at the same size, you could well have got community support because a lot of the community were willing to sort of have the status quo’[141] (Community, Kirkby Moor*).* In comparison, the life-extension committee report discussed how the visual impacts of the scheme ‘are known, apparent and have existed for 25 years’ and how the surrounding landscape features numerous examples of human interaction such as the Kirkby Slate Quarry.[142] The LPA described the initial development as ‘well designed in terms of its impacts on the landscape’ describing it as ‘quite contained,’ which made it more difficult to refuse the life-extension compared to the repowering.[143]

5.3.2.5 Familiarity

A narrative of familiarity was reflected in the life-extension committee report, which identified that ‘the windfarm turbines have become established structures in the landscape.’[144] The LPA identified that the wind farm is likely to have become ‘part of the landscape’ for local people, ‘I think in peoples everyday lives it probably doesn’t register that much’ … ‘a lot of the objections came from people who were in the area before the wind farm was there and they see it as this blot on the landscape, whereas I think a fair chunk of people who have moved into the area or have grown, born and bred and grown up in the area, that’s part of the landscape, that’s oh the wind farm there’[145] (LPA, Kirkby Moor), suggesting that previous experiences of the landscape may influence familiarity. In comparison, discussions with community members suggested that, for some, acceptance was not engendered over time and instead people were anticipating removal of the infrastructure,[146] revealing a need for a greater understanding of the views of residents, including those who may not have formally commented on planning applications, this is explored further in chapter 6.

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[140]Kirkby Moor repowering committee report, 2015, 46.
[141]Interview with local community representative Kirkby Moor, April 2018.
[142]Kirkby Moor life-extension committee report, 2017, 120.
[143]Interview with LPA Kirkby Moor, April 2018.
[144]Kirkby Moor life-extension committee report, 2017, 35.
[145]Interview with LPA Kirkby Moor, April 2018.
[146]Interview with local community representative Kirkby Moor, April 2018.

5.3.2.6 Pubic considerations of change

Community members identified some negative changes arising from the existing turbines, including perceptions that the bases had altered watercourses and contributed to flooding, although they did not provide evidence to support this. There were also feelings that turbines were not working, ‘there’s always one that’s not working, it’s never the same one. They’ll come out and fix it and then another one will break, but everybody around the moor has observed that and it doesn’t really add weight to the time extension’[147] (Community, Kirkby Moor). Regarding repowering, community members opposed the impact of the proposed changes, identifying that the turbines would be ‘essentially three times the height’ and that the existing bases would be left in situ, ‘you’d be concreting over more of the moor making new tracks, massive visual impact and everyone just thought no, this was not what we wanted’[148] (Community, Kirkby Moor). Awareness of wider industry change was also evident with community members expressing a preference for offshore wind in the area, reflecting how perceptions of infrastructure may change over time through the emergence of alternative technologies.

5.3.3 Varying narratives of duration

The duration of the scheme has been a central consideration since the original planning decision in which the SOS confirmed that ‘it is considered that permission should be given for the project to proceed for the expected life of the turbines which was stated in evidence to be 25 years, after which they should be removed. Any case for their continuation or replacement can be considered at that time in the light of experience gained during their actual working on the site,’[149] and imposed this duration in a condition. It is interesting that such a clause was used to prevent over-binding the future. The wording of this planning condition, as well as the section of the SOS report describing the scheme as a test for wind energy, were used by opposition groups in both the repowering and life-extension to argue that the wind farm should be removed.

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[147]Interview with local community representative Kirkby Moor, April 2018.
[148]Interview with local community representative Kirkby Moor, April 2018.
[149]Secretary of State decision notice, 1992.

5.3.3.1 The influence of duration on Planning Authority decision-making

The shorter time-limited period of the life-extension appeared significant in decision-making, with the planning committee identifying that 'landscape effects are medium term and non-permanent, provided the development is removed and the restoration plan completed.'[150] It is interesting to note here the variety of ways used to describe something as temporary. It was considered that 'on balance, the landscape harm that the windfarm causes is acknowledged, but in the context of a relatively short time extension that is itself limited by the subsidy regime, there are clear public benefits of a more complete restoration of the site and habitat improvement elsewhere within Kirkby Moor.'[151] Thus, there are numerous temporal dimensions influencing the LPAs perspective including the decommissioning and habitat improvements offered as part of the life-extension application and the expectation that the developer's desire to life-extend is linked to economic benefits of the subsidy regime. It is evident that the LPA were keen to contain the project, both in scale and duration. Temporariness and resistance to the idea of permanence was central in decision-making with the committee report identifying that the National Park did not feel that the continuation of the turbines for 8 years would be unacceptable but highlighting that it 'does not mean that they are acceptable long term structures in this sensitive landscape'[152] and that 'in accepting the temporary impacts of the windfarm the LDNP is explicit in stating that neither a permanent or new development on this ridge would be acceptable in the future.'[153]

The time-limited nature of the original scheme was also discussed, with the life-extension committee report identifying that 'it is clear that this windfarm was an experiment in as much as it was one of the first in the UK and established the pattern for future schemes. In saying it was an experiment, there is some reasoning behind the decision that it appears that the expected life of the turbines was 25 years, but equally could be shorter or longer.'[154] Temporality can thus be seen to be linked to experimentation, i.e. this windfarm was itself a test of time and so now as one of the earliest wind farms, it potentially continues to be at the forefront of precedent-making decisions. Significantly, the committee identified that 'changes in the funding and subsidy regimes mean also that future extensions and new onshore windfarms will

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[150]Kirkby Moor life-extension committee report, 2017,45.
[151]Kirkby Moor life-extension committee report, 2017,141.
[152]Kirkby Moor life-extension committee report, 2017, 38.
[153]Kirkby Moor life-extension committee report, 2017, 204.
[154]Kirkby Moor life-extension committee report, 2017, 26.

become extremely unlikely,'[155] suggesting a particular view of the future and lacking consideration of the possibility of non-subsidy methods of keeping wind farms operating.

5.3.3.2 Public consideration of duration

People who had moved into the area since the wind farm had been built were not necessarily aware of the 25-year permission period. The repowering application came as a surprise to some residents and the key trigger of opposition appeared to be the increase in size rather than duration, 'I guess that was the key turning point for a lot of people that yeah these are going to be a lot bigger'[156] (Community, Kirkby Moor). The planning system can thus be seen to have highlighted something as temporary that people had considered to be permanent and therefore opened up scope for agency and influence that they had not considered possible.

5.3.4 Strategies used

5.3.4.1 Developer's strategy for increasing duration of the infrastructure

The developer did not appeal the refusal of the repowering application as given the comments received they felt that their chance of success would not be high. In the case of appealing the life-extension they waited for the NPPF consultation to be published. Such behaviour reveals how the temporal patterns of planning policy and developer strategy (potentially including policy lobbying as well as policy timing) can influence the timing and strategy of end-of-life applications (even if it has scarcely done so to date, as chapter 4 explained). It also shows something of the freedom and therefore power available to the developer – they can wait, one might say they can exploit time (see Raco et al. 2018).

5.3.4.2 Community-developer relations

Poor community-developer relations over time and particularly during the end-of-life applications can be seen to have catalysed local opposition. The community felt that the developer tried to force the repowering application on them, describing how they distributed pro-forma support cards outside the local area such as the Westmoreland

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[155]Kirkby Moor life-extension committee report, 2017, 204.
[156]Interview with local community representative Kirkby Moor, April 2018.

county show, identifying that such actions made the community ‘get that David and Goliath feeling’[157] (Community, Kirkby Moor). Moreover, they felt that the developer purposely scheduled the life-extension community open day for a time when most local people could not make it. The repowering application created poor relations between the developer and community, influencing responses to the life-extension and demonstrating how temporalities are not just background ‘landscape’ changes but also made by the actors involved. ‘The community had been sufficiently upset by the repowering tactics that they weren’t in the mood to consider it’...‘if they had done life-extension without the whole big repowering effort, the community might, they’d have probably gone for it, but the whole repowering thing was such, just alienated the community so much’[158] (Community, Kirkby Moor). It was evident that the repowering application led to a lack of trust in the developer and consequently feelings of exploitation. During the repowering application people had suggested repowering with the same turbines but the developer said it was not possible.

The life-extension committee report identified that ‘a significant level of representation has been received regarding previous references to the longevity of the original turbines made in the re-powering application’ recognising ‘a tension between those previous statements and the fact that the turbines are now considered to be capable of lasting a further 9 years.’[159] The community recognised that the life-extension was set to end on the exact day that the subsidy for the wind farm would end. On researching the developer, they found that it was owned by an investment bank and thus ‘the local feeling was well, why, why should we have to live with this when an investment banker is going to be benefitting from subsidies’[160] (Community, Kirkby Moor). Community members identified how there were moral reasons for objecting as local people were living in poverty while paying a green levy to subsidise investment banks. Much objection was also focused on the original scheme being granted after refusal as an experiment to test wind energy, ‘wind energy is proven, you know, the experiment is over we should be sticking to the original condition’[161] (Community, Kirkby Moor).

There was evidence of accumulating relations of mistrust from a community where many were highly alert to previous promises and perceived unfairness. While the developer had provided community benefits in terms of a community fund (reporting

[157]Interview with local community representative Kirkby Moor, April 2018.
[158]Interview with local community representative Kirkby Moor, April 2018.
[159]Kirkby Moor life-extension committee report, 2017,186.
[160]Interview with local community representative Kirkby Moor, April 2018.
[161]Interview with local community representative Kirkby Moor, April 2018.

that they had contributed over £21,000 to community projects since 2008[162]), there was a feeling amongst community members that money had only been spent when requested and that ‘the onus should be on the, on the wind farm company to bring those benefits into the community not to wait for someone, to wait to ask for them’ (Community, Kirkby Moor). Community members explained that they tried to find out the value of the fund but were told it was empty, ‘the total value of what should have accumulated in the fund if it was paid as promised hasn’t been spent. But we don’t know where the money’s gone now. But if you ask for the fund now, it’s gone, and they’re still up’[163] (Community, Kirkby Moor).

5.3.4.3 The (lack of) promise of decommissioning

Significantly, as a result of a likely oversight after the SOS decision and the failure of the LPA to request it, the original planning permission did not provide for adequate decommissioning, requiring the removal of the turbines but not the associated infrastructure such as transformers (see photograph in figure 16 below) and access tracks, creating a situation that the LPA described as ‘environmentally unacceptable.’[164] Moreover, no decommissioning bonds were put in place. The LPA described the lack of condition as unusual, particularly when compared to the decommissioning of other ‘temporary’ permissions such as landfill sites and quarries[165]. They explained that they had received legal advice confirming that the developers would not have to remove the roads, cabling, bases, or transformer substations. They appeared hopeful that the developers might take the substations as ‘there’s an obvious long term issue in terms of something up there which isn’t very pleasant. It’s got perhaps chemicals in it which, which aren’t particularly pleasant, its also got copper I presume in a transformer that are all, got a value and you know it would be as well to take it’[166] (LPA, Kirkby Moor). However, UK Government officers confirmed that there would be no requirements for components to be removed in such cases, identifying the potential for infrastructure abandonment.[167] This situation reveals how decisions made at a certain point in time and then forgotten about can return to cause challenges in the future.

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[162]Kirkby Moor repowering consultation report, 2014.
[163]Interview with local community representative Kirkby Moor, April 2018.
[164]Kirkby Moor life-extension committee report, 2017, 96.
[165]Kirkby Moor life-extension committee report, 2017, 100.
[166]Interview with LPA Kirkby Moor, April 2018.
[167]Interview with Gov UK BEIS, August 2018.

As with other cases, the developer was able to offer improved decommissioning as part of repowering or life-extension. Such improvements formed a central consideration in decision-making particularly for the life-extension, with the committee report identifying that 'material in the assessment has been the decommissioning and site restoration, habitat management and enhancement – it will secure a more satisfactory outcome for the SSSI.'[168] A narrative of reversibility was considered within the life-extension committee report, which identified that landscape effects were 'non-permanent, provided the development is removed and the restoration plan completed.'[169] The benefit of the emergence of decommissioning guidance and experience was discussed, demonstrating how industry requirements may change over time as a result of experience. However, the LPA refusal of the life-extension confirmed that the benefits of a more comprehensive decommissioning and habitat restoration programme did not outweigh the adverse impacts.

Community members felt that the promise of decommissioning was used as a bribe and thus attempted to explore other options for removing the infrastructure in the case of a refusal. 'It felt like a threat really, that's how it felt to the locals, it was like you know, give us the time extension and we'll decommission and restore properly, if you don't we're just going to fall back to the 1992 position'[170] (Community, Kirkby Moor). They felt that the decommissioning statement made in the refused repowering application should be adhered to (despite the fact they were two separate, different applications). They argued that the fact that the 1992 permission was poorly written should not be an excuse not to carry out adequate decommissioning and restoration. They also highlighted the impact of precedent, stating 'if we don't do it properly then anywhere else in the UK will be able to say oh well on Kirkby Moor they didn't decommission properly, so it's fine'[171] (Community Kirkby Moor).

[168]Kirkby Moor life-extension committee report, 2017, 9.
[169]Kirkby Moor life-extension committee report, 2017, 45.
[170]Interview with local community representative Kirkby Moor, April 2018.
[171]Interview with local community representative Kirkby Moor, April 2018.

Figure 16: A transformer box next to the base of a turbine at Kirkby Moor wind farm

(Picture taken by author in April 2018)

5.3.4.4 Strategies used by opponents

Time and timing can impact the power and influence of those opposing. The community faced challenges in knowing how to make a strong objection and where to direct their efforts but noted that the WMS helped their position. They were organised in preparing speeches for the LPA hearings, ensuring that multiple people could each take an aspect to discuss. They identified the challenge of finding the time to prepare and read all of the documents that the developer produced, explaining ‘that’s how strong the local feeling was’ (Community Kirkby Moor). The group grew over time, ‘whilst we started as a small group of residents that were sort of Netherhouses, Broughton Beck, going round the moor, by the time word got out we had all these parish councils surrounding the moor saying we don’t want it. So, it grew and grew as people found out what we were doing and said we'll be part of that, we don't want it'[172] (Community, Kirkby Moor). They explained the benefit of canvassing for support, particularly the change in behaviour from statutory consultees such as environmental organisations who initially felt that there was no point in objecting as the developer was so powerful.[173]

5.3.5 The struggle to find a working fixity

5.3.5.1 Challenges faced by the developer

The developer identified that the lack of policy for repowering and life-extension created more uncertainty in the process as it leaves open a wider range of potentials. Such policy uncertainty echoes issues faced during the original decision.

5.3.5.2 Local Authority decision-making

The LPA identified that 'making the right decision is the biggest challenge'[174] (LPA, Kirkby Moor). They felt that they were 'left in a bit of a policy vacuum,' identifying a need for more guidance for repowering and life-extension including the weight to be given to community opinion. At the time of the applications there was no national policy for repowering or life-extension, thus they were considered in the context of the Written Ministerial Statement (WMS).[175] The life-extension committee report discusses the application of the transitional provisions of the WMS which 'establishes that whether a proposal has the backing of the affected local community is a material planning judgement for the local planning authority.'[176] Significantly, the lack of objection from the Lake District National Park was considered as material.[177]

Both applications were assessed against a site with no turbines due to the requirement of the existing scheme to be removed in 2018, despite the lack of full decommissioning condition, but consideration of the baseline is a judgement that varies across cases.

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[172] Interview with LPA, Kirkby Moor, April 2018.
[173] Interview with local community representative Kirkby Moor, April 2018.
[174] Interview with LPA, Kirkby Moor, April 2018.
[175] UK Government House of Commons: Written Statement (HCWS42) Written Statement made by Secretary of State for Communities and Local Government (Greg Clark) on 18 June 2015. Available at https://www.parliament.uk/documents/commons-vote-office/June%202015/18%20June/1-DCLG-Planning.pdf (accessed June 2019).
[176] Kirkby Moor life-extension committee report, 2017, 92.
[177] Kirkby Moor life-extension committee report, 2017, 202.

The LPA felt that the repowering was slightly easier to decide as the impacts were easier to quantify in terms of the turbines being significantly larger; however, they described assessing visual impact as a key challenge. In the case of life-extension, they explained that the difficulty was that the impacts on the landscape were known and the planning judgement had to be made weighing up the costs and benefits and interpreting any policy. They felt that during the life-extension 'at committee it went political'[178] (LPA, Kirkby Moor), this could be interpreted as a (mainly) Conservative council seeing refusing the life-extension and supporting community objections as consistent with overall Conservative policy of restricting wind development.

5.3.5.3 Local Authority consideration of decommissioning

The lack of decommissioning provisions created a difficult decision for the LPA regarding whether the benefits of decommissioning provided as part of a life-extension outweighed community and other concerns. The life-extension case officer described how 'it was a difficult decision, it really was and I was right up to the wire on it in sort of making my mind up because you know, in reading through the documentation and everything else I don't think that the public benefits were quite as extensive or as clear as the applicant would have liked them to have been perceived as.' (LPA, Kirkby Moor). The officer described the challenge of deciding what materiality to provide to the public benefit of removal, stating that 'the balance was actually really quite subtle'[179] (LPA*,* Kirkby Moor).

5.3.6 Conclusion

This case represents a rather rare set of circumstances, particularly regarding the lack of decommissioning requirements, the controversial location of the site, and greater levels of contestation of the baseline against which end-of-life decisions should be judged. However, there are elements of the case that may be seen more widely and from which one can extrapolate issues of broader relevance (discussed further in chapter 7). Looking at the key elements of the case in a broader sense (i) there were particular features of the original consent that could become points of contention downstream (experimental, poor decommissioning, failure to anticipate potential futures), (ii) things had changed over time (in the policy environment, physical environment, and developer-community relations), meaning (iii) the original

[178]Interview with LPA Kirkby Moor, April 2018.
[179]Interview with LPA Kirkby Moor, April 2018.

opportunities for contention were in fact mobilised. It is not inconceivable that these elements could feature in other end-of-life decisions.

5.4 Extending spatial as well as temporal dimensions, the case of Windy Standard

5.4.1 Introduction

Windy Standard provides an example of a different phenomenon, extending the physical area of a wind farm through site-extension as well as extending temporal dimensions. It enables an exploration of how temporal considerations influence wider strategies for the site. Windy Standard (also called Brockloch Rig) is located near the villages of Brockloch and Carsphairn within the LPA of Dumfries and Galloway in Scotland. Phase 1 of the wind farm was granted planning permission for 36 x 53.5m turbines in 1995 and became operational in 1996.

In November 2018 permission was granted to extend the life of phase 1 for an additional 6.5 years so that the consent will expire in 2027 (coinciding with the end of subsidy support). The application was submitted in July 2018 after the research interviews were undertaken in April, thus the interview data reflects considerations of possible life-extension or repowering rather than opinions of this application or the outcome.

Additionally, permission was granted by Scottish Ministers in 2007 for phase 2 comprising 30 x 100-120m turbines. Following an extension to the commencement of works it became operational in 2017. At the time of writing (July 2019) phase 3 of the wind farm, comprising 20 x 125-177.5m turbines was at appeal following refusal from the LPA (figures 17 and 18 reflect the controversial nature of this application).

It was not possible to speak to the LPA about this case as it was live; however, planning documents were reviewed in detail, providing a formal narrative of the LPA.

Figure 17: News headline regarding Windy Standard phase 3 (1)

Source: dailyrecord.co.uk (accessed June 2019)

News ▸ Local News ▸ Galloway News

Windy Standard extension given thumbs down by councillors who ask "When is enough, enough?"

Members have lodged an objection to the proposal to add 20 turbines to the Carsphairn Forest development with the Scottish Government taking the final decision

Figure 18: News headline regarding Windy Standard phase 3 (2)

Source: bbc.co.uk (accessed June 2019)

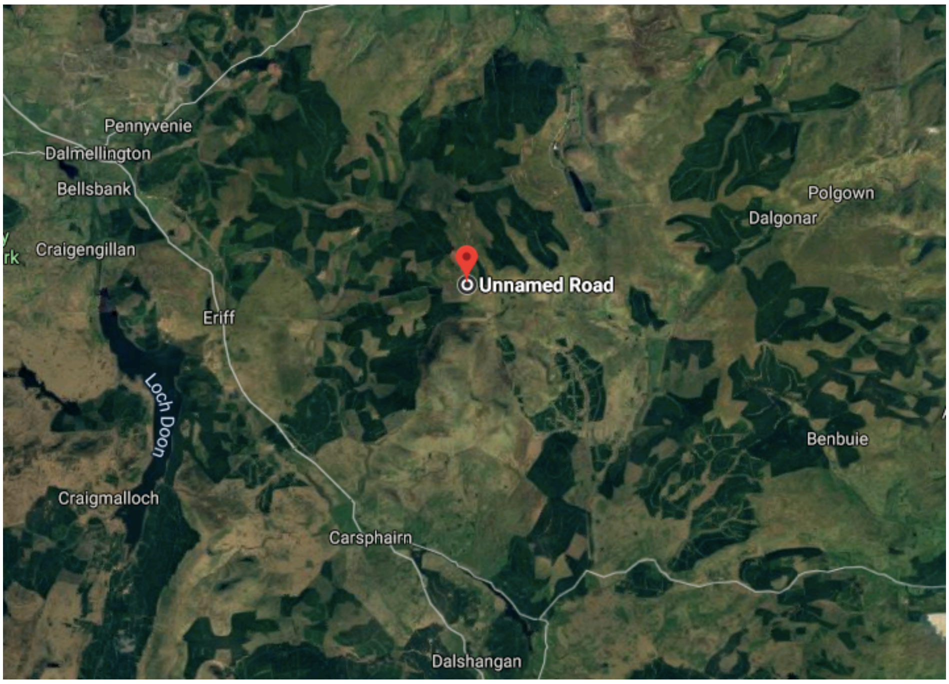
Advice not to oppose Windy Standard turbine expansion

8 February 2018 Share

The new turbines would take the total at the Windy Standard site to more than 80

Figure 19: Location of Windy Standard

Source: Google Map (accessed May 2019), wind farm marked by red point



5.4.2 Narratives of change

The context of the site and how it is considered changed over the 22-year lifespan of phase 1. One of the most significant changes was the development of a substantial number of wind farms in the surrounding area.

5.4.2.1 Policy change

The LPA can be seen to have taken into account updated policy and guidance, demonstrating how policy change over time influences decision-making. The phase 3 committee report identified the Scottish Onshore Wind Policy Statement,[180] which sets out a positive approach to wind energy, as a material consideration. Meanwhile, the life-extension committee report identified that in determining the application consideration should be given to whether any material change in policy or other circumstances occurred since the granting of the original permission.[181] Through doing so, it can be seen that original decisions take on a certain fixity and are set as benchmarks or reference points for whether anything has changed since that point.

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[180] Scottish Government. Onshore wind: policy statement. 2017.
[181] Windy Standard life-extension committee report, 2018, 4.4.

5.4.2.2 Industry changes

The developer identified how infrastructure has changed over time, explaining that due to the increasing size of turbines, the different phases of the site have different access requirements and grid connection points. The life-extension application revealed how industry changes may impact both physical and temporal elements of the site, for example, in the longer time needed for modern decommissioning practices and larger crane hard-standings to accommodate modern machines.

5.4.2.3 Change in visual impact

The committee report for phase 3 considered the cumulative visual impact of the proposal alongside all wind farms within 35km of the site, including those in the planning system, this involved 27 existing/consented sites and 21 proposed sites,[182] revealing how the context of a site can change substantially over time. Change over time can be seen to have significant effects, with the committee report identifying that 'the cumulative baseline has changed over the time of the application process,...it is no longer felt that the proportion of adverse effects attributed to Windy Standard 3 would make an objection sustainable.'[183] It identified a variety of turbine sizes in the vicinity of the site, stating that 'introducing the proposal is not considered to add significantly to the mix, given site design meaning that larger turbines would be located on lower ground only and therefore not increasing the vertical extent of the existing wind farm skyline, but over time will likely become even more aligned as other turbines in the wider array are replaced by fewer but larger turbines.'[184] Thus, there appears to be an acceptance from the LPA that this is i) a wind-farm dominated landscape (and they interpret this as diminishing the argument against approving more) ii) the visual baseline is in constant flux and repowering in the future will lead to changing visual impacts due to increasing height of turbines. Consequently, the fixity of past decisions appears to set a threshold or benchmark for decisions, but there is also an 'open future' linked to a trend of the increasing size of turbines as a 'future normal'. Meanwhile, despite such evidence of longer-term considerations from the LPA, the arguments of the visual and landscape impacts being temporary and reversible were reinforced by the applicant.[185]

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[182]Windy Standard Phase three committee report, 2018, 1.12.
[183]Windy Standard life-extension committee report 2018, 2.2 (e.1).
[184]Windy Standard life-extension committee report 2018, 2.2 (b.1).
[185]Windy Standard, phase three, Design statement, 2015, 2.5.27.

5.4.2.4 Public considerations of change

The community representative felt that people would not object to repowering as much as they would to a new wind farm, reflecting similar preferences in Taff Ely. Part of the reason is that older wind farms are often in less visually prominent locations, 'I think people would be happier to go with the repowering, but more objection will be raised to extensions to existing wind farms or to new wind farm developments because you know, like I say, there's already a set of windmills there, what does it matter if they're new ones or old ones that are on that site. But having a new set of pylons over there where there was none before, a new set of windmills where there was none before, I think that will raise more objections'[186] (Community, Windy Standard), thereby reinforcing the significance of familiarity on perceptions of change. From such a perspective, judgements can be seen to be anchored on what is already present. They also identified the significance of ancillary equipment, including pylons and substations, the impacts of which often get forgotten about. They felt that the impact of this infrastructure causes as much objection as the turbines as 'the wind farm is tucked out on the hill, you know, you see it from some locations, but you don't see it the whole time, but the pylons and the wooden poles, you know go right in front of houses'[187] (Community, Windy Standard), revealing that there are other elements of the infrastructure that become longer-lasting as well as the turbines.

5.4.3 Varying narratives of duration

5.4.3.1 The influence of duration on Planning Authority decision-making

Regarding the life-extension, the LPA felt that the original permission established the principle of development and therefore they did not need to reconsider the merits of the original application. They explained how in deciding the application 'consideration can only reasonably be given to whether there has been any material change in policy or other circumstances since the original planning permission was granted'[188] (LPA, Windy Standard), thus demonstrating the role of precedent and previous decisions becoming fixed moments in time that then project on to future decisions in powerful and significant ways, reflecting the enduring nature of earlier decisions, a significant overall concern.

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[186] Interview with local community representative Windy Standard, June 2018.
[187] Interview with local community representative Windy Standard, June 2018.
[188] Windy Standard life-extension committee report, 2018, 4.4.

The life-extension committee report discussed how the duration condition in the original permission was used so that the 'Planning Authority may retain control over the long term use of the land and to ensure satisfactory reinstatement.'[189] … 'In this case, the permission is essentially temporary, albeit long term to the extent that it is tantamount to a de facto permanent permission. Nonetheless, the spirit of the original condition was to limit the amount of time the development could operate for before decommissioning was required.'[190] Through doing so, they appear to refer to the site as both temporary, long-term, and permanent, reflecting confusion in how the duration of the site is labelled and considered.

5.4.3.2 Public consideration of duration

When asked if there was awareness of the 25-year consent for the original phase 1 site, the community representative suggested that the community have a longer-term perception of the infrastructure, 'I think we're all of the opinion that once they're there, they're they'll, it won't be twenty-five years, it will be at least fifty. You know probably at the moment they'll all, all these sites will be repowered. So, I think most people are astute enough to realise that, you know, yea it's a twenty-five lease at the moment, but that will be, they'll be repowered and um bigger turbines will be put on the same site and you know that will be another twenty-five'[191] (Community, Windy Standard). There was an expectation that phase 1 will be repowered and a sense of understanding as to why, 'you can see all the infrastructure and things there to build them and make them bigger so why take them away and build more somewhere else? When you can just put new ones, you know, decommission the old ones and put new ones back up. I think everyone's pretty astute to that'[192] (Community, Windy Standard). Such perceptions of wind farms as longer-term wind farm sites is reflected in the lack of opposition to the life-extension.

[189]Windy Standard life-extension committee report, 2018, 4.13.
[190]Windy Standard life-extension committee report, 2018, 4.14.
[191]Interview with local community representative Windy Standard, June 2018.
[192]Interview with local community representative Windy Standard, June 2018.

5.4.4 Strategies used

5.4.4.1 Developer's strategy for increasing duration of the infrastructure

Commercial factors influence end-of-life decisions for developers. In interview the developer explained that they expected to repower phase 1 but were likely to extend the life of the existing turbines first until subsidy support ends. 'If you consider replacing with a new turbine, even though it might be more efficient it wouldn't have a subsidy that went with it, so there is a much bigger gap between the two.'[193] (Developer, Windy Standard). In doing so, they end up aligning two public policy temporalities: consent duration and subsidy regimes.

Following the interviews, a life-extension application was granted later that year with the applicant identifying the benefits of continued renewable energy delivery and local operational and maintenance jobs.[194] The planning consultant explained that phase 1 probably proved the suitability of the landscape for wind farms and the site has subsequently evolved. They noted the difference in phase 3, explaining that the change in subsidy partly defined the nature of the site in terms of larger turbines.[195] Grid connection was a key element influencing timing and was responsible for the 12-15 year delay on phase 2, reflecting how there are elements outside of developers' control that can influence temporal strategies.

5.4.4.2 Community-developer relations

Although relations between the community and developer did not appear negative, the number of wind farms in the area appeared to be starting to cause local upset, 'we've obviously got Windy Standard 2 now and Windy Standard 3 has just been talked about and along with a whole load of other wind farms and…, people that were quite pro wind farm development in the area are now saying, you have to be joking, you know enough is enough'[196] (Community*,* Windy Standard). They identified that there are approximately 200 turbines in the community and if all of the wind farms that have been considered were built there would be over 600 turbines. 'I think we've already reached the tipping point where people are saying, you know crikey, how many wind

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[193]Interview with Developer Windy Standard, April 2018.
[194]Windy Standard life-extension application supporting statement, 2018.
[195]Interview with planning consultant Windy Standard, April 2018.
[196]Interview with local community representative Windy Standard, June 2018.

farms do we need?'[197] (Community, Windy Standard). Feelings of opposition thus appear to be linked to the number of turbines rather than their duration.

The community representative explained that the wind farms are on land owned by people who do not live in the local area and thus, while providing community benefits, they are not directly contributing to the local community. The landowner benefit is mostly spent outside the area rather than supporting local schools or businesses. They felt that it would be better if wind farms were on land owned by local community members who are part of village committees, expressing that some families have lived in the area for hundreds of years. This highlights the significance of long-term relationships with the land and community. Community benefits have supported a range of local projects including education grants, community groups, and events. However, they explained that the level of benefits that the community receives is very large for a community of 150-180 people, noting that there is a challenge of finding enough projects, 'there's only so many times you can paint the village hall and clean the church'[198] (Community Windy Standard). In this context they did not feel that the community fund led to increased support for Windy Standard 2, 'I think the people that would object to a wind farm would object to it no matter how much money was coming into the community benefit'[199] (Community, Windy Standard). This case demonstrates how community perceptions may change over time in response to the development of sites, even if this does not easily translate into active or effective opposition.

5.4.4.3 The promise of decommissioning

Discussions of decommissioning were not as significant in this case as they appear to have been in other cases due to the existence of decommissioning conditions providing certainty that the infrastructure will be removed at a point in the future. (Although the date of that point may potentially be altered by future end-of-life applications).

5.4.5 The struggle to find a working fixity

Windy standard phases 2 and 3 faced challenges that impacted the temporality of outcomes. In the case of phase 2, this was related to the substantial delay in securing

[197] Interview with local community representative Windy Standard, June 2018.
[198] Interview with local community representative Windy Standard, June 2018.
[199] Interview with local community representative Windy Standard, June 2018.

grid access, revealing the significance of this element on timescales. In phase 3, the decision-making process was slowed by politics, particularly disparity between local councils.[200]

5.4.6 Conclusion

This case demonstrates the significance of the spatiality of wind farm development on public response, revealing how the number of wind farm developments appears to be far more significant than the duration of existing sites. This is reinforced by the lack of controversy regarding the life-extension of phase 1. The assumption amongst the community that repowering would occur suggests that they have a longer-term view of existing sites rather than considering them as temporary. Meanwhile, the case demonstrates a different temporal strategy of developers, developing wind farm sites in phases and aligning consent durations. It also demonstrates the strategy of pursuing life-extension as an easier option than repowering (again influenced by subsidy regimes).

5.5 Exploring temporal considerations for solar energy infrastructure, the case of Pitworthy solar farm

5.5.1 Introduction

The following case provides insight into how temporal dimensions are considered in another form of energy infrastructure, field-scale solar. It demonstrates commercial and regulatory moments of time being brought together to achieve an extension of consent life at an early stage of an infrastructure's being. Significantly, solar represents a later phase renewable technology, thus regulation is in an earlier, potentially more experimental stage than for onshore wind, but with scope to learn from the regulation of wind.

Pitworthy was granted 25-year planning consent in 2013 for a 15-18 MW large-scale solar farm. The site covers 44.2 hectares of grade 4 arable farmland and was previously used as pasture farmland. The site is located in Pancrasweek, a rural hamlet in Devon within the LPA of Torridge. The 18MW solar farm became operational

[200]Interview with Developer Windy Standard, April 2018.

in 2014 and continued to be used for sheep grazing. An application was submitted and permission was granted in 2017 to vary condition three (relating to the duration of the permission) and thus extend the consent period to 40 years (see figure 20). This application was submitted shortly after the solar farm was sold to an investment company. Both applications received little public comment, the original planning application received six objections and three letters of support. Slightly more (ten) letters of objection were received in response to the life-extension, including objection from a local countryside campaign group.

Figure 20: Pitworthy solar news extract

Source: camelford-today.co.uk (accessed June 2019)

Solar farm can stay for extra 15 years, says council

Tuesday, 18 July 2017 - Local People

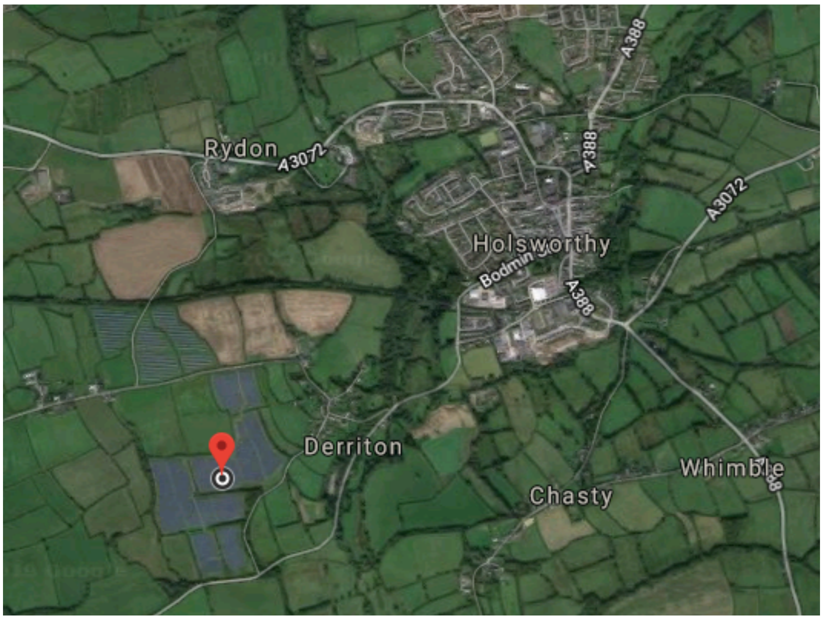
by **Rosie Cripps** - Reporter

@ThePostSeries info@thepost.uk.com

PLANS to extend the longevity of a 109-acre solar farm at Pancrasweek, near Holsworthy, have been approved by Torridge District Council, despite objections from a local organisation instrumental to protecting its countryside.

Figure 21: Location of Pitworthy solar farm

Source: Google Map (accessed May 2019), solar farm marked by red point



5.5.2 Narratives of change

As life-extension occurred three years after the site became operational, there had not been any identifiable changes to the nature of the site and no policy changes. The most significant change was perhaps that the site owner and thus the intentions of the site owner changed. Narratives of change in terms of site enhancement had been used to support both the original and life-extension application; however, such promises are not necessarily time specific. The life-extension application included discussions of additional landscape improvements such as hedgerow and tree planting,[201] demonstrating a potential material benefit of time-limited conditions.

The majority of the community did not have a strong reaction to the development of the solar farm, reflecting narratives of acceptance. The parish council identified that the solar farm, once built, was what people expected because they had seen solar farms before. They revealed how there was very little talk of it after it had been built, stating that ‘people object more before these things come and then when they’re there, well people accept it’[202] (Community, Pitworthy). Such a comment reflects the critical temporal stages of before and after development, although in reality, people may resign themselves to the infrastructure being there rather than necessarily accept it

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[201] Pitworthy original planning statement, 2012, 6.40.
[202] Interview with community representative Pitworthy, April 2018.

(Cowell et al. 2011). Changes in local perceptions before and after infrastructure development is explored further in chapter 6.

5.5.3 Varying narratives of duration

5.5.3.1 Arguments of temporality

The original decision notice imposed a condition stating that permission was for 25 years.[203] Arguments for the benefits of this 25-year period, in terms of facilitating future removal, were reinforced throughout the application and decision documents. The planning application stated that the lifespan of the solar panels was around 25 years[204] and reinforced the idea that the application was for a temporary use and thus the 'loss' of land would be temporary.[205] The Design and Access Statement used the temporary nature of the application to argue in favour of the change in land use stating that 'the proposed solar park will involve the change of use of the land, but due to the restricted or temporary nature of the development, the agricultural use will be retained, particularly in the long term.'[206] This provides an interesting example of a pre-existing use continuing alongside a new use, providing a thread of continuity from past through present to future, with agricultural use providing the selected value and benchmark. It continues, 'the panels are to be removed after their 25 year life time, the land will revert swiftly to agricultural use, if this is considered appropriate. In this respect the proposed scheme will result in a less permanent impact than most other forms of development, including some alternative methods of renewable energy production.'[207] The planning statement noted the benefit of the site being temporary and thus 'removed or reconsidered after a period of 25 years.'[208] Arguments of temporality and reversibility were thus relevant in this application.

While there is no formal guidance regarding the duration of solar farms, the developer revealed that the 25-year consent period was accepted by lenders/financiers, may be linked to the warranty of solar panels, has become entrenched, and is likely to be the norm for many councils.[209] It is felt that once a council grants a time-limit on one project

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[203]Pitworthy original planning decision notice, 2013, condition 3.
[204]Pitworthy original planning statement, 2012, 3.7.
[205]Pitworthy original planning statement, 2012, 6.14, 6.15, 7.1.
[206]Pitworthy original application Design and Access Statement, 2012, 3.5.
[207]Pitworthy original application Design and Access Statement, 2012, 3.5.
[208]Pitworthy original planning statement, 2012, 6.13.
[209]Interview with developer A Pitworthy, April 2018.

they are likely to apply the same restriction to future projects,[210] suggesting a feeling that within a LPA time is independent of site conditions and that developers, like other actors, have concerns about precedent and ways in which the past can configure the future. The original developer identified that a 25-year restriction helps to address the concerns of some councils about sites being turned into future building land.[211] Labelling consents as temporary may thus short-circuit debates about whether they set a precedent for permanent development.

5.5.3.2 Extending beyond 25 years

Solar panels are expected to be useful for significantly longer than 25 years. The replacement rates for panels at Pitworthy are expected to be 0.5% per year, so at the end of the 25-year period only 10% are likely to have been replaced.[212] In the developer's personal opinion, there is no need for the time-limit condition as it does not meet any of the six tests for conditions.[213] They stated that the solar farm 'is either in a good place or not, you're either granting permission or not and if you grant permission you shouldn't think of it as 25 years'[214] (Developer A, Pitworthy), suggesting that solar should be treated like most other forms of development rather than as temporary infrastructure. They also felt that 25 years is fairly permanent and if people were comfortable with the development they would not be concerned about it being permanent.[215] The life-extension letter states that the 'modification reflects the operational reality of a solar farm (or indeed any business) by providing operational certainty.'[216] However, this is a different operational reality than the original developer argued for in the first application. The life-extension application argues that the solar farm is 'anticipated to be able to function effectively over a longer period than the solar panel warranty period that may have influenced the original time-limit for the temporary permission.'[217] It also confirms that if part of the operation ceases to operate it can be

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[210]Interview with developer A Pitworthy, April 2018.
[211]Interview with developer B Pitworthy, April 2018.
[212]Interview with developer A Pitworthy, April 2018.
[213]The 6 tests for planning conditions are that it is 1.necessary, 2.relevant to planning, 3.relevant to the development to be permitted, 4.enforceable, 5.precise and 6.reasonable in all other respects. See Gov.UK Guidance: Use of planning conditions, para 003 Available at www.gov.UK/guidance/use-of-planningconditions (Accessed August 2019).
[214]Interview with developer A Pitworthy, April 2018.
[215]Interview with developer A Pitworthy, April 2018.
[216]Pitworthy life-extension application letter, 2017, 2.
[217]Pitworthy life-extension application letter, 2017, 2.

removed and that section of land will be restored while the remainder of the solar farm continues to operate, reflecting the use of a site as a complex space (see Bonta and Protevi 2004).

Significantly, the life-extension application stated that 'there is no government imposed limit on the lifetime of solar farms and the principal timeframe determinant for planning applications appears to be the individual whim of the developer and consultant submitting the application.'[218] This argument of developer whim appears to go against the reasons for justification. It is also worthy of consideration that the end of operation may occur due to a scheme becoming financially unviable. The application argued that a period of 40 years enables the development of a long-term investment strategy for the management of solar farms and helps to ensure that the panels are used productively. The delegated officer's report for the life-extension noted that there will be an ongoing need for renewable energy production and that targets will increase over the next 40 years,[219] suggesting that the LPA are considering a longer-term perspective.

5.5.3.3 The influence of duration on Planning Authority decision-making

Significantly, the LPA admitted that they are likely to agree with whatever duration the developer applies for or says is the useful lifetime of the solar farm, stating 'I don't think we really care how long they are, providing that at the end of their useful life they are removed because of their landscape impact'[220] (LPA, Pitworthy). Thus, while there does not appear to be a direct concern for landscape impact per se, there is balancing between the landscape impact and an active contribution to renewable energy generation, and in the absence of the latter, then the landscape impact becomes objectionable. A key temporal frame for the LPA appears to be the usefulness of technology, which is not easily known. They identified that 30-year time limits are typical but that recently they had received numerous applications to vary the duration of schemes from developers who claimed that they can achieve electricity generation for longer periods, often between 30-50 years.[221] In general, it appears that the LPA are not keen to introduce a break point in time that is disintegrated from the developer's preferences and reasoning, alignment is sought, albeit things change.

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[218]Pitworthy life-extension letter from applicant responding to representations, 2017, 3.
[219]Pitworthy life extension, delegated report, 2017.
[220]Interview with LPA Pitworthy, December 2018.
[221]Interview with LPA Pitworthy, December 2018.

5.5.3.4 Community considerations of duration

The representative from the local council felt that the increase in duration did not make a difference to local people as the solar farm was already there.[222] This is reflected in the lack of public response, suggesting that the duration of the infrastructures being is not a concern for local people once it is in place. However, Campaign for the Protection of Rural England (CPRE) Devon's objections to the life-extension centred on arguments of duration, stating that 'once it was approved we thought that was it, you know, 25 years and it be gone'[223] (Opposition group, Pitworthy), reflecting a promise of removal at a point in time. They argued that people consider 25 years as temporary, identifying that planning inspectors have said that 25 years can be considered temporary but anything beyond that cannot as it is more than one generation, (they did not provide evidence for this claim). From their perspective, the energy produced between the ages of 25-40 would be a lot less and may not outweigh the harm to the landscape and land.[224] Their perspective suggests some temporal factors linked to a net balance of gains and costs over time and a tipping point when this falls one way; however, what they appear not to have considered is that point would also be subject to various factors that could change throughout time (such as energy prices etc.). They speculated that the original permission would not have been granted if it was known from the outset that the duration would be longer and argued that the site would have insufficient benefit beyond 25-years. Setting precedence was a concern for the group as they did not want longer permission periods to become the norm. The timing of the application, shortly after the sites operation was also a reason for opposition, demonstrating the range of temporal concerns influencing opposition.

5.5.4 Strategies used

5.5.4.1 Developer's strategy for increasing the duration

The current nature of the industry makes life-extension applications likely due to the strategy of companies building then selling solar farms as assets. The original developer described their strategy as getting planning permission, securing grid access, and then selling shortly afterwards, referred to as 'pure-play development' (Developer B Pitworthy). They explained that they applied for a 25-year permission for

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[222]Interview with community Pitworthy, April 2018.
[223]Interview with opposition group Pitworthy, April 2018.
[224]Interview with opposition group Pitworthy, April 2018.

the site due to the feed-in tariff and as they were only confident that the business model would work for 25 years with government subsidies. They identified that applying for a time-limited period is likely to make it easier to get planning permission due to the benefits of providing flexibility for future land use or technology changes. Regarding Pitworthy, they discussed how challenges were overcome through ensuring relevant screening was planted and identified that the most difficult element was grid connection.[225] Links can thus be seen with the cases of St Breock and Windy Standard which similarly demonstrate how some of the more problematic issues are not the electricity generation facility in itself e.g. grid capacity and getting turbines onto site.

The current owner revealed that they are extending the life of all of the solar farm assets they own, some to 35 years and a majority to 40, depending on the precedent of the LPA. They disclosed that the decision regarding what timespan to apply for during a life-extension is made on a case-by-case basis by reviewing the history of permissions granted by the relevant LPA. They described how extending to 40-years avoids controversy while meeting investment needs, stating 'there is no logic in permanent if it is higher risk'[226] (Developer A, Pitworthy) (referring to the risk of not getting planning permission) and demonstrating the coming together of commercial and regulatory notions of time. A lot thus appears to depend on local precedent and custom, what has been tested locally, and what would not cause concern or produce a precedent in itself.

5.5.4.2 The promise of decommissioning

As seen in wind farm applications, ease of decommissioning and the reversibility of the site was a key argument used in both applications. The original application identified that the framework of the solar panels could facilitate easy decommissioning,[227] noting that the site would be able to quickly return to agricultural use after 25 years.[228] Moreover, grazing would enable the agricultural use to continue, in part, over the lifetime of the development. This narrative of easy decommissioning was further expressed in the life-extension application, which described how the structures could easily be disassembled and removed without heavy machinery.[229] The original

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[225]Interview with developer B Pitworthy, April 2018.
[226]Interview with developer A Pitworthy, April 2018.
[227]Pitworthy Design and Access Statement, 2012 (3.20) and Planning Statement, 2012 (3.3).
[228]Pitworthy Design and Access Statement, 2012, 3.5.
[229]Pitworthy life-extension application letter, 2017, 2.

committee report identified that 'the majority of works would be reversible,'[230] although not specifying what elements would not be reversible. The life-extension application reflected this, detailing how solar farms are constructed without creating material damage to the land and how forage and fodder grass is quick to regenerate following construction.[231]

The developer explained that decommissioning usually involves returning the land to its previous condition as assured by a survey undertaken before and after development,[232] thereby reflecting the idea of the infrastructure as 'reversible'. This relies upon a good survey of condition prior to development, i.e. to fix the condition at a point in time. The life-extension application proposed retaining safeguarding measures ensuring the removal of all structures associated with the solar farm when any part of it ceases to operate, providing reassurance that the land would be restored to 'undeveloped' farmland.[233] Such reassurance of eventual removal was a priority for the LPA. The developer stated that 'decommissioning is easy as everything has value'[234] (Developer, A, Pitworthy), suggesting that it is not a concern for them. Again we see a reliance on markets to resolve a future problem.

5.5.4.3 Strategy of opponents

The opposition group representative argued that once the solar farm was in existence, the development looked far worse than expected, describing it as 'a field of grey'[235] (Opposition group, Pitworthy), however then admitted to not having seen the site. Thus, opposition appears to have reflected the position of CPRE Devon as a group with particular interests rather than reflecting any concerns of the local community, 'It was just one of those things that we knew it was there and so we objected. I don't think we got involved with local community'[236] (Opposition group, Pitworthy). CPRE Devon admitted that there is often a lack of community involvement in opposition to solar farms as not many people are impacted, thus their group can be seen to reflect broader rural interests. Time can, therefore, be seen as just one dimension of extent for those opposed to renewable energy in rural areas more generally.

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[230] Pitworthy original committee report, 2013.
[231] Pitworthy life-extension application letter, 2017, 2.
[232] Interview with developer A Pitworthy, April 2018.
[233] Pitworthy life-extension application letter, 2017,1.
[234] Interview with developer A Pitworthy, April 2018.
[235] Interview with opposition group Pitworthy, April 2018.
[236] Interview with opposition group Pitworthy, April 2018.

5.5.5 The struggle (or lack of) to find a working fixity

In this case, the life-extension was relatively uncontroversial. Regarding LPA decision-making, it appears that the application was relatively straight forward to approve. The delegated report identified that 'in the absence of any clear overriding environmental concerns relating to the solar farm since its construction there are no substantive grounds to refuse the application', noting that the application increased the timescale but kept the safeguarding measures in place.[237] The increase in duration thus appeared to raise little, if any, concern. The LPA identified that if in the future a solar farm wanted to renew its permission, they would find it difficult to say no as long as it is acceptable in terms of landscape and visual impact. What matters more to the LPA is that solar farms are removed (and thus the landscape impact is removed) at the end of their 'useful life', rather than the exact length of their duration.[238]

5.5.6 Conclusion

This case reflects the different temporal considerations influencing solar energy. There are elements of solar farms that reflect the considerations and challenges facing the wind sector, particularly in terms of using time-limited consents to provide less risk for the application. However, there are also evident differences in how the duration of this infrastructure is considered and regulated, as is discussed in chapter 7. The application faced little challenge, suggesting that for this site, the exact duration of the infrastructure's being may not be a significant concern for those living with it or for those responsible for regulation as long as eventual removal is ensured i.e., the site has the option of changing in the future. While this case highlights the development of arguments challenging the use of temporary consents, the assurances provided by temporary consents (ensuring eventual removal) have held sway.

5.6 Chapter Conclusion

The above cases (summarised in table 13 below) reveal the different ways in which a multitude of changes have impacted the duration, context, and end-of-life decision-making for sites i.e. through processes of smoothing and striation they have shaped

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[237]Pitworthy life extension, delegated report, 2017.
[238]Interview with developer A Pitworthy, April 2018.

what sites become. They reveal the different temporal considerations of various groups of actors, and how they have been pulled together in decisions. In uncovering how certain interests, particularly of developers, shape end-of-life decision-making they reveal the wider consequences of how the temporalities of the infrastructure are regulated, something that is discussed further in chapter 7. While there are differences between cases in terms of the impact of different changes over time and the different ways that they have influenced and been considered in end-of-life decision-making, there are several important insights from this chapter, that will be developed further in the discussion chapter:

i) Numerous elements change over time impacting end-of-life decision-making, in particular, economic changes including subsidy regimes, the policy environment, and physical changes in the surrounding landscape, including those precipitated by the energy projects themselves.

ii) Different temporal concerns and changes in site context can be seen to mobilise the actions of different groups of actors.

iii) Particular features of original consents can become points of contention downstream, e.g. poor decommissioning, reflecting a failure of planning to anticipate potential futures.

iv) The focal point of baselines, evidently seen differently between the cases, is something that shapes what people feel has, and should become of, an energy landscape.

v) Overall, developer calculations of technical and economic options tend to dominate end-of-life decisions.

There are differences in the way actors prepare and plan for the end-of-life of wind and solar facilities (including what end-of-life factors matter and the timeframes that are sought and invoked). The main concern for LPA decision-makers is often ensuring that the infrastructure will be removed at the end of its operational life, rather than the duration of its being per se, reflecting broader concerns of government policymakers. Meanwhile, developers’ strategies are often striated by economic factors. The impact of various changes and whose preferences are most significantly shaping end-of-life decision-making are discussed in chapter 7.

The findings reveal how the physical extent of visual impacts appear to be more of a concern to publics than temporal dimensions. It appears that, for some, an end-of-life application raises awareness of the time-limited nature of a scheme, providing an unexpected opportunity to influence its future. This is something that is explored more closely in the following chapter. While the case studies provide an overview of community responses to end-of-life applications, this reflects the perspectives of those willing to speak in interview which is often the opposition group, those firmly in favour of a scheme or community representatives. There is thus a need for greater insight regarding how local people consider duration. In order to understand how a range of community members, including those who were not active in opposing or supporting a wind farm, considered end-of-life applications and the duration of sites, chapter 6 presents a comparative analysis of the results of two surveys undertaken with communities living in close proximity to two of the wind farms.

Table 13: Key case study characteristics

	Original consent duration	Type of end-of-life application	Successful?	Consideration of decommissioning	Key developer challenges
St Breock	No consent duration	Repowering	Yes (implemented)	Lack of decommissioning consideration in original permission, conditions added to repowering.	Accessing land, grid capacity and selling old turbines.
Taff Ely	No consent duration	Repowering	Yes (not implemented)	Lack of knowledge of decommissioning consideration in original permission, conditions added to repowering.	Deciding between implementing the repowering consent or continuing to operate the existing wind farm.
Kirkby Moor	25 years	Repowering and life-extension	Both refused. Life-extension granted at appeal.	Original permission required removal of turbines not associated infrastructure. Life-extension captured full decommissioning.	Public opposition. Lack of policy for repowering and life-extension.
Windy Standard (phase i)	25 years	Life-extension	Yes	Decommissioning captured in conditions.	Lack of challenge for life-extension.
Pitworthy	25 years	Life-extension	Yes	Decommissioning captured in conditions.	Lack of challenge for life-extension.

Chapter 6: exploring public perceptions of the duration of wind farm sites

6.1 Introduction

The findings from the case study research identified a need for a more detailed understanding of how publics consider the duration of schemes and how and why they respond to end-of-life applications in order to understand how their perspectives may be reflected in outcomes. Such a gap was also evident from the literature review which lacked consideration of how the public consider the duration or end-of-life of energy infrastructure i.e., if they consider wind farms as permanent or as a temporary use of a site that may become something else in the future. This chapter seeks to understand if temporariness and the way it is considered by actors in the planning process is shared among wider publics. This is important, not least because public support is often invoked in justification but without evidence.

Two locations were selected for this stage of the research, Kirkby Moor and St Breock (see chapter 5 for case histories). They were chosen in order to explore both an area that faced strong opposition during repowering, in terms of formal responses sent to the Local Planning Authority (LPA) (Kirkby Moor), alongside an area that experienced local support and a relative lack of controversy (St Breock). The two cases offer an opportunity to explore different experiences and temporal aspects. St Breock enables exploration of a site that has been repowered, facilitating investigation of how perceptions may have changed after the repowered scheme was built. Meanwhile, Kirkby Moor facilitates exploration of an application that faced significant public objection and two refused applications to increase its duration, providing an opportunity to investigate how and why local perceptions may have changed and if people reacted differently to the repowering and life-extension applications.

This chapter presents and discusses the survey responses for each location in turn. Firstly, it provides an overview of respondent characteristics. Place attachment values are then discussed in order to understand if attachment to the local area appears to influence considerations of whether the area is suitable for the continuation of wind energy generation. Consideration of such values were included as existing literature has identified place attachment as having a significant influence on perceptions of energy infrastructure (see, for example, Devine-Wright and Howes 2010). The chapter then compares perceptions of the original wind farm before and after construction (if residents were living in the area at that time), doing so facilitates consideration of the U-shaped curve hypothesis that perceptions of the infrastructure will often improve after construction (Wolsink 1989; Gipe 1995; Wolsink 2007b). In both locations perceptions of the repowering application are provided, with the St Breock survey exploring the issues that the operational (original and repowered) schemes raised, how people reacted to them, and if they had a preference. Meanwhile, the Kirkby Moor survey provides perceptions of the life-extension application. In both cases, levels of awareness of the time-limited planning period are discussed alongside potentially more fundamental issues regarding interpretation of the period and expectations on expiry (significant considerations missing from existing literature). Finally, perceptions of the developer, perceived benefits of the wind farm, and height of the turbines are presented. Such factors have been identified as significant in existing wind farm research, see for example, Firestone et al. (2018) for the importance of community-developer relations, Aitken (2010b) and Cowell et al. (2011) for the role of community benefits, and Warren et al. (2005) for the importance of the visual impact of turbines. The question here is do they also help explain attitudes to end-of-life decisions?

The survey results are presented through descriptive statistics and the use of Spearman's Rank Correlation Coefficients and Mann-Whitney U tests to test relationships. Some survey questions provided opportunities for respondents to expand on their answers, such comments have been analysed and summarised within the chapter.

6.2 Kirkby Moor survey

6.2.1 Kirkby moor participant overview

In Kirkby Moor 430 questionnaires were delivered and 128 complete responses were received, reflecting a 29.8% response rate. Additionally, three partial but almost complete responses were received and included in the analysis.

The following bar chart shows the age of respondents. Significantly, most respondents (79.4%) were aged 50 or over. As 61% of residents in the Kirkby-in-Furness (LA17) postcode area are aged over 45,[239] the respondent population is slightly skewed towards those aged 50 or over.

Figure 22: Age of participants, Kirkby Moor

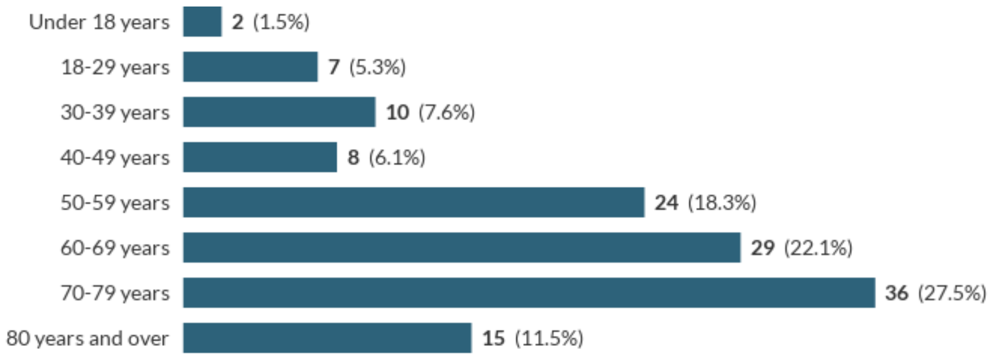


Figure 23 reveals how often people see the wind farm. 95.4% of respondents see the wind farm either every day or most days, demonstrating a high degree of familiarity and experience with the visual impacts of the scheme as part of everyday life.

Figure 23: How often participants see the wind farm, Kirkby Moor

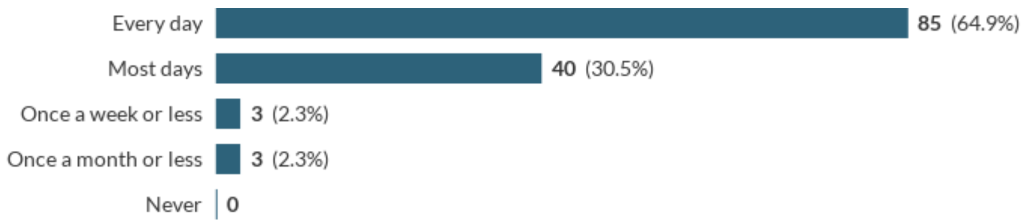
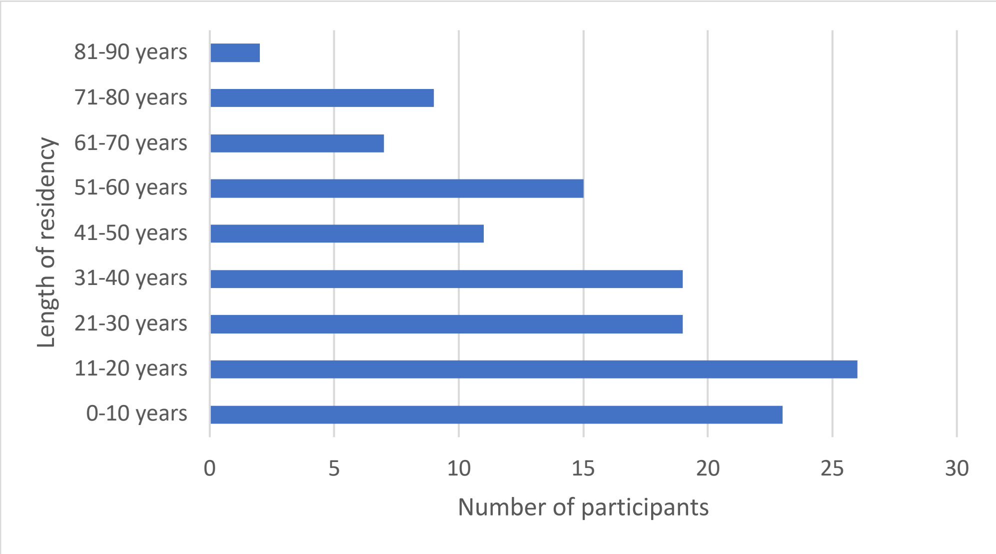


Figure 24 provides an overview of how long respondents have lived in the area. As the existing wind farm was still in operation at the time of the research, all respondents had experience of living with it. At the time of the research the wind farm was almost 25 years old, 53% of respondents identified having lived in the area for 26 years or longer and thus are expected to have experience (of varying durations) with the site pre-operational windfarm.

[239] Based on 2011 UK Census, see www.streetcheck.co.uk.

Figure 24: Length of participant residency in area, Kirkby Moor



Mapping respondent's postcodes enabled an insight into who replied (figure 25) which can be compared to the boundary in which the surveys were distributed (figure 26), revealing a spread of respondents from most residential locations. Unsurprisingly, the majority are from the largest settlement, Kirkby-in-Furness. Two respondents came from outside but very close to the boundary, which is likely to have been a result of human error in delivering to a property outside of the postcode area. Due to their proximity the responses were included.

Figure 25: Distribution of survey respondents, Kirkby Moor

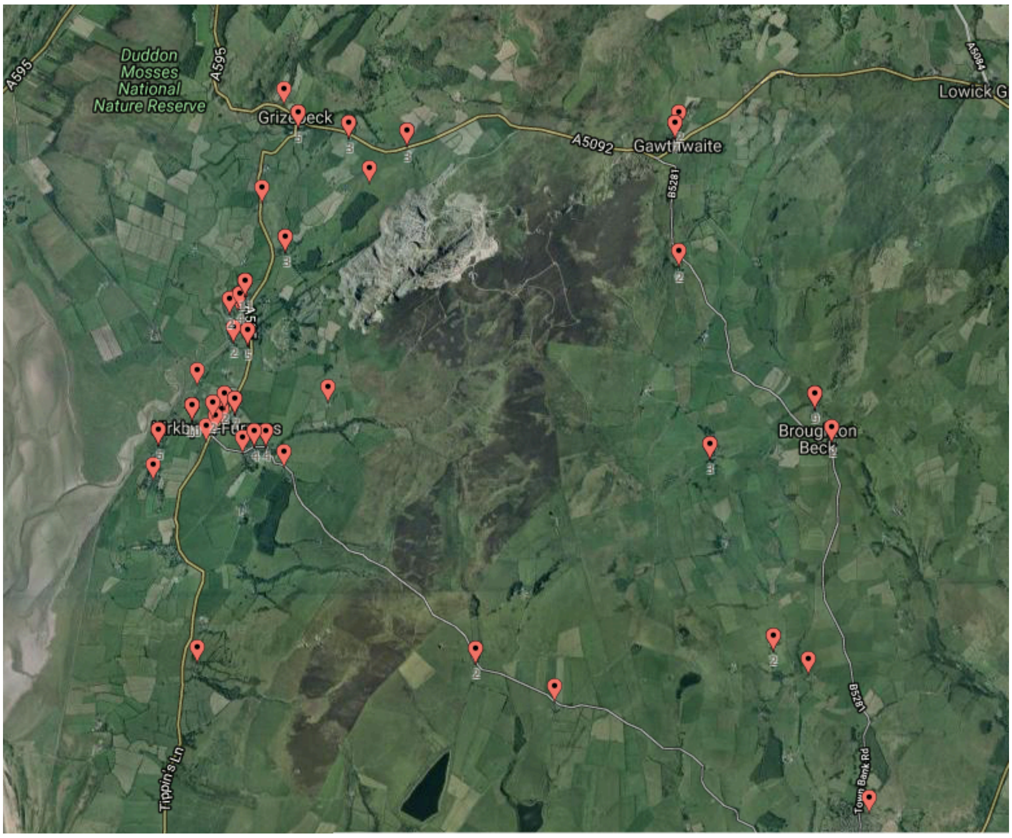
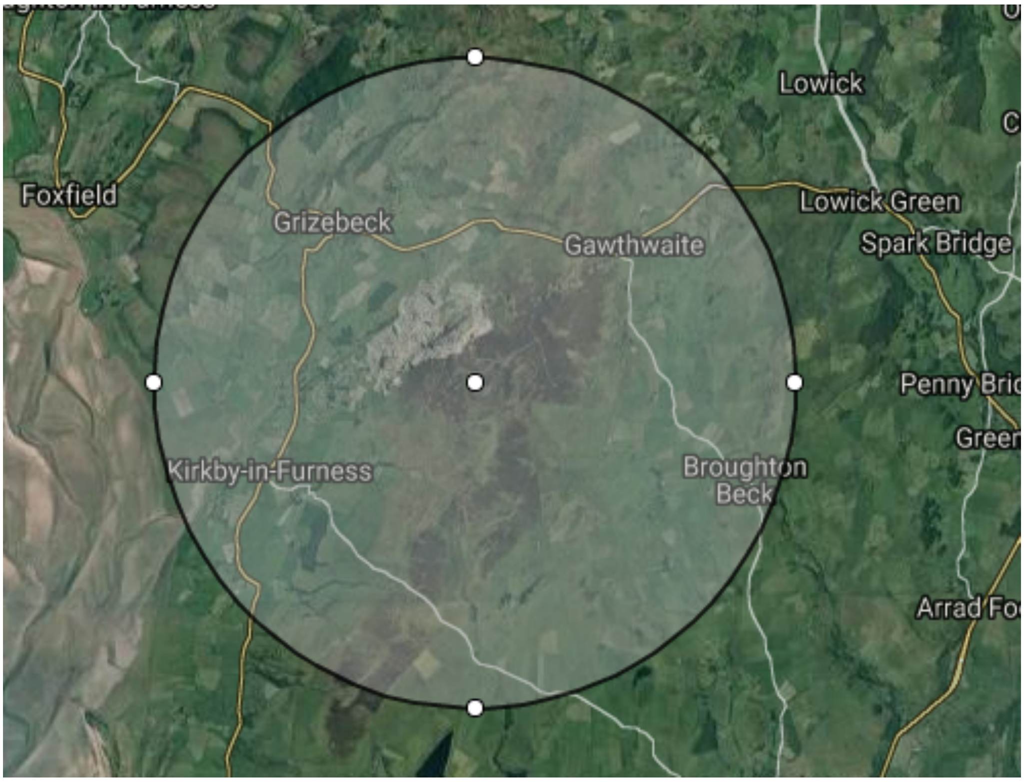


Figure 26: 3.5KM boundary in which surveys were administered, Kirkby Moor



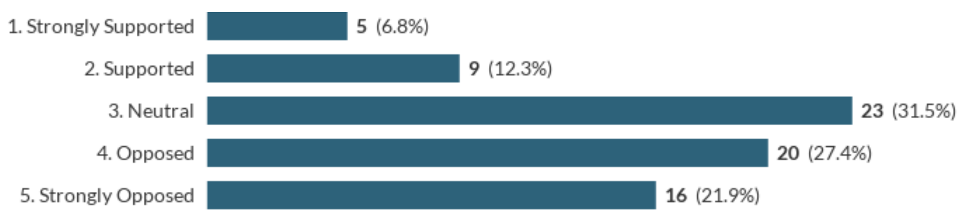
6.2.2 Place attachment in Kirkby Moor

Existing research identified place attachment i.e., the relationships that people form with a particular location, as a central reason influencing community responses to proposals for renewable energy infrastructure (Haggett 2011), leading to what has been termed 'place protective action' (Devine-Wright 2009b). It has been identified that a person's attachment to place can influence their response to the visual impact of wind farms (Wolsink 2018a). In this context, there was a need to investigate if respondents' attachment to their local area influenced their perception of the suitability of continuing wind energy development in that area. In order to explore this, the survey contained seven Likert Scale questions to understand respondent's level of place attachment. The results revealed very high levels of agreement across all place attachment indicators (see appendix G). The analysis then aimed to understand if such high levels of place attachment influenced perceptions of end-of-life applications. Spearman's correlations[240] were run to see if there was a correlation between place attachment and perceptions of repowering or life-extension, however in both cases the results showed very weak, insignificant, correlation, thus demonstrating that place attachment does not appear to significantly influence opposition to end-of-life applications for the continued use of the site as a wind farm in Kirkby Moor.

6.2.3 Perceptions of the original wind farm in Kirkby Moor

6.2.3.1 Perceptions of the original Kirkby Moor wind farm before it was built

Figure 27: Perceptions of the original Kirkby Moor wind farm before it was built

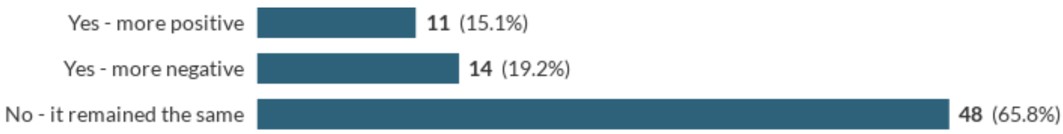


[240]In order to be included in a statistical analysis the number of factors was firstly reduced through the use of a principle component analysis (PCA). PCA is used to reduce data through identifying strong intercorrelations (Dunteman,1989). The analysis identified one component to be used 'this place is special to me' (see appendix H for calculation results).

44.3% of respondents recalled living in the area at the time of the original planning application and thus were eligible to provide their recalled perception of the wind farm before it was built. A high percentage (31.5%) of these respondents recalled their perception as neutral, only 19.1% supported the wind farm before it was built and 49.3% opposed or strongly opposed. The main recalled reasons for support included support for renewable energy, testing wind energy, and employment. Negative comments fell into the categories of visual and landscape impacts, impacts on wildlife, lack of local benefit, noise, anti-climate change mitigation, and comments objecting to wind as an energy source.

6.2.3.2 Change in perception following construction of the original Kirkby Moor wind farm

Figure 28: Change in perception following construction of the original Kirkby Moor wind farm

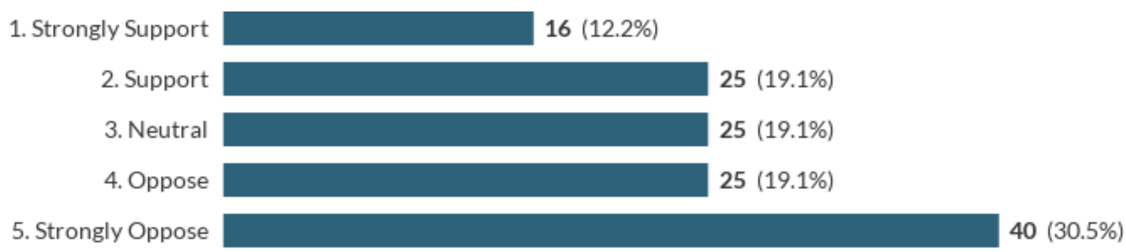


Existing literature suggests that people's attitudes become more positive following the construction of a development (see, for example, the commonly discussed U-shaped curve in Wolsink 2007b). However, the findings demonstrate that for many (65.8%), perceptions of the existing wind farm (of those who were living in the area before it was built) remained unchanged over time, suggesting that familiarity does not always lead to more positive relationships with the infrastructure as has been suggested in studies such as Warren et al. (2005) and Wheeler (2017). The findings demonstrate that projects that have had a contested birth may find that oppositional attitudes alter little over time, adding support to the argument of Devine-Wright (2005) that an increase in positive perceptions are context dependent and cannot be assumed to occur for every site.

34.3% of perceptions did change following construction of the wind farm, split evenly between those becoming more positive or more negative, perhaps reflecting a limitation to the ability to predict and anticipate the future. Those stating that their perception became more positive identified that the visual or noise impact was not as bad as expected. Reasons for a more negative response included visual impact, noise, traffic impacts, perceived inefficiency, damage to the moor, and objections to wind energy. Some comments reflected broader temporal impacts including that Kirkby moor ‘opened the door’ to other windfarms including offshore and identifying ‘broken promises to remove them after contract.’ Although the removal of all elements of the infrastructure was not conditioned, respondents identified removal as an implied promise. This reflects existing literature describing planning as a promise for the future with the potential to break down (see Abram and Weszkalnys 2011), here we see the consequences for public attitudes.

6.2.4 Perceptions of the operational Kirkby Moor wind farm

Figure 29: Perceptions of the existing operational Kirkby Moor wind farm



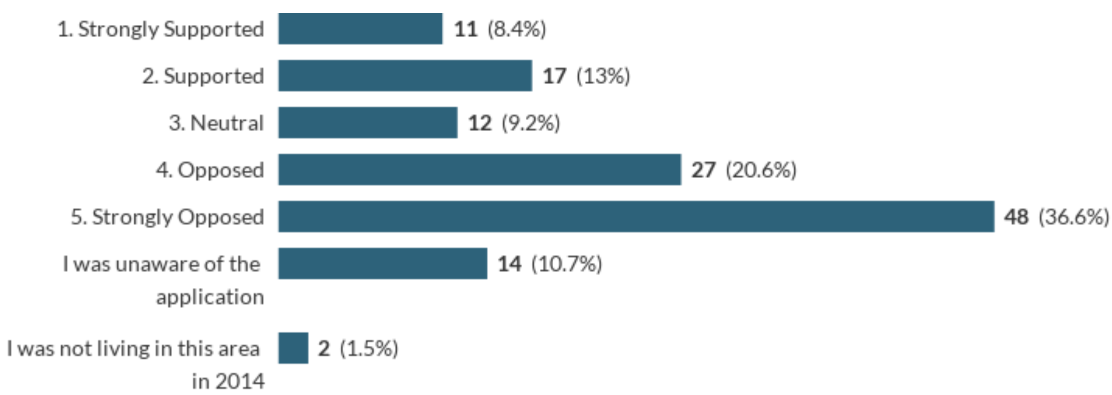
Almost half of all respondents (49.6%) identified that they are opposed to the existing wind farm, while only 31.3% identified that they support it. The most commonly identified positive impact of the wind farm was money provided to local causes, although many people stated that they did not know much about it, that it was a small amount or linked it to bribery.[241] Generation of renewable energy and provision of walking routes were other common reasons for support. Meanwhile, the most common negative impact was visual impact, while the second most common was noise. Longer-term or temporal considerations were rarely mentioned except for a small number of respondents who stated that it had led to more wind farms in the area. While the above question included all respondents, it is noteworthy that the percentage of people who oppose or strongly oppose the existing windfarm is almost identical to the percentage that had lived in the area since before the wind farm and recalled being opposed or strongly opposed to the wind farm before it was built (49.3%). These findings add strength to the fact that levels of opposition appear not to have changed over time.

[241] In the Kirkby Moor repowering consultation report (2014), the developer stated that they had contributed over £21,000 to community projects since 2008.

6.2.5 Perceptions of repowering and life-extension in Kirkby Moor

6.2.5.1 Perceptions of repowering in Kirkby Moor

Figure 30: Perceptions of the repowering application in Kirkby Moor

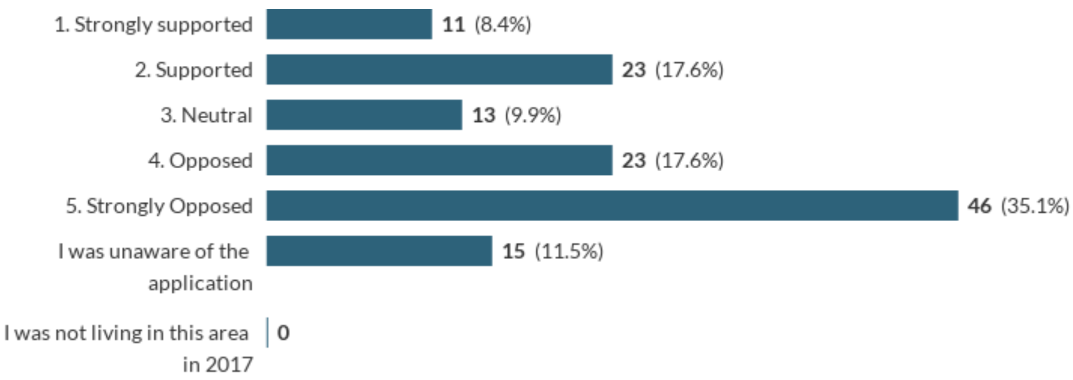


The repowering application generated significant reaction with only 9.2% identifying their position as neutral, this contrasts with the high number of neutral responses to the original wind farm before it was built, reflecting lived experience with the wind farm over time. Over half of respondents (57.2%) opposed or strongly opposed the repowering application. Significantly, the most common reasons for opposition included the increase in height but also the desired removal in accordance with the 25-year agreement, alongside the knowledge that the wind farm was a ‘trial’, suggesting that many local people desired this infrastructure to be temporary. The most common reasoning given for opposition thus involve the impacts of repowering and perceptions of planning agreements having been made and broken, suggesting that for many there is no acceptance of the kind of positive trade-offs that were used to help justify the repowering. While end-of-life provides a smoothing of space and thus scope for a new agreement between planners, developers, and to some extent the community, it is evident that many local people desired the removal of all striations created by the existing wind farm rather than a new agreement.

Only 21.4% supported or strongly supported the repowering application, with the most common reason being support for renewables. There was limited consideration of temporal impacts, reflected in comments identifying that they had become used to the wind farm, a lack of perceived negative impacts from the existing wind farm, or that there was no benefit in removing it, particularly as the infrastructure was in place. Such respondents thus appeared to support the continuity of wind power in the location, for these, a minority of respondents, it had come to fit.

6.2.5.2 Perceptions of life-extension in Kirkby Moor

Figure 31: Perceptions of the life-extension application in Kirkby Moor



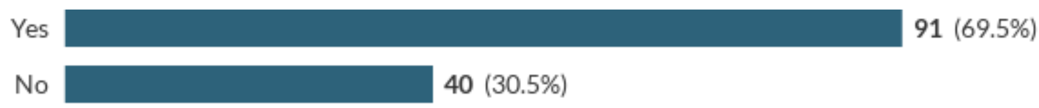
Similar to the repowering application, over half of respondents opposed the life-extension application (52.7%). Significantly, the majority of negative comments identified that the original wind farm was for a 25-year period as a 'trial' to test wind energy and thus should be removed, reflecting one of the most common reasons for opposition to the repowering. Again, this suggests temporal preferences for the infrastructure as a 'temporary' development and ignores the idea of a trial as leaving open various potentials.

26% supported or strongly supported the life-extension. The most common reasons for support were different from repowering as they identified the benefit of getting maximum life from existing infrastructure and not seeing harm from the existing site. Others mentioned the decommissioning provision that all infrastructure would be removed afterwards and the consequential benefits for the moor i.e. it brings some degree of certainty for the future. Such comments reflect longer-term considerations of the future of the site i.e., that the moor would be in a better condition in the long-term if the application was granted.

Spearman's correlation tests were run to see if there was a relationship between length of residency or age of respondents and opinions of the repowering or life-extension applications, however there were no statistically significant relationships. This suggests that opinions do not necessarily change over time with length of residency in the area or with age.

6.2.6 Awareness of the 25-year planning consent in Kirkby Moor

Figure 32: Responses to the question 'were you aware that the original planning permission for Kirkby Moor wind farm was for a temporary period of 25-years?'



The majority of respondents (69.5%) were aware of the time-limited nature of the planning consent which is likely to be reflective of the high level of publicity of the repowering and life-extension schemes in local press, consultations, and by local opposition groups. Such awareness did not correlate with factors such as age or length of residency. Many comments identified frustration with the continuation of the wind farm and a clear feeling that it had not become part of the local area. For some continuation was considered a broken promise, '25 years is long enough', 'temporary should mean temporary'. For others, comments implied a desired sharing of the impacts, 'time they were dismantled, restore lake district environment'. Other comments reflected the idea that a past burden should imply no future extension, 'so why are they still there? Why weren't contingency plans to remove enforced?' 30.5% were not aware of the 25-year consent. Comments reflecting this position included a lack of knowledge of the application such as 'it was all done quietly' and 'I assumed it was permanent like other planning permissions', and also reflected a lack of trust in the wind farm developer. Others identified that they only became aware of the 25-year duration during the repowering application.

Participants were asked if they agreed with the statement '25 years is a temporary period.' 37% agreed, 31% were neutral, and 32% disagreed. Comments left on the side of questionnaires suggested that this was a difficult question for respondents to answer, as reflected in the high number of neutral positions. This raises questions regarding the suitability of describing such consents as 'temporary' and may support the use of a 'time-limited' descriptor instead.

A Spearman's correlation indicated that there was a strong positive correlation between the statement 'I would support wind farms having permanent planning permission'[242] and support for the existing wind farm (r(127)= .716 p=0.00), (significant at the 0.01 level), demonstrating that those who support the existing wind farm are likely to be more supportive of the continuation of the site for this use. Additionally, participants responded to the statement 'I would like the Kirkby Moor site to be returned to moor land as soon as possible', 57% agreed or strongly agreed with this statement, 19% were neutral, and 24% disagreed or strongly disagreed, reflecting the high levels of opposition to the site.

6.2.6.1 Summary of key insights from Kirkby Moor

Kirkby Moor reflects a site where opposition to the original wind farm was high and negative perceptions appear not to have changed significantly over the duration of the site. It also reflects high levels of preference for the infrastructure to be a 'temporary' development. End-of-life applications can be seen to have generated significant reactions and high levels of opposition, with a central argument being a desire for removal in accordance with the 25-year planning agreement. The results revealed a high level of awareness of both the duration of the original consent and the description in the inspector's report of the scheme as a trial to test wind energy, demonstrating how elements of the original consent can be deferred and return to the foreground in end-of-life decision-making.

6.3 St Breock survey

6.3.1 St Breock participant overview

In St Breock 280 questionnaires were delivered and 74 complete responses were received, reflecting a 26% response rate. Two partial responses were also included.

Figure 33 shows the age of respondents. Over half of the respondents (52.6%) were aged 60-79. This is generally in line with the older demographics of St Breock.[243] However, significantly, no respondents were aged 29 or younger, perhaps due to only one survey being delivered to each household and the tendency for a head of household to reply.

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[242]See appendix H for PCA calculation table.
[243]2011 census, see Wadebridge Area Neighbourhood Plan - Evidence Report.

Figure 33: Age of participants, St Breock

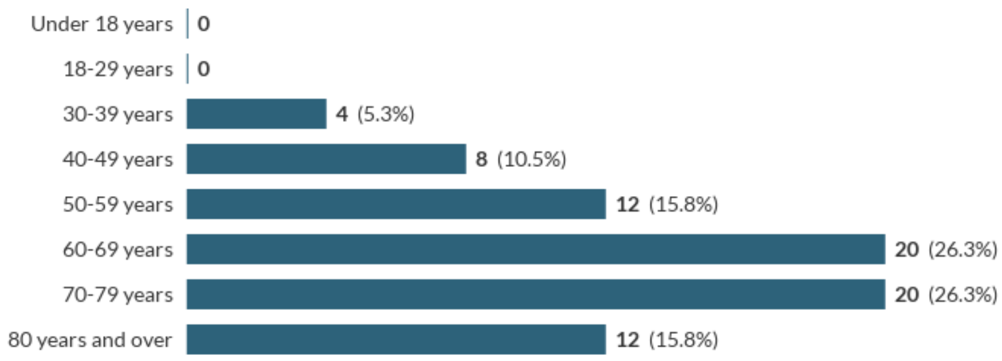


Figure 34 shows how often people see the wind farm. 82.9% of respondents see the wind farm either every day or most days, reflecting a high level of familiarity with the repowered scheme.

Figure 34: How often participants see the wind farm, St Breock

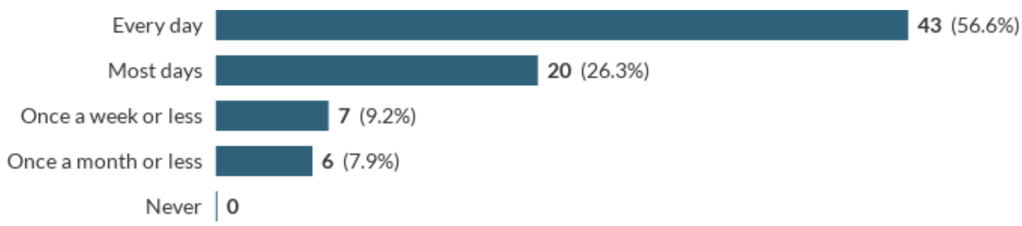
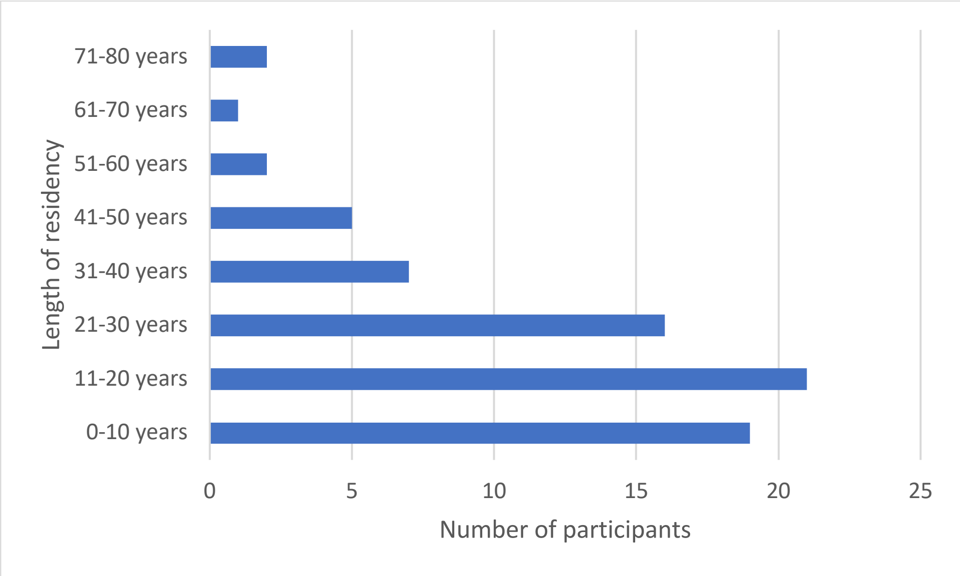


Figure 35 shows how long respondents have lived in the area. The repowered site was operational during the time of research, so all respondents would be familiar with it. Only 10.5% of respondents had lived in the area for five years or less and thus are not expected to be familiar with the 2012 planning application for the repowered wind farm.

Figure 35: Length of participants residency in area, St Breock



As is evident from figures 36 and 37, only residents within the 3.5km boundary responded to the survey, with the largest number of respondents coming from the main settlements.

Figure 36: Distribution of survey respondents, St Breock

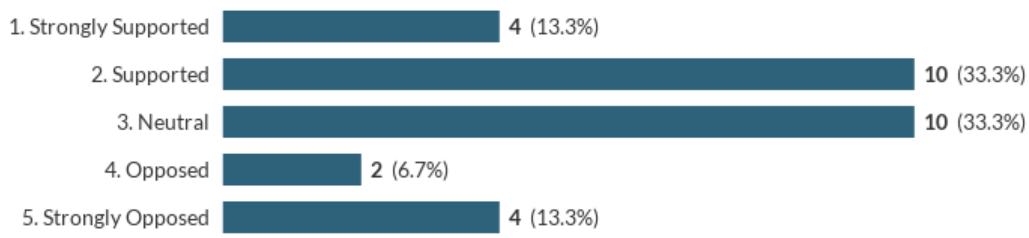
Figure 37: 3.5KM boundary in which surveys were administered, St Breock

6.3.2 Place attachment in St Breock

Seven Likert Scale questions were used to understand respondents' levels of place attachment. The results revealed very high levels of agreement across all place attachment indicators (see appendix G). The results of a Spearman's correlation test[244] revealed no significant correlation between place attachment and the dependent variable of response to the repowering application. Like Kirkby Moor, the findings suggest that in this case place attachment did not have a substantial influence on response to repowering.

6.3.3 Perceptions of the original St Breock wind farm before it was built

Figure 38: Perceptions of the original St Breock wind farm before it was built

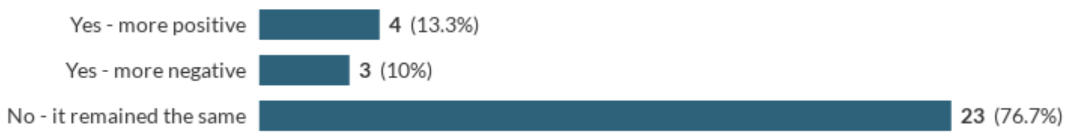


39.5% of respondents were living in the area at the time of the original planning application. Of those respondents, 46.6% recalled supporting or strongly supporting the wind farm before it was built, 33.3% were neutral, and 20% opposed or strongly opposed. The wind farm thus faced substantially less opposition before development than Kirkby Moor. The most common reason for support was support for renewable energy. Reasons for opposition included landscape impact, a perception that they were not economically viable, and preferences for other renewables.

[244] In order to be included in a statistical analysis the number of factors was firstly reduced through the use of a principle component analysis (PCA). The analysis identified one component to be used 'I am very attached to this place' (see appendix G for calculation results).

6.3.3.1 Change in perceptions following construction of the original St Breock wind farm

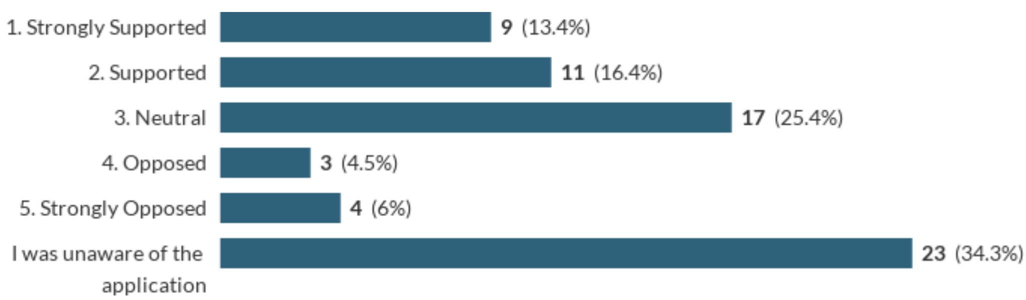
Figure 39: Change in perceptions following construction of the original St Breock wind farm



Despite being one of the first UK wind farms (generating since 1994) the majority (76.7%) of those who had lived in the area before the original wind farm was built identified that their perception remained the same following construction. 13.3% stated that their perception became more positive and only 10% stated that their perception became more negative. As with Kirkby Moor, these findings are based on recalled perceptions, but they can be seen to contrast with the U-shape curve hypothesis (see Wolsink 2007b and the conclusion of this chapter).

6.3.4 Perceptions of repowering in St Breock

Figure 40: Perceptions of the repowering application in St Breock



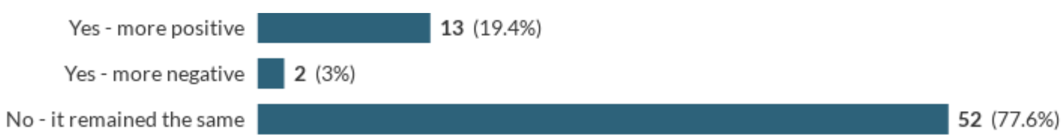
88.2 % of respondents lived in the area at the time of the repowering application and were thus eligible to provide their perception of the application. A large percentage (34.3%) of residents living within 3.5km of the site were unaware of the application. This is likely to be reflective of the lack of opposition to the previous wind farm and the lack of formal opposition to the repowering application. This lack of controversy and debate surrounding the application is also reflected in 25.4% of respondents identifying their perception as neutral. Such findings suggest that a lot of local residents were not especially concerned about repowering and that for many, changes do not register. Moreover, in comparison to Kirkby Moor there was no sense of having been promised something as the original consent was granted without a time limit.

29.8% supported or strongly supported the application, with the most common reasons including support for renewables or wind energy, familiarity, lack of negative impacts from the existing turbines, and decreased number of turbines. Notably, only 10.5% identified that they opposed or strongly opposed the repowering application. As with Kirkby Moor, the main reasons for opposition included the height and visual impact of the turbines and temporal considerations were not mentioned.

Spearman's correlation tests were run to see if there was a relationship between length of residency or age of respondents and opinions of the repowering (both before and after construction), however this produced no statistically significant relationships. As with Kirkby Moor this suggests that opinion change is not directly correlated with age or length of residency.

6.3.4.1 Change in perception following construction of the repowered wind farm, St Breock

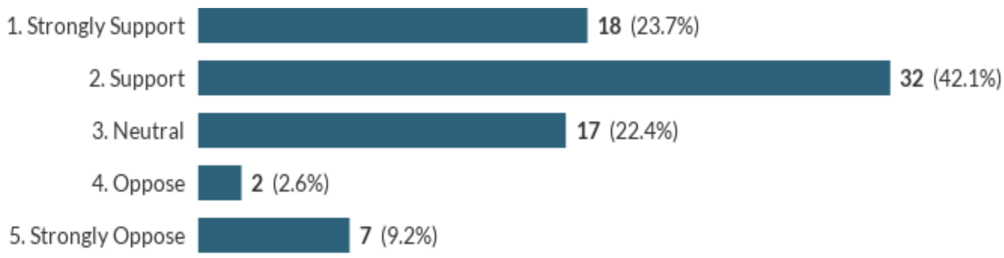
Figure 41: Change in perception following construction of the repowered St Breock wind farm



The majority of respondents (77.6%) stated that their perception remained the same following construction of the repowered wind farm, echoing the findings above suggesting that perceptions of wind farms often do not change with the passage of time following construction. 19.4% of respondents stated that their perception became more positive with reasons including lower visual and noise impacts than the previous scheme or their expectations. Only 3% stated that their perception became more negative after the building of the repowered wind farm, identifying the height of the turbines as the reason. Visibility thus appears to be a common influence on perceptions of repowering schemes, while again duration was not mentioned.

6.3.5 Perceptions of the repowered wind farm in St Breock

Figure 42: Perceptions of the repowered St Breock wind farm



65.8% support or strongly support the repowered wind farm, 22.4% are neutral, and only 11.8% oppose or strongly oppose. The most common positive identified impacts of the wind farm included the community fund and projects it has supported, (however many identified issues with the funding distributor), environmental benefits, and lower visual impact than the previous scheme. Once again, the most common identified negative impacts were the visual and landscape impacts, reinforcing the significance of visual scale rather than temporal concerns for local communities.

6.3.6 Preference for the repowered or original wind farm in St Breock

A question asked participants that had been living in the area during the time that the original scheme was operating if they preferred the original or repowered wind farm. This question did not apply to 34.2% of respondents. Of the eligible respondents, 50% did not have a preference. 42% preferred the repowered scheme with the most common reasons including the decrease in number of turbines and lower visual or landscape impacts. Only 8% preferred the original wind farm with the reason being the visual impact on their property. Again visual impact appeared as a key influencing factor on perceptions.

6.3.7 Awareness and perception of the 25-year planning consent in St Breock

Figure 43: Responses to the question 'are you aware that the planning permission for the repowered St Breock wind farm is for a temporary period of 25-years?'

In St Breock the original consent was granted in perpetuity, but the repowering was granted for a period of 25 years. A large majority of participants (82.9%) were not aware of the 25-year consent duration for the repowered scheme. Only 17.1% were aware, with reasons for awareness including attending the local presentation and reading planning documents. This is reflective of the above findings, suggesting that duration does not appear to be a key consideration for local residents.

Participants were asked if they agreed with the statement '25 years is a temporary period.' The majority (49%) were neutral with 40% agreeing and only 11% disagreeing. As with Kirkby Moor this suggests that people have difficulties in considering what a 'temporary' period should constitute. Additionally, participants responded to the statement 'I would like the St Breock site to be returned to farmland as soon as possible', 20% agreed or strongly agreed with this statement, 29% were neutral, and notably 51% disagreed or strongly disagreed. Here, a large proportion are happy for the site to continue as a wind farm, reflecting the lack of opposition to the site and that this is not mediated by potential duration – they accept that the site has 'become a wind farm' and will continue to be so.

A Mann-Whitney U test was run to determine if there was any difference in perceptions of the repowered wind farm between those who were aware that planning permission for the repowered site is for a period of 25-years and those who were not aware. Opposition to the repowered wind farm from those with no awareness of the time-limited planning period (median =40.92) was higher than those who were aware of the time-limited planning period (median =26.77). The Mann-Whitney U test indicated that this difference was statistically significant U (N=63, N=13) =257.000, $P<0.27$. Thus, while duration is not a central factor influencing perceptions of a site, for some, the time-limited nature of repowering positively impacted perceptions. This raises questions regarding how developers might tactically manage the time-limited nature of proposals and consents. In effect, time-limiting facilitates more positive acceptance, but can perhaps be interpreted as a ‘promise’ of what follows at the end of that period (see Abram and Weszkalnys 2011 and the Kirkby Moor findings), so, all implies a very careful managing of the future and that time can be played as a means of inhibiting opposition. One might say that developers are content to hand over some control over the future if that enables them to gain consent swiftly, in order to start earning a sufficient return.

6.3.8 Summary of key insights from St Breock

St Breock is different from Kirkby Moor in that the original permission did not face significant opposition and was not time-limited. The lack of controversy surrounding the site is reflected in the high number of respondents that were unaware of the repowering application as well as the high levels of support for the repowered site. This case provided the opportunity to understand the preferences of those who had experience of both the repowered and original site, revealing significantly higher levels of preference for the repowered site. The duration of the site did not appear to be a central concern for most respondents with the majority of participants not being aware of the 25-year time-limit of the repowered scheme.

6.4 Explanatory factors

An understanding of people’s perceptions of the benefits of wind farms, the developer, and the height of turbines provides insights that help in understanding their perceptions of the duration of schemes and end-of-life applications. It also reveals the benefits of considering these factors over the duration of the site rather than just during the planning stages. The following section compares the influence of these factors for both cases.

6.4.1 Perceived benefits of wind farms

The benefits that people recognise from wind farms may influence their reaction to an end-of-life application. In the case of Kirkby Moor, results of a Spearman’s correlation indicated that there was a strong positive correlation between perceived benefits of the wind farm[245] and perceptions of the existing wind farm (r(127)= .646 p=0.00). They also indicated that there was a weak positive correlation between perceived benefits of wind farms and response to the repowering application (r(127)= .273 p=0.02) and a weak positive correlation between perceived benefits of wind farms and response to the life-extension application (r(127)= .363 p=0.00). (All significant at the 0.01 level). In the case of St Breock, results of the Spearman's correlation[246] indicated that there was a moderate positive correlation between perceived benefits of the wind farm and those supporting the repowered wind farm (r(74)= .471 p=0.00). (Significant at the 0.01 level). The above shows the importance of communities being able to recognise the benefits that the wind farm has provided over its life in order to increase support for both the existing site and continuation of a site as a wind farm.

6.4.2 Relationship with developers

Public comments (both in interview, submitted to the LPA, and in the survey) identified poor relations with the developer in Kirkby Moor as a contributing reason for opposition to end-of-life applications. Such attitudes are reflected in perceptions of the interests of wind farm developers more generally. 62% of respondents disagreed or strongly disagreed with the statement 'wind farm developers care about the opinion of local residents,' 27 % were neutral, and only 11% agreed or strongly agreed. Results of a Spearman's correlation indicated that there was a strong positive correlation between the statement 'wind farm developers care about the opinion of local residents' and support for the existing wind farm (r(127)= .613 p=0.00), suggesting that caring about residents and their views is a path to creating stronger support. The Spearman's correlation results also indicated a weak positive correlation between this statement and support for the repowering application (r(127)= .275 p=0.02) and a weak positive correlation between this statement and support for the life-extension application (r(127)= .312 p=0.00). (All significant at the 0.01 level). A community's perception of and relationship with the developer is thus likely to contribute to their perception of a scheme.

In St Breock, 38 % of respondents disagreed or strongly disagreed with the statement 'wind farm developers care about the opinion of local residents', a substantial 43 %

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[245]Three questions measured respondent's perceived benefits of windfarms. A PCA identified that these could be represented by the component 'wind farms create social benefits for the local community' (see appendix H).
[246]The PCA identified that perceived benefits of wind farms could be represented by the component 'wind farms create economic benefits for the local community'(see appendix H).

were neutral and 18 % agreed or strongly agreed. Results of the Spearman's correlation indicated that there was a strong positive correlation between the statement 'wind farm developers care about the opinion of local residents' and support for the repowered wind farm (r(74)= .618 p=0.00). This reinforces the findings in Kirkby Moor that a community's perception of and relationship with the developer is likely to contribute to their support, reflecting existing literature that identified the importance of community influence and developer transparency on positive attitudes to wind farms (see, for example, Firestone et al. 2018).

Trust between the developer and communities has been identified as important in existing literature (Wolsink 2007b; Aitken 2010a; Ricci et al. 2010; Walker et al. 2010; Friedl and Reichl 2016) and can be seen to be important in end-of-life applications. In Kirkby Moor 61% of respondents identified disagreement or strong disagreement with the statement 'I trust wind farm developers' with 28% identifying their position as neutral, and only 11% agreeing or strongly agreeing. Results of the Spearman's correlation indicated that there was a strong positive correlation between the statement 'I trust wind farm developers' and support for the existing wind farm (r(127)= .691 p=0.00). There was moderate positive correlation between this statement and support for the repowering application (r(127)= .410 p=0.00) and weak positive correlation between this statement and support for the life-extension application (r(127)= .387 p=0.00). (All significant at the 0.01 level). Such findings further reinforce the importance of community-developer relations in ensuring community support for the longevity of wind farm sites.

In St Breock, 39% of respondents identified disagreement or strong disagreement with the statement 'I trust wind farm developers' with 47% identifying their position as neutral and only 13% agreeing or strongly agreeing. It is interesting to note that in such a scheme with high levels of support, trust in the developer remains low. Results of the Spearman's correlation identified a strong positive correlation between the statement 'I trust wind farm developers' and support for the repowered wind farm (r(74)= .661 p=0.00). Relationships between practices and public attitudes identified more widely in wind farm research can thus also be seen to apply to repowering and life-extension i.e., there is a temporal dividend to developers continuing good relations with the community.

6.4.3 Perceptions of height change

Comments submitted to survey questions suggest that visual impacts of schemes often form a central reason for opposition. As repowering usually involves turbines of an increased height, the survey sought to understand how respondents considered such a change. In Kirkby Moor, 54% of respondents showed disagreement with the statement ''A smaller number of larger turbines is better than a larger number of smaller turbines.' 32% were neutral and only 14% agreed. This goes against industry expectations that people will prefer a smaller number of larger turbines (see, for example, Sustainable Energy Ireland 2003). However, it is likely to reflect the specifics of this case given its visual impact on the Lake District National Park and the high level of opposition to the repowering application.

48 % disagreed with the statement 'I would support repowering at Kirkby Moor if the turbines remained the same height', 15% were neutral, and 37% agreed. Results of the Spearman's correlation indicated that there was a moderate positive correlation between this statement and support for life-extension ($r(127)=.535$ $p=0.00$). Such findings reflect that in this particular case the increased size of the turbines was a key reason for opposition to the repowering application, but that there were several contributing factors beyond that (as described above). Thus, for opponents of Kirkby Moor, opposition is often not just conditional on height as the core concern appears to be the duration of impacts and conditions associated with the original scheme. So, the handling of the original scheme leaves behind important legacies that impact on life-extension and repowering. This is especially important in view of the changing ownership of developments over time.

In comparison, in St Breock, only 12% of respondents showed disagreement with the statement 'A smaller number of larger turbines is better than a larger number of smaller turbines.' 32 % were neutral and 56% agreed. A Spearman's correlation test revealed that there was moderate positive correlation between this statement and support for the repowered wind farm ($r(74)= .428$ $p=0.00$). These findings support industry expectations regarding preference for fewer taller turbines (see, for example, Sustainable Energy Ireland 2003) and are particularly interesting as in this case many respondents have been able to see and compare both sites. Comparing the two cases reveals how public support for the industry's repowering equals net gain hypothesis is greatly mediated by context, especially where many in the public would prefer no windfarm at all (for them, anything the developer does is viewed through the lens of overall objection).

6.5 Conclusion

As wind farm facilities age and approach end-of-life there is a need to understand public perceptions regarding the duration and future of sites (forming a key element of answering research question one). Understanding different preferences regarding the future of sites is important in considering whose preferences are influencing end-of-life decisions and the wider consequences of such temporal decision-making (see research questions two and three). Such an understanding also adds a temporal dimension to the existing body of literature on public acceptance of wind energy. Through undertaking surveys in two very different contexts, a site that faced high opposition and another less controversial site, it was possible to gain an understanding of the different factors and contexts that may influence public considerations of duration and responses to end-of-life applications.

In a number of instances the surveys revealed that elements that have been shown in existing literature to be generally true of wind power also apply to repowering and life-extension. Visual impacts have been identified as a critical element influencing responses to wind farms (see, for example, Pasqualetti 2000; Johansson and Laike 2007; Wolsink 2007a). This survey reflects that this is also true of end-of-life applications, revealing how visual scalar concerns appear far more significant than temporal concerns. There is an industry expectation that people will prefer a smaller number of larger turbines (see for example Sustainable Energy Ireland 2003) and the findings in St Breock reflect this. However, the case of Kirkby Moor demonstrates how this may not always be true, particularly when repowering involves a significant increase in turbine height and when the wind farm is in a highly valued landscape. Comments on the Kirkby Moor case reflected findings of research in Denmark demonstrating how opinions may change from favourable to negative as a result of increases in the size and number of developments i.e., infrastructure that was previously considered as new, unusual, and small-scale became increasingly prominent, larger, and industrial-scale (see Möller 2010). Perceptions of the suitability of turbine height on a landscape can thus be considered as context-dependent.

Community benefits can also play a significant role in perceptions of wind farms over time, particularly where communities can identify the projects that the fund has supported. This reflects existing literature identifying the potential opportunities but also challenges associated with community benefit payments (see, for example, Aitken 2010b). Existing literature has also identified the importance of community influence and developer transparency on positive attitudes to wind farms (see Firestone et al.

2018), particularly the importance of trust on public responses to renewable energy developments (see Wolsink 2007b; Aitken 2010a; Ricci et al. 2010; Walker et al. 2010; Friedl and Reichl 2016). The survey findings support this through identifying trust and a community's perception of and relationship with the developer as important to their perception of a site and its continuation as a wind farm. Both locations demonstrated very high levels of place attachment; however, surprisingly this does not appear to influence perceptions of end-of-life applications. This was unexpected in the context of existing literature that identifies the influence of place attachment on community responses to energy infrastructure (see, for example, Haggett 2011; Wolsink 2018).

Awareness of the temporal regulation of schemes can be seen as context-dependent. In Kirkby Moor opposition primarily focused on the argument that the site should be removed in accordance with the original 25-year planning consent, reflecting a desire for the infrastructure to come to the end of its life and the site to become open moorland again. There was evident awareness that the original decision described the site as a trial for wind energy and this was used by opponents to argue for its removal. There was a strong narrative of promises (i.e. the promise of a 25-year consent) being made and broken and new promises to be made, reflecting Abram and Weszkalnys' (2011) narrative of planning as a promise for the future with potential to break down. This case also reveals that where the public consider infrastructure as temporary, the positive trade-offs used to help justify the repowering are not necessarily enough to change perceptions of the continuation of the site. It also demonstrates how the handling of the original scheme leaves behind important legacies that impact on end-of-life decision-making. Comparatively, in St Breock there was an apparent lack of knowledge or concern regarding consent durations, with the majority appearing to accept that the site has become a wind farm. Differences in awareness of consent durations between the sites reflects how such awareness is context-dependent and particularly appears to be influenced by opposition, reflecting limited public awareness of planning per se and an intuitive attribution of permanence.

The findings suggest that in many cases, perceptions of the infrastructure do not change over this more prolonged period, thus contrasting with existing expectations that experience of wind farms or familiarity changes opinions of the infrastructure to become more positive over time or to lead to increased ambivalence (Warren et al. 2005; Wolsink 2007b; Eltham et al. 2008; Wheeler 2017). The survey findings support Devine-Wright (2005) that there is not a clear linear relationship between experience of a wind farm and perceptions of the wind farm due to the multidimensional nature of familiarity and context of sites. This is most clearly evidenced in the case of Kirkby

Moor where there were particularly bad community-developer relations and a lack of evident benefit from community benefit payments. Differences in the findings could also be influenced by the fact that previous studies were undertaken in sites that had not experienced end-of-life applications and many were undertaken a shorter period of time after operation. Wolsink (2007) stated that there is no guarantee that a positive change in attitudes will occur after construction as the U-shape curve effect only occurs if the existing environmental impact is considered to have been dealt with adequately. However, the results of this survey reveal that there are a greater range of factors influencing a positive change in attitudes, including perceptions of visual impact, community benefits, and community relationships with the developer.

What this research has revealed is that publics seem somewhat uneasy about compromised solutions. In many cases they place little value in the manipulation of time as an impact regulation practice. They tend either to oppose wind farms, or like them and if the latter, tend to be happy with increases in duration through life-extension or repowering (which still provide future opportunities for renegotiation and reconsideration). The St Breock survey reveals that in a case with little controversy there may be limited knowledge of the duration of consent. Moreover, most comments in support of applications did not mention duration as a factor, with the only significant discussion of duration occurring from those opposing Kirkby Moor wind farm who identified that the original permission was consented as a 25-year development. However, it should not be assumed that a time-limited consent provides no benefits for publics, as while for many end-of-life changes tend not to register, there was a positive correlation between awareness of the time-limited nature of the consent and support for repowering in St Breock. Meanwhile, the case of Kirkby Moor demonstrates that if people are opposed to wind farms then it seems that, for them, this cannot be softened by introducing time limits. In this case, objection appears to be focused on the continued use of the site as a wind farm with communities aiming to shape the site for an alternative use. Thus there was a strong rhetoric of broken promises and wanting removal in accordance with community expectations. Differences in considerations of duration between the two cases reflect differences in perceptions of what the site has or should become i.e. if it is considered to have become a wind farm and consequently differences in opinions of what should constitute the baseline upon which end-of-life decisions are made.

Site-specific factors appear to influence knowledge of the duration of the infrastructure as it can be used as a strong argument for those opposing a scheme. Additionally, the research highlighted the importance of positive community-developer relations in achieving support for the longevity of sites. While such insight into public considerations is useful, it raises questions regarding how such perceptions may have been reflected in the outcome of applications. The following chapter thus considers these findings alongside the results of the other empirical research, enabling a more comprehensive discussion of how the temporal aspects of sites are considered and formed.

Chapter 7: Discussion, assessing the multiple temporalities of end-of-life decision-making

7.1 Introduction

A wind or solar farm is not simply a fixed entity. While it is fixed in location, often for a certain duration, other elements of the site and its context are likely to evolve and change. Such changes may include changes in policy, social changes, and physical changes to the equipment, site and the surrounding area. Each of these changes are likely to occur over a different timespan, potentially impacting decisions regarding the duration of the infrastructure in situ and the future use of the site. This chapter explores such changes through a discussion of the key findings from the previous three empirical chapters. In doing so it responds to the aims of the thesis, i.e. to understand how the temporary and reversible nature of wind and solar farms are considered, constructed, or resisted by the range of actors involved, how this influences end-of-life decision-making and with what consequences.

The chapter firstly discusses multiple temporalities (see Adam 1995; 1998; 2004) - the multitude of changes that have impacted cases over time, including their different temporal dimensions and how the range of actors involved considered them. The bringing together of such temporalities in end-of-life decision-making is then discussed (research question one). While there are different temporalities involved in decision-making for each case, this chapter considers if there are any patterns or common features across cases, the conditions that lead to specific temporalities dominating (research question two). In doing so, wider consequences of how the temporalities of renewable energy infrastructure are regulated are considered (research question three).

7.2 Multiple temporalities

Existing literature identified the multiple time frames operating in planning and the inevitable selectivity and partiality of planning (see Graham and Healey 1999; Van Der Knaap and Davidse 2010; Madanipour 2010; Abram and Weszkalnys 2011; Del Río et al. 2011; Davoudi 2012; Abram 2014; Moffatt 2014). Considering end-of-life decisions as influenced by multiple temporal processes, occurring in parallel and operating on different timescales, draws upon the work of Adam (1998) regarding the multiplicities of time. Adam (1995; 1998) argues that linear considerations of time transform complexity into an enclosed, fixed object when in reality time is less tangible as it is constructed through interactions and embedded in knowledge, practices, and the environment. Considering multiple dimensions of time and the complicated temporalities of changes to landscapes as suggested by Adam (1998) facilitated an exploration of the variety of physical and social changes that occur over the operational lifespan of renewable energy sites and how considerations of time differ amongst actors, impacting their relationship with a place and, in this case, infrastructure. It also provided insights into how multiplicity is rendered linear for the purposes of regulation, with consequences for elements left outside of regulation.

Drawing upon Deleuze has enabled an exploration of the multitude of temporal processes occurring over time and, significantly, how they have shaped (or striated) the context in which decisions are made. Of particular usefulness to this thesis was Deleuze and Guattari's concept of becoming which is used to describe the potential for an entity to develop and change in the future (Deleuze and Guattari 1988; 2004; DeLanda 2002; 2006; Hillier 2008) and in this research was used to understand how planning facilitates or constrains potentials and how sites change over time in various ways. Applying a Deleuzian perspective involved considering entities in terms of what they potentially may become, rather than just their being (DeLanda 2002) and thus considering sites as dynamic. From such a perspective entities are considered to smooth space (through removing existing characteristics) and striate space (through defining and closing spaces) in order to meet their operational requirements, in turn configuring other becomings (Deleuze and Guattari 2004). Such an approach revealed the selectiveness of how the planning system manages change, how time is struggled over in planning and why certain notions of time endure while others are left outside regulation. It also facilitated an exploration of the third research question regarding the wider impacts of the regulation of the temporalities of renewable energy infrastructure. The research revealed that over the lifespan of a site many different elements change, all with different temporal dimensions, forming both striations and smoothings. The range of temporalities influencing wind and solar farms are outlined in table 14 below. End-of-life decisions can be seen as a conjunction of multiple temporalities, including both physical and social elements, the following discussion considers the potential influence of different temporalities on end-of-life decision-making.

Table 14: The multiple temporalities influencing wind and solar farms

Form of temporality and processes of striation / smoothing	Examples of such temporalities
Affecting the project	
Economic temporalities Economic changes can: - Form striations through making repowering or life extension unviable. - If positive, economic changes can smooth the site, removing constraints and opening up a range of future options.	Variations in: - Subsidies. - Investment strategies. - Taxation. - Viability calculations. - Levelised energy costs. - Asset values. - Production efficiency.
Materialities of equipment - A lack of availability of machinery and parts can striate the options for sites. - However, the development of new technology can open up different possibilities, causing smoothing.	Tendencies for: - Parts of equipment wearing out. - Changes to ability to replace or maintain parts. - Change in size / type of turbines available.
Changes in ownership - A change in ownership may smooth the site through offering a range of future options or form a striation if the new owner has a specific aim and priority.	- Sale of sites. - Changes in structure or priorities of site owners.
Affecting the institutional context	
Policy changes - If restrictive, can striate sites through preventing some end-of-life applications from being submitted or granted. - If supportive of repowering / life-extension, can smooth the decision-making context, sidelining potential constraints, increasing the likelihood of successful applications.	Changes to: - National approach to renewable energy expansion. - Spatial steering or zoning of onshore wind / solar. - National end-of-life policies. - Local level policies. - Decisions forming precedents.
Affecting the setting	
Social landscape changes - Perceptions change over time. - Negative changes can create a striation to the site, should local people want the site to return to its original condition. - If perceptions of the facility become more positive over time then people are likely to be open to the continuation of the use, thus smoothing the site for future applications.	Shifts in: - Familiarity with the infrastructure. - Perceptions of the landscape and the presence of the windfarm within the landscape. - Community-developer relations. - Perception of community benefits. - Composition of the local community.
Physical landscape changes - Changes in the surrounding area can striate the site through creating a physical/ perceptual/ regulatory restriction on future development.	Development of: - Nearby windfarms. - Landscape designations (national and local level). - Houses in surrounding area.
Site-specific factors - Site specific factors often striate sites through creating barriers to certain forms or compositions of development.	- Site access. - Grid availability. - Position of landowner.

7.2.1 Economic temporalities

Economic factors can be seen to directly influence end-of-life decision-making for both wind and solar farms. For project owners and prospective developers temporal decisions are linked to the economics of energy generation regarding a net balance of gains and costs over time, with assessments of tipping points when this falls one way or another. These tipping points affect the end-of-life strategy and are influenced by various factors that themselves change throughout time forming processes of smoothing and striation, such as energy prices, policy, and subsidy regimes (as identified by Ziegler et al. 2018). Other economic dimensions of the infrastructure can also influence developer strategies such as production efficiency and asset value. Economic factors can influence the timing of decisions, a developer explained that end-of-life decisions are usually made when the infrastructure is 15-18 years old so that the existing machines can be sold.[247] Changes in ownership or the structure of companies owning the asset may influence temporal strategies due to differing priorities (e.g., in the case of Pitworthy where the site was sold to an investment firm).

Subsidy regimes appear to have been a major influence on wind farm developer strategies across cases, directly influencing the timing of decision-making through striating and smoothing the decision making context. These are in turn linked to political concerns as well as underpinning legislative commitments. Many wind farms have a subsidy attached to their consent as part of the Renewables Obligation Scheme which was introduced into England, Wales, and Scotland in 2002, requiring electricity suppliers to purchase a set amount of energy from renewable sources. As part of this scheme, Renewables Obligation Certificates (ROC's) were given to renewable energy firms for each megawatt-hour of electricity produced, the certificates would then be sold to electricity suppliers. Reflecting a political move away from onshore wind in England, this scheme ended for new onshore wind farms in 2017, the same year that the government prevented onshore wind from participating in the Contracts for Difference scheme (a scheme of price auctions to acquire new renewable energy at the lowest cost). Subsidies are attached to the original project as consented, the subsidy could thus continue if a site is life-extended (developers state that they could continue to benefit until 2027), but subsidies are not transferable to a (new) repowered scheme, thus forming a striation, inhibiting the potential range of becomings of a site.

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[247] Interview with Developer A St Breock, May 2018.

As subsidies are no longer available for new onshore wind projects, developers are faced with the decision of whether it is more viable to extend the life of an existing scheme (and thus continue to benefit from the existing subsidy) or to repower with more efficient turbines that will produce larger energy output but without subsidy, 'the question is then do you want to repower today, or do we want to continue to operate the existing site for the meantime…as a generalisation you start looking at the commercial and operational realities of continuing to run the existing site versus repowering, and in fiscal terms all of those older sites continue to be eligible for ROC until March 2027'[248] (Developer, Kirkby Moor). Developers explained that life-extension provides a lower-risk, cheaper, and easier option than repowering as the infrastructure is already in place. Emphasising the significance of subsidy changes, the developer in Windy Standard identified that the removal of subsidy changed their strategy, 'because quite clearly the existing turbines have to some extent a greater income'[249] (Developer, Windy Standard). Similarly, the Taff Ely developer explained that life-extension applications are likely to coincide with the end of subsidies in 2027 and that there will then be a time when it is more profitable to repower.

The variability of economic changes can also influence strategies regarding the physical attributes of sites, for example in Taff Ely the developer described how the removal of subsidies has led to a situation in which taller turbines are necessary for viability.[250] The increasing need for taller turbines to make schemes viable was recognised across cases. Economic considerations are also starting to change the consent durations being sought. Illustrating this, the Taff Ely developer (who owns a large number of wind farms) identified that developers are now pushing for longer periods in planning applications, identifying 30 years as the operational life of wind farms (relating to when parts will wear out).[251] However, impacts on duration also include certification and warranties as after a certain period there is a need to do more screening and turbine components may wear more quickly in turbulent sites. Taxation can also influence decisions between new machinery and existing assets. Economics and equipment materialities have different time signatures, but these are the factors that matter most to developers' internal calculations.

[248]Interview with Developer Kirkby Moor, April 2018.
[249]Interview with Developer Windy Standard, April 2018.
[250]Interview with Developer Taff Ely, April 2018.
[251]Interview with developer Taff Ely, April 2018.

The temporalities of solar farms are also linked to commercial decisions. While not explored in this research in detail, solar farms are also influenced by the changing temporalities of subsidy regimes. The current nature of the industry (at the time of writing) makes life-extension likely due to the practice of companies building then selling solar farms as assets. When investors buy operational solar farms to manage they are often looking for a longer-term investment.[252] The original developer in Pitworthy suggested that buyers would be likely to want to extend the life of a site in order to maximise value, particularly when sites are used for long-term investments such as pension funds. A 25-year site is considered likely to be a challenging investment whereas 40-year permissions provide longer returns, 'once you've got over the worst of getting planning in and everyone's got used to it, the landscapes in place, you know it might be that It, you know, it would be sensible to renegotiate'[253] (Developer B Pitworthy).

Generally, for developers and owners, economic striations and their temporalities tend to dominate end-of-life considerations for both wind and solar. Developers regularly explore options in order to decide how to manage the end-of-life of the infrastructure. Economic subsidies, the levelised cost of energy, and consequently how long a project needs to run to be profitable without support appear to be the most significant influence on developers' strategies. Due to the complicated range of factors, developers' strategies often change over time. The relationship between this change and temporal fixes is particularly interesting. In the case of wind, it appears that developers are responding to such uncertainty of economic contexts (and uncertainty in the policy regime – discussed below) by pursuing a strategy of life-extension (a cheaper and lower-risk option than repowering) with the intention of repowering in the future if the economics are more certain. Such findings add strength to the argument that we need to consider how social acceptance involves different actors and processes operating at different levels within institutional frameworks, rather than just community responses (Wolsink 2018b).

However, while developers' financial and investment strategies form one critical dimension of time, they cannot wholly align the future around their economic interests. There are also several factors that can influence the economics of a site, that lie primarily outside of their control, creating striations on the directions in which change can take place. Such elements may include the ability to extend the lease, the

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[252] Interview with Developer A Pitworthy, April 2018.
[253] Interview with Developer B Pitworthy, April 2018.

possibility of acquiring replacement parts for existing turbines, grid access, taxation, and the ability to get planning permission. The physical attributes of a site can also influence end-of-life decision-making, for example, while repowering can increase output, it depends on grid availability, so if there is no more grid availability then life-extension provides a fall-back option.[254] In many cases, temporal decisions have been influenced by the perceived useful life of the infrastructure in both a physical and economic sense, but that is not easily known. However, the ability of the infrastructure to be maintained, repaired, or geared to working longer can influence strategies. Such elements are closely tied to the economics of considering the cost of replacement and productivity. The duration of the original consent may also influence decision-making as some of the older sites without time-limited consents may continue to operate through replacing parts. [255]

7.2.2 Policy change

Central government and LPA policymakers have a potentially important influence on the decision-making of both developers and planning authorities through policy development, most clearly through the delivery of systems of market support that can smooth the decision making context. So far, developers have experienced a high success rate for repowering applications (as seen in chapter 4). This high success rate is likely to have been influenced by broader policy supporting onshore wind and the benefits offered as part of applications (e.g., restoration and community benefit improvements). Additionally, developers took a lower-risk strategy of applying for 25-year consents, why this lowers risk is an issue returned to below. However, for most of the last 25 years specific end-of-life policy has been sparse and the majority of existing repowering and life-extension applications were decided before policies were in place. Central government interventions have only recently begun to influence what is happening. National-level planning policy can be seen to have changed over time in all three countries in terms of the overall approach, requirements and spatial steering for onshore wind as well as considerations of repowering and life-extension (see chapter 4). Although policy can influence the alignment of temporalities in end-of-life decision-making, limitations remain.

Policy change can be seen to influence developers' temporal strategies and end-of-life decision-making. The cases revealed that an unclear policy context can create

[254] Interview with Developer A St Breock, May 2018.
[255] Interview with Developer A St Breock, May 2018.

difficulties for developers when deciding what end-of-life strategy to pursue. The policy context in England raised issues of uncertainty regarding future applications, for example, the Kirkby Moor developer expressed that 'without more clarity on the change in government policy, it's pretty hard, you know we're, it's hard to envisage much repowering happening in the UK'[256] (Developer, Kirkby Moor). There have thus been calls for the rest of the UK to follow the supportive approach to repowering and life-extension in Scotland.[257] From a Deleuzian perspective, there are some benefits of plans remaining open to change, as it is impossible to imagine exactly what may happen in the future or what may become of these sites (Hillier 2008; 2011). However, policy clarity regarding end-of-life options at a national level, particularly in Scotland, has provided benefits for decision-makers in reducing uncertainty in how applications should be considered.

While all countries now have a positive stance on repowering onshore wind, difficulties are likely to remain in England and Wales, where there is a lack of detail regarding how applications should be assessed. Although this leaves possibilities more open, LPA officers in multiple cases identified that they struggle to make decisions due to a lack of guidance. Illustrating this, the LPA in Kirkby Moor felt that the English planning system is very complicated particularly when compared to the more simplified Scottish system, describing it as 'a cop-out by the government'[258] (LPA, Kirkby Moor). The consideration of the updated Scottish Onshore Wind Policy Statement in Windy Standard provides an interesting contrast to the Kirkby Moor case. Greater clarity in policy could thus potentially increase speed and confidence at the LPA decision-making level. However, not all LPAs experience difficulty from a lack of policy, for example, in Taff Ely the LPA did not feel that policy needed clarifying, giving the widely held view that 'I think it's clear enough that there's a recognition that it's probably better to repower existing sites rather than going looking for new'[259] (LPA, Taff Ely). Although local-level policies on wind energy have developed over time in many areas, there is little evidence of emerging local-level policy consideration of end-of-life issues. In this context, LPA decision-makers appear to be facing challenges in assessing end-of-life wind farm applications. Moreover, developers also identified challenges in inconsistencies between LPA policies and in Scotland, wind farm capacity studies.[260] There is also a

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[256]Interview with Developer Kirkby Moor, April 2018.
[257]Interview with Developer A St Breock, May 2018.
[258]Interview with LPA Kirkby Moor, April 2018.
[259]Interview with LPA Taff Ely, April 2018.
[260]Interview with Developer Windy Standard, April 2018.

perceived lack of uniformity in planning officers' experience,[261] creating challenges in decision-making for both developers and LPAs.

Meanwhile, solar is a later phase technology and appears to lack significant regulation, which is reflected in the varying durations of consents, regulation thus appears to be a catch-up activity. However, to date the policy absence for solar does not appear to be creating significant challenges, perhaps due to the less-controversial nature of the infrastructure. In Pitworthy, the developer stated that they are comfortable without additional government guidance as they had not had any negative experiences with life-extension. However, they did note that current policies are not clear and there is a lack of certainty about what developers can do, describing how they often rely on looking at previous consents granted by an authority due to the lack of policy or guidance.[262] Meanwhile, the LPA felt that they had sufficient guidance to make decisions, specifying that they refer to their local plan and assess the supporting documents provided by the developer. Significantly, they identified that a time-limited condition is easier to enforce than one that refers to the end of a useful life,[263] reflecting the importance of practicality and enforceability for the planning system in how it regulates time. However, it is essential to consider that such enforcement is still a matter of discretionary choice. For solar infrastructure, the absence of policy is creating a situation in which there is a lack of uniformity in the duration of sites and where longer consent periods (achieved through life-extension) are becoming the norm.

7.2.3 Landscapes

Visual impacts have long been identified as a critical factor shaping wind energy consent decisions (Wolsink 2007b) and this remains the case for repowering, as evidenced in interviews with both LPAs, developers, and community members. The entanglement of technologies with landscapes can be seen to impact end-of-life decisions in numerous ways. Landscapes are unstable, shifting, and subject to multiple uses. Where physical landscapes (in terms of features of the land and landscapes) and social landscapes (involving peoples' relationship with and perceptions of landscapes) change over the lifespan of infrastructure, this can form smoothings and striations, impacting end-of-life decision-making.

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[261]Interview with Developer Taff Ely, April 2018.
[262]Interview with Developer A Pitworthy, April 2018.
[263]Interview with LPA, Pitworthy December 2018.

Perhaps the most significant element of landscape consideration in end-of-life decision-making is what is considered as the baseline upon which repowering or life-extension applications are judged. This baseline reflects a preference for a specific point in time. In some cases, the baseline has been considered as the site without the wind farm in place, such as in Kirkby Moor[264] which was pivotal to the controversies faced by successive applications. In other cases the presence of the wind farm forms part of the baseline assessment, for example in the life-extension for phase 1 of Windy Standard it was considered that as the principle of development was established, it was only necessary to consider the acceptability of any material changes, rather than reconsidering the merits of the original proposal.[265] Accepting that the landscape has 'become a wind farm' is the main dividing line, shaping the dynamics of public and regulatory responses and these earlier decisions thus set precedents for the future. Significantly, such considerations of sites having become wind farms has begun to influence policy, with Scottish Policy explicitly classifying the current use of a site (as a wind farm) as a material consideration.[266]

Landscapes are not fixed or stable, characteristics of landscapes can alter significantly over the lifespan of renewable energy developments. The landscapes of energy infrastructure can be seen to be in flux, changing the context in which decisions are made. In most cases, further development, particularly of other wind farms, has occurred in proximity to sites. Physical changes in the surrounding area can be seen to form striations that influence temporal strategies, for example in the case of Taff Ely, the developer identified that when it comes to end-of-life applications site constraints have often become greater and the developable area is often a lot smaller due to encroachment by development and the existence of greater protection measures.[267] Meanwhile, relationships with the landscape and perceptions of the suitability of the windfarm on the landscape and its perceived fit (see Bailey et al. 2016) can be seen to change over time. In some cases, land designations (such as World Heritage Site status for the adjacent Lake District National Park in the case of Kirkby Moor) have occurred, striating sites through providing additional development constraints. Current experience shows this trend flowing one way in terms of increasing constraints over time, rather than in terms of some landscape changes being a loosening of constraints

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[264]Kirkby Moor life extension committee report, 2017, 110.
[265]Windy standard life extension committee report, 2018.
[266]Scottish Government. Scottish Planning Policy. 2014, 174. Additionally, draft guidance in Scotland suggesting that the baseline for an EIA should comprise a decommissioned site despite the fact that the current use of the site as a wind farm will be a material consideration- see Scottish Natural Heritage, assessing the impact of repowered wind farms on nature, consultation draft 2018.
[267]Interview with Developer Taff Ely, April 2018.

and restrictions (e.g., de-designation of landscapes, other wind farms being decommissioned etc).

Visual impact on the landscape is one of the central considerations for assessing applications to increase the duration of sites through repowering or life-extension. Due to wider landscape shifts, it is not as simple as judging whether the application, in its narrow dimensional terms, creates an acceptable net change in visibility. LPA decision-makers revealed that assessing the impacts of the visual change upon the landscape was particularly difficult[268] in terms of deciding if a smaller number of larger turbines or a larger number of smaller turbines was visually preferable. Existing industry research asserted that a smaller number of larger turbines is usually preferred (Sustainable Energy Ireland 2003). This assumed preference is reflected in comments such as from the LPA in St Breock who assumed that repowering was ‘felt locally to be a reasonable proposal not least because it could be seen as decluttering the landscape by more than halving the number of turbines, but increasing the output’[269] (LPA, St Breock). However, the findings of this thesis revealed that this assumption is not always born out. The public surveys revealed that while in St Breock a smaller number of taller turbines was preferred by the majority of respondents, in Kirkby Moor the opposite was true. Thus the context of the site, including perceptions of the suitability of the turbines on the landscape, is significant, and the perceived suitability of energy infrastructure in the landscape is important (see also Hirsh and Sovacool 2013; Otto and Leibenath 2014). These findings reflect the arguments of Wolsink (2018a) who identified that as a concept visual impact is often misunderstood, arguing that it is not purely an assessment of the aesthetics of the infrastructure itself, but of wider landscape concerns such as (but not limited to) a person’s assessment of the landscape, the change in the character of the landscape, and a person’s attachment to place.

Landscape considerations are often regarded as longer-term, with 25-years seen as short-term in the duration of landscapes. Longer-term perceptions of the landscape can also be seen to significantly impact how a wind farm is perceived. For example, in Cornwall, there is a long-established tradition of working on the land and thus viewing the land as a resource e.g., now an energy resource. The developer in St Breock felt that Cornwall has ‘a very Scottish view of its landscape’ referring to the fact that people ‘see landscape as something that has to earn its living’ (Developer B, St Breock) and that this is reflected in Cornwall’s positive approach to wind energy,[270] demonstrating

[268]Interview with LPA Kirkby Moor, April 2018.
[269]Correspondence from LPA via email St Breock, June 2018.
[270]Interview with developer B St Breock, May 2018.

how longer-term experiences of land use and landscape considerations may influence the treatment of such applications. Contrasting such long-term considerations of wind farm sites, in the case of solar there was a more explicit recognition of the potential use of sites for other future uses, such as food production.[271]

7.2.4 Community considerations

Social changes also occur over time forming striations and smoothings through affecting perceptions of energy infrastructure. Social history is important, temporalities are not just background landscape changes but also made by the actors involved. The communities living close to energy infrastructure are likely to change over the lifespan of the infrastructure both in terms of the composition of the community and potentially how they consider the site and the duration of its various impacts - although the findings show considerable stability of views over time. A range of factors can influence community considerations of the duration of the infrastructure including the history of how the land was used before the wind farm (e.g. the history of using land as a resource in St Breock and Taff Ely, compared to the protected National Park landscape in Kirkby Moor) and how they consider the impacts of ancillary equipment that is often located closer to the community (a key issue raised in Windy Standard). Consequently, community responses to end-of-life applications have varied.

The context of how the original scheme was considered and perceptions of the existing site appear to influence responses to end-of-life applications. For example, the original Kirkby Moor wind farm faced high levels of opposition and the LPA described how people 'felt as if it had been imposed for no good reason'[272] (LPA, Kirkby Moor), rejecting the reasons that had been provided. In such emotive cases, memory of resistance can endure over decades, sustained in local narratives. Meanwhile, sites with less opposition to end-of-life decisions appear to have often (but not always) been less controversial originally and have not created significant negative impacts over their lifespan. In many cases, public awareness of the duration of permissions is only raised by an end-of-life application. In such cases the planning system highlights something as temporary that people had considered to be permanent, thereby opening up scope for agency and influence that they had previously not considered possible.

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[271]Interview with Developer Pitworthy, April 2018.
[272]Interview with LPA Kirkby Moor, April 2018.

Generational differences can potentially influence responses due to how the temporal dimension of land use is perceived. Demonstrating this, a LPA officer in Taff Ely interpreted a difference between generations, noting historical parallels about who benefits from energy extraction and development in the area. They described how younger generations consider turbines as 'something that represents clean energy going forward'[273] (LPA, Taff Ely), whereas they felt that older people consider the turbines as another form of pillaging the land in an area that was previously pillaged for coal, noting that local people didn't see the benefits of the coal industry as the money was spent outside of the area. Such experiences reflect literature discussing how different representations of places and renewable technology have been used to portray a development as acceptable or unacceptable in a particular location (e.g. Woods 2003; Fast and Mabee 2015).

7.2.5 Familiarity

Familiarity is a temporally-infused process that the research found was often invoked in end-of-life decisions. There is a perception amongst industry and LPA planners that familiarity or acceptance is likely to occur amongst communities living with infrastructure, smoothing the future decision-making context. Such a perspective suggests that wind farms will become a familiar part of the landscape, as reflected in quotes such as 'if they've been there 25 years, people will have you know, they are such a custom feature in the landscape that people probably pass them without even noticing that they're there'[274] (LPA, Taff Ely) and 'I would have thought there would be an element that after a project's been there for a set period of time even if there has been objection to that, initially people get used to things and potentially start to see things in a different light'[275] (Planning consultant, Windy Standard). This perspective reflects existing literature suggesting that those living close to wind turbines become more supportive or at least less active in their objection or opposition to them after installation (Damborg and Krohn 1999; Warren et al. 2005; Wolsink 2007b). Such perceptions of familiarity are reflected in developer confidence that people will not object to life-extension applications, as reflected in the following quote, 'those turbines have been there for nearly 25 years they're used to being part of the landscape, people would be perfectly happy for them to remain for another 5-10 years'[276] (Developer Kirkby Moor), representing another example of developers (and sometimes planners)

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[273]Interview with LPA, Taff Ely, April 2018.
[274]Interview with LPA Taff Ely, April 2018.
[275]Interview with planning consultant Windy Standard April 2018.
[276]Interview with Developer Kirkby Moor, April 2018.

representations of publics that are not always necessarily accurate. Such a quote ignores the significance of influential factors such as the balance of impacts, trust, confidence, and ideas of broken promises from planning consents.

There is also widespread expectation that local communities will prefer repowering of an existing site rather than a wind farm in a completely new site, evidenced in community comments in Taff Ely and Windy Standard. The developer in St Breock explained how familiarity helps local people to understand what to expect, ‘if you go to a bare site and you say to people imagine a turbine, 100m to blade tip on it, they can’t do that. Why would they be able to do that, it’s beyond their experience. But if you take them to look at an existing wind farm and say the turbines will be half the number and twice the size, they can kind of do that because there’s a reference for them’[277] (Developer B, St Breock), depicting how uncertainty is anchored. The LPA in Taff Ely explained this as ‘people are almost used to the, used to the fact that there are turbines there. Then you’re not introducing a whole new feature into the landscape, notwithstanding the fact they might be taller’[278] (LPA, Taff Ely). So, there is a sense that benchmarks have shifted over time, there’s not an immediate desire to return to a pre-wind farm landscape, but also a sense that only incremental change to the quantum and extent of wind infrastructure is likely to be acceptable. From a LPA perspective there is also an expectation that repowering applications are likely to face less opposition, although we have seen how this is not always the case.

Expectations of local familiarity and acceptance have shaped developer strategies for end-of-life applications. Illustrating this in the case of Windy Standard, the developer described how familiarity influenced their strategy of phasing, explaining that if they had tried to put forward both phases after Windy 1 was developed, it would have seemed rather inappropriate in terms of perceptions of the industry, identifying the significance of evolution and perceptions. However, familiarity is not always engendered over time, particularly in cases where people perceive the wind farm as not working or not creating any benefits, most notably in the case of Kirkby Moor where the survey demonstrates that the majority of respondents recalled that their perception (including a high number of negative perceptions) had not changed over time. This qualifies evidence against the suggestion by Warren et al. (2005) and others, that familiarity with a wind farm will lead to contentment (discussed further in the conclusion).

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[277]Interview with Developer B St Breock, May 2018.
[278]Interview with LPA Taff Ely, April 2018.

7.2.6 Community-developer relations

The social history developed over time between communities and developers/operators can influence community reactions to end-of-life options and many developers appear to be aware of this. Moreover, the temporal strategies of developers can be influenced by local support. Illustrating this, the developer in Pitworthy described how they may not have pursued the life-extension application if there had been significant local opposition.[279] Relations can improve over time through communities recognising the value of community benefits and through good communication and the establishment of trust with the developer, as we saw in the cases of Pitworthy, Taff Ely, and St Breock. This reflects existing literature that identified the importance of trust on responses to renewable energy schemes (see Wolsink 2007b; Aitken 2010a; Ricci et al. 2010; Walker et al. 2010; Friedl and Reichl 2016). In other cases, such as Kirkby Moor, relations worsen over time, negatively impacting perceptions of the site and its duration. In cases where poor relations are formed between the community and developer, end-of-life applications provide an opportunity for the community to oppose or renegotiate, raising issues that have long been of concern and exploiting the shifts and inconsistencies of developers' positions over time – the attempted continuation of initial temporary permissions - as part of their case against. However, while this is a common strategy of opposition groups, only in exceptional cases does it gain traction, e.g., Kirby Moor.

Survey results demonstrated the importance of communities being able to recognise the benefits of a wind farm in order to support the existing and continuation of use of a site as a wind farm (see chapter 6), reflecting existing literature identifying the importance of community benefits in acceptance or opposition (Ellis et al. 2009). Either the provision or lack of community benefits was a common element of discussion by communities in all of the wind cases. The perception of community benefits appeared to vary across cases with support for the continuation of a site being reflected where people recognise the benefits that their community has gained from the existing site. Such recognition of community benefits was particularly notable in the expression of support for repowering in St Breock and Taff Ely. Over time the provision of community benefits appears to foster positive public response; however, in some instances the impact may diminish over time if the demands for such a fund diminish. Such

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[279]Interview with Developer A Pitworthy, April 2018.

diminishing value can be seen to have occurred in the case of Windy Standard where, due to the volume of wind farms in the area compared to the relatively small local community, the community is running out of projects to spend the funds on and thus attribute less value to their benefit.[280] This reflects existing literature identifying communities varying capacities to make use of community benefits and the challenges and opportunities associated with such payments (see Aitken 2010b; Cowell et al. 2011; Munday et al. 2011; Bristow et al. 2012). Meanwhile, community benefits do not form an element of solar farms, perhaps due to the often lower levels of community opposition and limited precedents.

7.3 How multiple temporalities influence decision-making

The research has shown how wind and solar farms do not simply comprise the infrastructure itself, rather they comprise interlacing flows of multiple temporalities (as described above) that are temporally and spatially sensitive and that come together in episodic fragmented ways. Table 14 (above) depicts how these temporalities are dynamic, changing over time and can be seen to both smooth and striate. Such temporalities should not just be considered on their own, but rather together in the context of the site as they are interconnected and overlap. From this perspective, wind and solar farms should be considered as complex spaces comprising various uses and human and non-human aspects that change over time (see Bonta and Protevi 2004). As the various temporalities are in flux so too are the characteristics of sites, shaping end-of-life decisions. The different changes occurring along different temporal pathways are brought together in end-of-life decision-making, with some obtaining more influence than others, to striate the direction in which change takes place and thus form regulatory-economic-physical fixes.

While cases vary in outcomes and the influence of particular temporalities, the data reveals that certain temporal elements dominate across the sector, reflecting certain preferences (as per research question two). These often include economic temporalities promulgated and acted upon by owners and developers and changes in the surrounding physical and social area. Planning processes for end-of-life decisions are a mediating arena in which these temporalities are brought together and – to different degrees – acted on. Nevertheless, planning has its own temporal assumptions and norms which shape how decisions are constructed and justified.

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[280] Interview with community members Windy Standard, June 2018.

To date, most end-of-life decisions for solar and wind energy have been relatively uncontroversial, most entail consent, with the developers' conceptions of time being accommodated and with LPAs largely supporting. However, as discussed in the following section, i) there are complexities and conditionalities to that picture, it is not that simple and this pattern does not always apply. As well as reacting to developers applications, LPAs are influenced by norms and precedent which in turn are internalised by developers, sometimes pre-emptively. Resistance from third parties can be effective and the planning dimensions of the case have relevance here. (ii) There is a contingency to mediating between the temporalities at play and (iii) there are wider consequences (as per research question three) such as elements neglected by most actors e.g. decommissioning, or future alternative uses of the land.

7.3.1 How different temporalities are brought into alignment in decision-making

Decision-making regarding the future of sites is challenging as the varying temporalities discussed above (and outlined in table 14) can be seen to come together in various formations, with different temporalities gaining superiority (and thus being able to smooth or striate space), depending on the nature of the case. End-of-life possibilities interact as actors present and trade-off different scenarios for how things might end, with different balances of control. However, as chapter 4 discussed, most applications for repowering and life-extension have gained consent regardless of levels of public opposition. This reflects existing literature identifying that initial consenting decisions for wind farms are rarely refused on grounds of public opposition alone (see Ellis et al. 2009). To date LPA planners have been forging their judgements largely in the absence of policy. While they have identified challenges arising from such a scenario this does not appear to have influenced the granting of consents. Planners - in their reports - tend to uphold developer claims of the advantages of repowering i.e. sustainability, energy generation, and community benefits. In acting in these ways, the initial temporariness is violated or at best deferred. However, decision-making appears more difficult where there is high public opposition and difficulties also arise in assessing the visual changes of repowering.

There are deviations from this broad pattern as there are certain factors that mean that typical accommodating planning responses do not apply. Decision-making is often different if the original site has permanent planning consent as this provides the fall-back position of continuing to run the existing site (or abandon it) rather than requiring removal after a set period. Unlike in other cases there is no period of smoothing created by the end of a consent life and thus the site is not as easily opened to new potentials or striations. For LPA decision-making in such cases, beliefs about possible permanence are central, particularly regarding landscape considerations and impact, and thus form part of the judgement-formation and bargaining that takes place in planning. Deviations can also occur for sites that are subject to time-limited consents where public opposition is particularly strong. In such cases opponents do not accept that a site has become a windfarm and they thus seek to enforce temporariness, acting to striate space in a particular direction (i.e. for infrastructure removal). While there was a perception, particularly from LPAs, that publics would not be aware of consent durations, in cases of opposition the duration of the original consent can be used by opponents, reflecting how elements of the original decision can re-surface to be used to argue for the removal of schemes. For opponents seeking to act on and influence duration is rarely an adopted tactic, however it can be in cases of high opposition. Additionally, such arguments are utilised by NGOs who might regard themselves as guardians of the long-term future for certain becomings (i.e. the countryside not becoming industrial), albeit that they have only patchily engaged in end-of-life decisions and often without much evidence of local public involvement.

Central to such cases is contestation of what the baseline that end-of-life applications are assessed against should comprise and thus how landscape change and the temporary nature of the site is considered. Whether sites are considered to have become wind farms is a judgement that can be seen to vary across cases and consideration has been largely absent from policy or guidance (see the discussion of landscape temporalities in 7.2.3).

7.3.2 The domination of time-limited consents

The way in which the planning system considers and regulates time influences decision-making for energy infrastructure. The short-term temporal focus of the planning system can be seen to have led to a focus on managing permissions, forming striations that leave certain elements (such as decommissioning) to consider in detail in the future. This reflects existing literature critiquing planning-systems for focusing on issues that are having the most significant impact on the near-future in order to achieve political gain and short-term results (see Myers and Kitsuse 2000; Van Der Knaap and Davidse 2010). Interviews with a range of industry experts revealed a widespread lack of understanding regarding where the 25-year permission originated from, but with speculation that it originated from the expected design life of turbines. While the 25-

year period is nowhere specified in policy, it appears to have remained the norm through replication and repetition, despite having arbitrary qualities, perhaps as practices easily become routinised.

Despite the explicit statement in the 2017 Scottish Onshore Wind Policy Statement that consent periods do not have to be 25-years and the 2014 Scottish 'in perpetuity' policy,[281] most consents (for both new schemes and repowering) have remained as 25-years.[282] Here we see a norm that is institutionalised, despite actors on the ground recognising that it jars with other temporalities. Significantly, across Great Britain time-limited consents (usually for 25-years) have been used to replace consents granted in perpetuity, due to expectations from planners and the public as it is an established practice[283] and thus a lower-risk strategy for developers. Demonstrating this, the developer in St Breock described how they applied for a 25-year consent in the repowering as it was the industry standard at the time, based on the life expectancy of the turbines. They appeared to have an optimistic view of repowering and thus perhaps applying for a shorter duration would be less of a concern, 'if you can consent it once, why wouldn't you be able to consent it again? I think repowering kind of proves that, that situation'[284] (Developer B St Breock). This contrasts with the negative view of consent durations and the regulatory system from the developer in Kirkby Moor who expressed, 'I've never had someone who could clearly articulate what the origins of the, you know, 25-year policy was,' arguing that 'planning is unfit for purpose'[285] (Developer, Kirkby Moor).

Another temporal theme which emerges are the temporalities of industry learning, which are now rubbing against the planning norm of 25-year consents due to a recognition that infrastructure is often capable of lasting longer. Developers revealed that they are only just starting to consider longer consent periods.[286] This was explained by the developer in Windy Standard who identified that while 25-year permissions have historically been the norm, the industry is starting to evolve, noting that they have a submission in Scotland for a 35-year consent and identifying that if they were submitting the Windy Standard 3 application now they would be applying for a longer duration of 30/35 years. There is thus a situation whereby initial estimates meet practical learning, over time and about time, 'to some extent it's always been

[281]Scottish Government, Scottish Planning Policy 2014, 170.
[282]Interview with planning consultant, Windy Standard, April 2018.
[283]Interview with Developer Windy Standard, April 2018.
[284]Interview with Developer B St Breock, May 2018.
[285]Interview with Developer Kirkby Moor, May 2018.
[286]Interviews with Developers St Breock and Windy Standard April and May 2018.

assumed that you've purchased a piece of equipment, it is maybe, has a technical design life of 20-25 years, but this is what was put in place at the outset, that doesn't mean, actually, that it can't be operated beyond that and there's really never been a focus on what do you do to carry on. So to some degree, we are getting to a point where people are now starting to say, what sort of condition are these things in, would you run it further?'[287] (Developer, Windy Standard). They identified that as people are aware of the level of work involved in maintaining turbines and replacing components there is no reason why the life of the turbine shouldn't continue with the replacement of some parts, 'there's no reason why that wouldn't be a norm to say well actually that's a perfectly good operating site, it is producing energy for the national need ultimately and it can do that and it can continue to do that for a further 10 or 15 years'[288] (Developer, Windy Standard), reflecting the potential for new norms to develop.

Generally, LPAs appeared happy to accept the norm of 25 years without any real degree of questioning. Illustrating this, the LPA in Taff Ely noted that 'it just seems to have become adopted and now it's a matter of, you know, a matter of practice that that's the lifetime that's seen for these consents…, I'm not aware of that many that have deviated from 25 but you know if suddenly people start saying 30 or 20 or whatever it may be then, you know, that may become the new norm'[289] (LPA, Taff Ely). It is interesting to consider that one norm is expected to be replaced not by site-based considerations or circumstances or by public preferences as the basis of judgement, but by a new norm informed by developers' conceptions of facilities' physical and economic life. This openness from the LPA was far more evident in the case of solar, where it was more than just rhetoric. While similar to wind, there is a lack of planning policy striating consent durations, in practice there is more variability across solar sites with consent durations varying from 25-40 years and even some sites not being subject to a time-limit.[290] For solar infrastructure, there appears to be a common strategy of sites obtaining an initial 25-year consent then applying for a longer consent period (often of 40 years) a few years after operation. In the case of Pitworthy, the LPA suggested that part of the reason that time-limited conditions are used is probably for public relations as it is easier to sell to the public when it 'isn't a permanent feature

[287]Interview with Developer Windy Standard, April 2018.
[288]Interview with Developer Windy Standard, April 2018.
[289]Interview with LPA Taff Ely, April 2018.
[290]Interview with Developers A and B Pitworthy, April 2018.

even though it clearly is'[291] (LPA, Pitworthy), further suggesting that the LPA does not consider the infrastructure as temporary, while instituting consents that can be interpreted otherwise.

7.4 Exploring claims of reversibility and temporariness

As we have observed throughout this thesis, the terms reversible and temporary are often used in planning applications to highlight the benefit that infrastructure can easily be decommissioned and sites returned to their previous use and condition. The literature review identified that while the terms appear to be commonly used, there is a lack of understanding regarding how they are interpreted in practice and the social and material consequences. All five case studies reinforced arguments that land-use change created by developments is temporary, providing reassurances (of varying degrees of certainty or strength) for both LPAs and communities that the infrastructure can and will be removed (i.e., is reversible). There appears to be an assumption amongst developers that decommissioning will not present a challenge, reflecting market logic which itself makes assumptions about the future. However, there is some concern from publics (reflected in discussions with UK Government officers) that in some cases inadequate decommissioning requirements could lead to legacy issues like long-term dereliction (i.e., as some striations cannot be smoothed the anticipated reversibility will not be achieved).

This section of the discussion firstly considers how the terms reversible and temporary have been used strategically as part of end-of-life applications across cases, particularly through highlighting the ease of decommissioning. It reflects the selectivity and partiality that is implicit in claims of temporariness and reversibility i.e. what will actually become of the site or what elements will be reversed. In doing so insights are provided regarding what end-of-life factors appear to matter at the various stages of an infrastructures being (research question one), whose preferences appear to be shaping end-of-life decision-making (research question two) and the wider consequences of how the temporalities of infrastructure have been regulated through the use of such claims (research question three). Perceptions of consent durations are then discussed before a discussion of how decommissioning has been considered in practice. In doing so the use of the narrative of temporariness and reversibility is critiqued, drawing upon the arguments of Adam (1994;1995).

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[291]Interview with LPA Pitworthy, December 2018.

7.4.1 Strategic use of the terms reversible and temporary

The terms reversible and temporary were used by developers across cases to highlight the benefit of both the original and repowering/life-extension applications, through (in most cases) highlighting that they are only in place for a set period of time (usually 25-years) and particularly through highlighting that sites can be easily decommissioned and returned to their original condition and use. A common feeling amongst developers is that if wind farms are suitable in the landscape for 25-years, they should be suitable for longer periods i.e. they often consider sites as having become wind farms. Despite this, in planning applications the temporary and reversible nature of the 25-year impact on the landscape is often emphasised, demonstrating how temporal considerations can be used as part of developer tactics.

This confidence in the ability of the impact of sites to easily be 'reversed' was reflected in interviews with developers. Illustrating this, in the case of Taff Ely, the developer explained that applicants highlight the reversibility of wind farms and the benefit of having no legacy impacts compared to other infrastructure, e.g. nuclear, identifying that 'they will be removed at some point'[292] (Developer, Taff Ely). Similarly, the developer in Windy Standard highlighted the benefits of the reversibility of wind farms compared to other developments, 'I guess the difference is if you are looking at a quarrying operation, once you've dug the hole you've dug the hole, you can't just simply put the hillside back. The turbine can be decommissioned, the hillside will be returned to its natural state and can be'[293] (Developer, Windy Standard). As with many reversibility claims the developer did not specify what the natural state of the landscape should involve, however across the board there was an assumption that decommissioning will involve removal of all visible and above-ground impacts, reflecting controversy around visual impacts more generally. Thus there is a selectivity in consideration of what reversibility is expected to involve, lacking consideration of wider changes or potential becomings (discussed further in 7.4.3).

7.4.2 Perceptions of 'temporary' consent durations

The benefits of time-limited consents are widely recognised amongst developers and LPAs, particularly as they provide the opportunity to revisit applications. End-of-life measured in clock-time is comfortingly less ambiguous to regulators than a conditional

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[292]Interview with Developer Taff Ely, April 2018.
[293]Interview with Developer Windy Standard, April 2018.

‘end’, requiring a judgement that turbines are not working. A time-limited permission can be considered as a partial striation of space through time, given it leaves open other potentials and becomings at end-of-life. For LPAs, revisiting applications provides an opportunity to ensure that the site is working, to renegotiate community benefits and possibly update decommissioning requirements. For developers, revisiting applications provides the potential to increase energy output from the site. It is evident that applying for a 25-year period and then extending the life for a longer period provides a low-risk strategy for increasing the temporal lifespan of infrastructure.

Meanwhile, community considerations vary, while the benefits of providing an opportunity to renegotiate benefits and re-assess site suitability are widely recognised, there are differences in awareness of consent durations. Moreover, linked to perceptions of consent durations is the significant question of whether the infrastructure has formed a new baseline upon which future applications should be assessed i.e. if it is considered to have become a wind farm site.

Planning applications often describe 25-year consents for solar and wind farms as temporary; however, across the groups of respondents, there was a general feeling that 25 years is not a temporary period. Such a feeling is reflected in a quote from the Taff Ely developer who stated ‘3-5 years is temporary, outside that there is a degree of permanency to it’ (Developer, Taff Ely), identifying that it should be described as a set life span rather than temporary.[294] Similarly, the LPA in Taff Ely explained that temporary consents are supposed to be used in planning to assess uncertain impacts over a period of a couple of years and thus a 25-year period is not temporary and ‘for all intents and purposes it’s permanent’[295] (LPA, Taff Ely). Meanwhile, a quote from the planning consultant for Windy Standard reflected confusion surrounding the use of the terms temporary and permanent, ‘they are temporary but 25 years isn’t that temporary’...‘25 years is long enough that that feels fairly permanent’[296] (Planning consultant, Windy Standard). References to ‘temporary’ in planning applications and consents serves an abstract public interest in the possible merits of future regulation, not felt experience, potentially ignoring distributive consequences (see Davies 1972).

Reflecting such considerations, many public respondents identified that 25 years is a significant percentage of a human lifespan. Survey results reflected difficulties in considering what a temporary period should constitute. Such findings can be seen to

[294]Interview with Developer Taff Ely, April 2018.
[295]Interview with LPA Taff Ely, April 2018.
[296]Interview with planning consultant Windy Standard, April 2018.

demonstrate the way in which temporal periods can be anchored by different actors, e.g., to the human lifespan or the duration of landscapes or as a long-term human asset. There can thus be seen to be a distinction between human, embodied subjectivities of time ('it's permanent') and the attachment of measurable time to development rights (i.e. to planning consents). The benefits of a site being temporary and reversible did not feature in survey responses to why people favoured developments, however many public respondents appreciated the benefit of time-limited consents in providing a chance to review the suitability of infrastructure in the landscape. The time-limited nature of consents can thus potentially offer a degree of reassurance to communities that there will be an opportunity to re-assess schemes.

Industry identified the benefits of longer permissions, for example, 'going for a 30, 35 year planning consent makes the whole operation cheaper, so what you're doing is subsidising the subsidy you're not getting in a way'[297] (Developer A, St Breock). Such arguments often compared renewable infrastructure to other forms of infrastructure, reflecting anchoring in perceptions of suitable durations, 'I don't personally see why planning consent for them, you know wind farms, would be necessarily different to a planning consent for you know, a gas-fired power station'[298] (Developer, Kirkby Moor). 'In many ways there's no reasoning why it should be any different, why it should be any different from a commercial shed or anything else for that matter. Ultimately once you've identified the suitability of the site, it is suitable, it is simply a piece of infrastructure that sits there so there's no rationale that it should be time-limited to 25 years or 35 years'[299] (Developer, Windy Standard).

Despite preferences for longer consent periods, developers also recognised that time-limited consents provide benefits. In the case of St Breock, the developer identified that without a time-limit there is a risk of turbine abandonment and there would be likely to be a reliance on enforcement, noting that there are several turbines in Cornwall that are no longer operating, but where removal has not been enforced. They also recognised that time-limited consents are clearer for the public, describing how it 'seems the right thing to do, to put in a series of break clauses'[300] (Developer B, St Breock), so that the use as a wind farm can be reconsidered (i.e., uncertainties can be revisited). Time-limited consents provide periods of smoothing, opening-up potentials. LPAs identified such benefits, particularly in ensuring that infrastructure is not

[297]Interview with Developer A St Breock, May 2018.
[298]Interview with Developer Kirkby Moor, May 2018.
[299]Interview with Developer Windy Standard, April 2018.
[300]Interview with Developer B St Breock, May 2018.

abandoned and providing opportunities to review sites, assess performance, impacts, and renegotiate benefits, reflecting a sense that there's a public interest that is stewarded. However, the range of benefits that planners refer to in order to justify a particular form of control do not necessarily reflect all public perceptions. Publics do not currently comprise one of the groups of actors most significantly shaping end-of-life decision making (as per research question two).

Notably, the time-limited nature of consents does not appear to be the most important factor influencing decision-making as the crucial consideration is the suitability of the infrastructure and its impact on the landscape rather than its duration.[301] Assurance that the infrastructure will be decommissioned and removed without leaving traces was widely identified as more important than describing consents as temporary.[302] Thus it is the assurances provided by the use of time-limited consents rather than the rhetoric of temporariness which appears to be important. The developer in St Breock acknowledged that developments might face less opposition due to having a 25-year consent, but 'not much less', noting that 'it's not a show-stopping argument, but on occasions we've needed every, every prop we can find'[303] (Developer B, St Breock). In this way time-limited consent periods can be seen to be utilised as an extra argument in favour of the site. Additionally, time-limited permissions can only be considered beneficial for developers where there is a positive approach to facilitating repowering, reflecting the contextual nature of planning decisions.

While industry is pushing for increasing consent durations, it is not yet going to be for consents in perpetuity as there is not enough reason, or enough broken with the status quo, to do so (thus incremental change is occurring as developers cannot wholly align the future in their interests). Meanwhile, in the case of solar, permanent permissions have been granted with conditions requiring the removal of any element that stops working and the subsequent reversal of that land to agricultural use;[304] however, this is not the norm. The duration of schemes can thus be seen to be considered less in terms of presence versus absence, but rather in terms of a fluidity of possible future actions that would need to prove to be advantageous (i.e. time-limited permissions can be considered as a holding position but with no bar on permanence). While there is a potential risk to the continuation of renewable energy in the future from the use of time-limited consents, this can be considered as part of a trade-off in ensuring permission is

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[301] Interview with Developer Windy Standard, April 2018.
[302] Interview with planning consultant Windy Standard, April 2018.
[303] Interview with Developer B St Breock, May 2018.
[304] Interview with Developer Pitworthy, April 2018.

granted. It was felt that permanent permissions would face more considerable opposition from both publics and LPAs,[305] temporariness, therefore, is perceived as having opposition-softening qualities.

7.4.3 Decommissioning considerations

The research revealed the selectivity of planning regulation and policy, raising potential wider consequences (as per research question three) for elements missing from regulation – of which patchy attention to decommissioning is a major finding. Such an absence of detailed consideration of decommissioning reflects its lack of detailed consideration in existing literature and its limited treatment in Life Cycle Assessment studies (see Ardente et al. 2008; Price and Kendall 2012). Future land uses also appear to be given limited consideration due to a focus on reversibility and the assumption that decommissioning will not present challenges. Notably, in granting an original time-limited permission, some things are indeed permanent (because they are not conditioned for removal) while others are temporary. It appears common for conditions to require the removal of any visible above-ground elements, revealing partial striations and particular interpretations of what reversibility of the site should constitute.

Developers generally did not expect decommissioning or legacy issues to create challenges, but there is certainly ambivalence. The developer in Windy Standard described how although none of their sites have been decommissioned, it is something that they recognise and maintain funds for from the outset, revealing longer-term considerations of the future of sites.[306] Additionally, they explained that as some of their wind farms are approaching end-of-life, they are recognising the potential for reuse of turbines, 'when we have decommissioning what we are probably going to be talking about is the resale of those turbines to other sites. In a way where they are fully refurbished, reconditioned and as I say, most of those turbines have replacement, bigger components replaced, so when it gets to 20 years they are probably as capable of operating for another 10 years as they were when they were at their 10th year of age'[307] (Developer, Windy Standard). The St Breock developer explained that decommissioning of wind farms is considered to be self-funding through the value of the materials, 'so perhaps less of a problem than some other forms of development'.

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[305]Interview with Developer, Taff Ely, April 2018.
[306]Interview with Developer Windy Standard, April 2018.
[307]Interview with Developer Windy Standard, April 2018.

However, they also cautioned that if the turbines had no life left in them, selling the turbines or parts would not cover decommissioning costs but that 'a lot of the planners haven't cottoned onto that yet,'[308] reflecting a position that decommissioning is often considered as something that may happen in the future and has not been considered in detail by various actors. They also identified that developers are 'not going to do any more than they have to'[309] (Developer A, St Breock). Planning can thus be seen as an important factor in setting the threshold of what has to be done. From such a perspective it was identified that decommissioning may cause difficulties in the future, 'in the same way that we've had problems with quarries and all the rest of it, with not sufficient money put aside for restoration'[310] (Developer B St Breock, see also McHaina 2001), potentially influencing the becomings of sites in unexpected and unwanted ways.

Considerations of decommissioning by many developers and LPAs appear to assume that it will be relatively straight forward and will, at a minimum, involve removal of all visible and above-ground impacts. This is reflected in the lack of detailed decommissioning policies across the devolved planning systems. There is also an expectation that longer-term legacy issues will not present an issue for decommissioned sites and the two cases that have already been successfully decommissioned appear to support this (see chapter 4). Decommissioning bonds are typically used as well as decommissioning method statements (often required in conditions attached to planning consents) which usually cover how the site will be reinstated and any monitoring of the landscape which may be carried out following decommissioning.

However, an issue raised across the cases and actors was potential decommissioning challenges for some of the oldest sites that lack decommissioning conditions or bonds. This reflects existing literature regarding issues surrounding the lack of procedures or in some cases regulatory obligations for decommissioning wind farms in the USA (see Ferrell and DeVuyst 2013). The LPA in Taff Ely identified a potential issue with decommissioning bonds or agreements, explaining that 25 years ago costs of decommissioning would have been an estimate and thus are likely to be lower than actual costs, moreover they could not recall if there was a legal agreement for Taff Ely.[311] Such an example says something also about the effect of time on administrative

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[308]Interview with Developer A St Breock, May 2018.
[309]Interview with Developer A St Breock, May 2018.
[310]Interview with Developer B St Breock, May 2018.
[311]Interview with LPA Taff Ely, April 2018.

competence and power, people do not seem to know and more importantly, cannot easily find out, the terms of the grant of the original planning permission, leading to more space for uncertainty.

Infrastructure abandonment was also raised as a potential concern, as evidenced in the recognition by UK Government officers that in some cases infrastructure abandonment may occur.[312] The case of Kirkby Moor demonstrates that where decommissioning planning conditions are lacking, there is potential for large visible elements to be left in perpetuity. This was also raised as a potential issue by the LPA for Taff Ely who discussed the potential of infrastructure abandonment if a developer went bust and the LPA was left to sort it out.[313] This is illustrated in a comment by the St Breock developer who noted that there may be particular challenges for the earliest sites without time-limited consents, 'if they have an unlimited time, um and the machines become unviable and they can't secure a consent to repower, I can see there being a huge problem'[314] (Developer B, St Breock). This reflects concerns in the literature that the wind industry may experience similar abandonment issues to those experienced by the oil and gas industry (see Ferrell and DeVuyst 2013). Potential site abandonment and dereliction risk marring the 'green' connotations of wind energy, whatever claims might be made about the potential temporary and reversible nature of the impacts of such technologies. Concerns regarding abandonment and dereliction already form a dimension of wind farm opposition (Fugleberg 2014; Fadie 2017). Meanwhile, although bonds are not always used in the solar sector, it is felt that decommissioning will not present a challenge, reflecting market logics about the saleability of equipment, which itself makes assumptions about the future.

Repowering or life-extension could provide an opportunity to mediate potential issues of abandonment through providing an opportunity to construct a new fix and new compromise that includes elements not included the first time around i.e. planning conditions that impose time limits and improved decommissioning requirements. However, while repowering and life-extension can provide the benefit of improving decommissioning requirements, this raises difficult questions regarding the trade-off between the duration of turbines and the duration of other elements of the infrastructure. This creates situations in which site restoration and the difficulties of securing this without regulatory support, may be used to try to gain support for the new application, similar to cases where opencast coal mining has been justified in relation

[312]Interview with UK Government BEIS, August 2018.
[313]Interview with LPA Taff Ely, April 2018.
[314]Interview with Developer B St Breock, May 2018.

to the restoration of sites previously used for deep mining (see Milbourne and Mason 2017). In such cases a longer life for a wind farm – a renegotiation of temporariness and probably an increase in capacity – is the public ‘price’ of greater assurance of the eventual end-of-life outcome. Such narratives were evident in the case of Kirkby Moor where residents felt that improved decommissioning provisions were used as a bribe during the life-extension application.[315] Thus temporalities of control are bargaining chips and can be used to exert leverage. However, looking to the future, fewer projects will be able to point to a time un-limited initial consent, therefore there is a temporality to the dynamics of temporality in planning.

The findings support the argument of Barbara Adam that reversibility is impossible to achieve as the infrastructure is not simply abstractable from its impacts on its environment (Adam 1994; 1995; 1998). Changes occur in both the surrounding physical and social landscapes of sites over time and thus sites cannot return to exactly how they were before the infrastructure was in place i.e. any of the changes that have occurred over time cannot simply be reversed (see Adam 1998). There is thus a selectivity to any claims about ‘reversal’ or ‘full removal’. To date there is little public disagreement about the selective focus of end-of life-decisions like decommissioning. There is a widespread assumption that decommissioning will remove all above ground, visible impacts (as evidenced in developer interviews) and identification that this is beneficial when compared to the legacy impacts caused by other forms of energy infrastructure (see Pasqualetti et al. 2002; Dale et al. 2011). However, the range of changes that occur over the lifespan of a site means that it cannot be returned to the exact condition that it was in before the infrastructure was in place. Actual final end-of-life decisions have focused more on decommissioning (to the extent that they have been considered at all), i.e. what needs to un-become of the infrastructure, rather than considerations of the future land uses, post-wind. The terms reversible and temporary are often used tactically to highlight the advantages of wind and solar energy sites, however through using such concepts and planning conditions the planning system pushes certain elements to be considered at a later date. As shown in the case of Kirkby Moor (with the issues surrounding decommissioning), such unconsidered elements may return to cause problems in the future.

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[315] Interview with community members Kirkby Moor, April 2018.

7.5 Conclusion

Bringing together the research from across the empirical chapters provides several key insights, particularly regarding the range of temporal changes that occur over the lifespan of sites forming smoothings and striations. There are several temporalities dominating that are common across the sector, creating striations with particular consequences that may vary by case or circumstance. These include the significance of economic changes (particularly changes in subsidy regimes) driving developer agendas, the precedence of temporary consents, and changes in surrounding physical and social landscapes. Planning conditions can be seen to have been used as a way of managing uncertainties regarding the future of sites, providing a 'fix' but not one with certain material effects, as the majority of sites that have reached the end of their consent period have continued operation in the same or a different form. It thus seems that claims to achieve 'reversibility' or 'temporariness' for renewable energy facilities have, to date, been poorly tested by regulation designed, on the face of it, to achieve just that.

The role of precedent is significant as previous decisions become fixed moments in time, forming striations that then project on to future decisions in powerful ways, reflecting their enduring nature. In this way, the fixity of past decisions, particularly regarding the 25-year permission period, can be seen to set an accepted threshold or benchmark for asessing whether anything has changed since that point. The 25-year period has become accepted as a standard despite questions regarding its suitability given the working lifespan of turbines, perhaps as practices easily become routinised and as developers continue to follow precedent in order to reduce risk. While the 25-year period may not be considered as the most suitable, the benefits of having some temporal limits appear to be widely recognised. So there remains this tension, with windfarms continuing to be treated as temporary and this discourse of temporariness continuing to dominate, despite evidence of the longevity of sites through repowering and life-extension and despite a widespread expectation by various actors that sites will be in place for longer than 25-years. While describing permissions as temporary may influence the planning process, even more significant for both communities and LPA decision-makers appears to be the ability to decommission and remove the infrastructure (often with the aim of returning the land to its previous condition).

The patterns of decision-making revealed in this thesis are not without their critics and there are hints of potential future change. Developers expressed optimism for a more 'open future' for wind energy linked to a trend of increasing size of turbines as a 'future normal' and the possibility for a further push towards a new normal for duration. Potential changes in temporal norms are starting to be understood and regulated as governments realise that the earliest sites are beginning to reach the end of their operational life and recognise the benefits of ensuring that wind energy is kept in suitable locations. Meanwhile, life-extension, often undertaken at an early age of the infrastructure, is becoming an increasingly common occurrence for solar farms in Great Britain. Repowering or life-extension provide opportunities to construct a new fix and new compromise, that includes elements not included the first time around such as better end-of-life controls, or – as sought in Scottish Government guidance – improved community benefits (such elements, if unconsidered have the potential to cause difficulties).

Overall, the research has revealed a world in which there is a powerful tendency for end-of-life decisions to unfold in ways that negotiate but largely facilitate the ongoing presence of wind and solar farms in existing locations. However, in response to research question three, there is another consequence to this, another omission. This is the very limited consideration given to whether existing wind farms are in the best locations, in landscape terms, going into the future and if there is a public interest argument for reconsidering appropriate locations as temporary consents run out. Strategic thinking about landscape enhancement rarely, it seems, influences development control, despite widespread recognition that the 1990s ‘wind rush’ did tend to propel developers to exploit the windiest, often most visible sites first (Mitchell 1996). Only rarely do such arguments surface, often in conflictual cases, such as Kirkby Moor. Becoming a landscape free of visual intrusion is a becoming that rarely attracts effective support.

Chapter 8: Conclusion

8.1 Exploring end-of-life decision-making for onshore wind and solar

The aim of this thesis was to understand how the temporary and reversible nature of wind and solar farms are considered, constructed or resisted by the range of actors involved and how this influences end-of-life decision-making. These are vital issues if renewables are to make a long-term contribution to a decarbonised energy system and command social legitimacy. This thesis aimed to explore the reasons for particular temporal preferences by different actors, how end-of-life decisions are made, whose interests are included and excluded in that process, and with what consequences. It also sought to consider if changes in the surrounding physical, social or cultural area or shifting perceptions of the site, developer, or technology influence considerations regarding duration and end-of-life options. Through doing so, it aimed to understand the challenges for planning regulation and the broader impacts of how the regulatory planning system considers time. It achieved this through i) mapping and assessing the policy context and current status of the sector for onshore wind and solar in Great Britain, ii) providing an in-depth investigation of end-of-life decision-making in five cases and iii) analysing public perceptions through two public surveys.

One of the most significant gaps identified in the literature review was the lack of consideration regarding how end-of-life decision-making occurs in practice and how it is considered by the various actors involved. Existing literature lacks detailed consideration of what happens to wind and solar infrastructure at the end of its operational life. While there is a small amount of literature discussing developer considerations for end-of-life decision-making, particularly repowering (see, for example, Ziegler et al. 2018), keeping consented wind energy capacity in place over time faces several issues and complexities and thus ought to be seen dynamically. This research has revealed the potential challenges surrounding end-of-life issues. It has shown that end-of-life is a bundle of concerns, affecting i) the specific equipment, with developer assessments of viable physical or commercial life and the benefits of replacement, ii) the temporal terms of any planning consent, which have conventionally been time-limited, iii) the ongoing presence of a wind energy-generating facility and its relationship to that site, the landscape and the public. Each has its own temporality, which require coordination but also create the possibility for tensions.

This thesis has produced a wealth of data in a sphere that has been little studied, providing useful findings for both academia, policy, and practice. The research was shaped by three research questions, section 8.3 addresses the main findings for each in turn. The chapter then provides an overview of the wider research contribution before discussing limitations, suggestions for future research, and recommendations for policy and practice.

8.2 The benefits of adopting a Deleuzian approach

Adopting a Deleuzian approach helped facilitate an exploration of the complexities of end-of-life decision-making by providing an insightful ontological perspective on the nature of reality. It enabled the impacts of renewable energy developments to be considered as part of a world in which developments, environments, and social concerns are all in flux, rather than merely as a development that will be there and then removed. Such an approach enabled exploration of the temporal dynamics of energy infrastructure, particularly in terms of how energy landscapes are reproduced over time. Deleuzian ideas of being and becoming were significant in the design of this research in terms of understanding what drives the becomings: of the various assemblages influencing the renewable energy projects, the research participants, and the wider sites. Instead of simply considering sites as wind farms, it considered them as complex spaces with various uses and human and non-human aspects that change over time (see Bonta and Protevi 2004), as sites that are influenced by a multiplicity of changes and thus constantly in flux. Deleuze and Guattari's (1987) concepts of striated and smooth spaces facilitated consideration of how sites change over time due to the influence of an intricate network of material and non-material factors that go beyond overt state steering. Through considering such processes, the research revealed how wider changes in society, landscapes, policies or economic factors have the potential to impact what a site becomes.

8.3 Answering the research questions

This thesis sought to answer three research questions the main conclusions for which, in turn, are as follows:

1. **How do different actors (including developers, Local Authorities, the public, and any others) prepare and plan for end-of-life decision-making for wind and solar facilities? For each actor:**
   a) What end-of-life factors matter?
   b) What timeframes are sought and invoked?

This thesis revealed the multiple temporalities (see Adam 1994;1998; 2004) influencing end-of-life decision-making for each group of actors, including the range of material and non-material changes occurring over the lifespan of sites. The findings revealed how considerations of duration and end-of-life factors vary amongst actors. Due to their priorities, each group can be seen to have preferences for different time frames and to place different emphasis on preparing for the end-of-life of sites. Taking each of the key groups of actors in turn:

i) Central governments

This thesis revealed how end-of-life issues have only recently emerged as a concern for national governments. There is often a lack of consideration of the end-of-life of the infrastructure or its duration at point of consent, as the future is usually striated by planning conditions, reflecting some degree of deferred control and influence. Longer-term considerations of the infrastructure are thus enclosed by regulation, but not an object of intense, strategic concern. Notably, since 2014 in Scotland and 2018 in England and Wales we have seen governments seeking to establish the long-term appropriateness of existing sites for wind power, to provide a conducive context for the consideration of future wind energy projects. Through doing so the temporariness of wind energy is being renegotiated. English, Welsh, and Scottish Governments have all moved to adopt supportive policy stances on repowering, although there is a lack of detail regarding how applications should be assessed, particularly in England and Wales. The Scottish Government has given the most significant consideration as to what needs to be considered as part of their longer-term approach to wind farm sites. Where governments have intervened to influence dynamics of end-of-life decisions, it has been with a view to helping maintain wind energy capacity into the future, thus striating space for the continuation of this use. Meanwhile, government policy in all cases gives simplistic consideration to decommissioning, focusing on ensuring that above-ground visible elements are removed, reflecting an assumption that it will not present challenges. There is no policy specification of a time period of duration for solar or wind farm sites, reflecting a degree of openness at a government level.

ii) Local Planning Authorities

At LPA level, there has been a similar lack of strategic consideration regarding the long-term future of sites, with LPAs largely being reactive to developers' applications and the limited government-level guidance steering decisions. This is reflected in the lack of local-level policy for repowering, life-extension, decommissioning, or duration of sites. It is also reflected in challenges faced by LPA decision-makers in assessing end-of-life applications and their identified need for greater policy or guidance from central government to steer decision-making. The main concern for LPA decision-makers appears to be ensuring that infrastructure will be removed at the end of its operational life, rather than the duration of its being, reflecting the broader concerns of government policymakers. However, the time-limited nature of consents appears significant for LPAs to ensure that eventual removal will occur and to provide flexibility for future developments and changes in the interim including land use, viability, or technology changes. LPA decision-making appears to have been easier for solar sites, reflecting that temporal concerns are not considered as such an issue for solar.

In the past, long-term legacy issues have not been given significant consideration from LPAs, with some of the oldest sites having been granted permission with inadequate decommissioning requirements or without decommissioning bonds. From the cases explored in this research, this issue does not appear to pose a concern to many LPAs due to the assumption that developers will either repower or sell the infrastructure. The focus of LPAs is thus largely on granting consent and reacting to applications as they arise, reflecting wider literature identifying the short-term nature of the planning system (Myers and Kitsuse 2000; Couclelis 2005; Van Der Knaap and Davidse 2010). The use of planning conditions and legal agreements to ensure that decommissioning will occur has developed over time and in most cases this involves removing all visible above-ground elements. As with government policy, there is a lack of consideration regarding how changes that may occur to the site over time should be considered.

iii) Developers

While developers have experienced a high success rate for end-of-life applications, in most cases securing what they asked for, the things developers ask for have been shaped by broader economic forces, policy, and norms. Their end-of-life strategy is usually very closely linked to economic temporalities, particularly subsidies. Changes in subsidy regimes and an uncertain government planning policy context (especially in England) can be seen to have striated the decision-making context, creating difficulties for both making end-of-life decisions as well as deciding whether to implement existing consents. Subsidy regimes have striated end-of-life decisions through having a set expiry date. Developers thus regularly test end-of-life options in order to assess if it is more viable to run existing sites with subsidies (potentially involving life-extension) or repower. Additionally, the use of sites as investment assets is central to solar developers' temporal strategies.

The strategies of developers are also influenced by site-specific factors, each with their own temporalities, including the ability to extend the land lease, the condition of the turbines and calculations of the possibility of obtaining planning permission. Managing community relations is often a central part of developer strategy and thus in many cases, they attempt to establish good relations with the community alongside the provision of community benefits. The duration of the original consent can also influence end-of-life decision-making as sites without time-limited consents can continue to run through replacing parts. While developers would prefer longer (than the common 25-year period) consent periods for infrastructure, they have not yet pushed for such consents due to perceived risks of transgressing regulatory norms. Their tactics thus often rely on obtaining consent then looking to extend the permission at a later date (or a relatively near date in the case of solar).

iv) Publics

In many cases, publics appear to have little knowledge of the time-limited nature of planning consents and have given little consideration to decommissioning, particularly in the case of solar infrastructure. Significantly, this research revealed how publics are often largely unaware of the duration of energy infrastructure until an end-of-life application is submitted, smoothing space and opening up discussions and interest around potential futures. In some instances end-of-life applications provide an opportunity for opposition to (re)surface, demonstrating that while there may have been some acceptance of facilities while publics were unable to exert impact, an end-of-life application re-opens the opportunity, creating new potentials for influence. As the Kirkby Moor case demonstrates, publics may use an end-of-life application to campaign for the removal of infrastructure, significantly increasing local awareness of the time-limited nature of the site. The research shows that opposition to life extending applications is particularly likely where publics perceive few benefits from the existing site, have bad relations with the developer, or if elements have changed over the life of the site (such as designated landscapes). Moreover, temporal issues provide another argument to be used by opposition groups i.e. the failure to deliver temporariness.

Conversely, in cases where communities have a positive outlook on end-of-life applications they can often recognise the benefits that they have gained in terms of money spent on community projects over the lifetime of the scheme and often have a positive perception of the developer.

In many cases, publics appear more concerned with ensuring that the infrastructure will be removed at end-of-life, avoiding dereliction, rather than the exact duration of consent. They often recognised the benefits of time-limits in terms of providing an opportunity to review applications but did not have a definite opinion on what that duration should be. There was ambivalence on whether 25 years could be considered ‘temporary’ and it appeared that in most cases the public had not considered what would happen to infrastructure in the future.

2. **Whose preferences most significantly shape end-of-life decision-making?**

Graham and Healey (1999) argue that different actors involved in the planning and development process operate on diverse notions of time and through favouring certain notions of time the planning system may undermine particular interests. They identified that it is often the more powerful groups with clear understandings of their space-time parameters, such as corporate interests, that have the most influence. From such a perspective time can be considered as a resource, as something that can be used strategically (see Raco et al. 2018). In the case of renewables, this research showed that end-of-life can be seen as a negotiation between the actors involved, with the interests of the developer usually having more considerable influence. From looking at the success rate for repowering and life-extension applications, wind and solar farm developers could be considered as powerful actors due to their ability to align many different threads impacting end-of-life. However, while the preferences of developers can often be seen to dominate, their strategies are often striated by the policy context, economic factors, and precedents of the sector.

Across cases, local public perception does not appear to significantly shape decision-making as end-of-life applications appear to have been granted irrespective of levels of opposition. While the long, conflictual history of the Kirkby Moor case reflects the strength of significant local opposition, the granting of the application at appeal reflects developers’ interests continuing to win. Meanwhile, government policy on end-of-life issues and LPA responses appear to have been reactive, primarily guided by the behaviour of developers and have shifted from initial scantiness to gradually tip the balance of considerations in favour of site re-use and facility life-extensions and against removal at 25 years.

This question also sought to understand the influence of different actors at potential end-of-life decision-making moments:

(i) Before projects are consented.

In the case of both wind and solar, a key concern for developers is obtaining consent, they are thus likely to pursue a lower-risk strategy of opting for the norm in terms of duration of planning consent (i.e., in Great Britain, 25-year permissions). The benefits of the temporary and reversible nature of schemes are often promoted and discussed in planning documents; however, visual impact appears to be a key influence on public response, to a greater extent than duration.

(ii) When projects are consented and in any conditions.

When granting permission, LPAs can be seen to use planning conditions to control certain elements such as decommissioning so that consideration of some aspects of end-of-life are deferred to a future point, embraced within regulatory control but with a lack of detailed consideration. Developers are likely to accept the imposed consent duration even if they plan to change it in the future (as is often the case in solar) and thus LPAs can be seen to have influence at such moments in time.

(iii) At end-of-life.

End-of-life decisions are not always undertaken at the end of the working life of the infrastructure as multiple factors can be seen to come into play to influence timing (e.g. economics, policy context, condition of the infrastructure). Developers may undertake applications early due to financial reasons such as selling the existing turbines or to achieve greater efficiency benefits. They may also undertake them when they consider it least risky to do so, reflecting their power to trigger end-of-life considerations at a chosen point. End-of-life applications open up the potentials for the site, providing an opportunity for all actors to come together and for the duration of the infrastructure (which previously may have been given little consideration) to be discussed. Such applications often reveal to communities that the infrastructure is time-limited and that there is a potential for removal. Such a context can enable public opposition to resurface; however, the influence of such public opposition appears limited.

End-of-life applications provide an opportunity to consider what has changed over the life of the site, but this appears to only be considered in terms of what is regulated by the planning system, e.g., policy changes, land designations, updated landscape, and visual assessment, rather than considering what may have changed for the local community. In this way, the planning system can be seen to partially striate end-of-life decisions, making certain futures more likely.

(iv) At any intermediate point where repowering or life-extension is considered.

Of the various actors involved, developers are the least short-termist and this too confers power to them. Developers often have to consider end-of-life options at an early point due to wider influences including economics, policies, and the planning system. Moreover, many undertake ongoing analysis of potential end-of-life opportunities. It does not appear that any other actors consider the duration or future of the site until an end-of-life application is submitted, end-of-life considerations are thus initiated from developers. It is developers who bring the different end-of-life temporalities into moments of action or initiation.

3. What are the wider consequences of how the temporalities of renewable energy infrastructure are regulated?

The research revealed the multiple temporalities (see Adam 1998; 2004) in play influencing wind and solar farm sites, revealing how planning acts selectively on them, with distributive consequences. In doing so it revealed consequences for the regulation of energy infrastructure as well as wider insights for planning regulation. In Great Britain, planning policy for wind and solar can be seen as strategically selective, focusing on regulating consents and lacking consideration of broader impacts that may change over time or what may happen to the infrastructure at the end of its consent period, reflecting a deferral of certain aspects. It appears that developers coordinate while planners regulate time. Through focusing on elements i) at the point of consent and ii) when they present an issue, the planning system defers consideration of physical and social changes that may occur over the duration of the site. Changes may include physical changes such as accumulating developments (e.g. the wind farms in Windy Standard) and land designations (e.g. the WHS designation in Kirkby moor) as well as changes in the social landscape (e.g. recognition of community benefits in Taff Ely), that can influence the decision-making context.

This thesis uncovered potential problems surrounding end-of-life issues - temporariness is anything but simple and thus the use of the term temporary in planning can be problematic. Such findings reveal how planning regulation and the actors involved in the planning system are partial in their engagement with temporalities and utilise particular temporal terms and considerations while pushing others aside in order to act in favour of achieving development. One result is that planning action has served, mainly, to reproduce and enlarge wind energy capacity.

In the case of wind and solar infrastructure, the terms temporary and reversible can be seen to have been used as social constructs to highlight the potential advantages of the infrastructure and legitimise regulatory control. However, temporariness is not an innate property of the infrastructure as sites are often replicating in the same locations through a series of time-limited consents and their development has wider ramifications. Through being broadly facilitative of repowering and life-extension, there has been no revisiting of the wisdom of initial siting choices and limited attention to decommissioning, reflecting a focus on continuation of development in existing sites rather than opening up sites to an array of future potentials.

Beyond the regulation of energy infrastructure, this research provides broader insights regarding how the regulatory and development control aspects of the planning system consider time. It demonstrates how consideration of multiple temporalities provides useful insights for planning through enabling an exploration of the multiplicity of changes occurring over the lifespan of developments, impacting the context in which decisions are made. Considerations of time can be seen to impact sustainable and equitable outcomes through influencing what is considered, in what level of depth, and what is left outside regulation. Significantly, the thesis revealed how difficulties may arise when sufficient attention has not been given to the future e.g. how inadequate decommissioning conditions may lead to potential issues of infrastructure abandonment.

8.4 Research contribution

As outlined in the introduction, this thesis is located at the intersection of several overlapping debates: in energy transition, in key dimensions of sustainability (particularly reversibility and justice), and in the treatment of time in planning. While considering such debates has been essential in the design of this research through highlighting the wider context influencing end-of-life decision-making for energy infrastructure, this thesis also provides insights for these broader issues.

8.4.1 Insights for the Energy Transition

Considerations of the global energy transition provided the broader context in which this research was situated. The continuation of existing renewable energy schemes is likely to form a crucial element of the global transition towards sustainable energy systems, particularly in the context of the need for the transition to occur quickly (see Sovacool 2016). This research has revealed potential challenges associated with the ability of existing renewable energy generation sites to continue contributing to future energy production, particularly if a longer-term approach to sites is not considered. This is important as the stock of energy capacity is not fixed, rather it is a fluid entity subject to ongoing needs for repair, adaptation, and re-consent. Although most end-of-life applications so far have been consented, there are no guarantees that renewable energy sites will continue in the future as subsidies end and existing infrastructure wears out (see also Kooij et al. 2018). This research unearthed examples of refusals and there is undoubtedly potential for the multiple temporalities pervading end-of-life decisions to slip into new alignments that make life-extension less certain.

The research has revealed that, in Great Britain, through focusing on time-limited consents there has been a lack of consideration regarding what happens to sites when their consent period ends, including how applications to replace the turbines with more efficient turbines through repowering should be considered. Periods of policy absence and turbulence (in England) and challenging economic conditions, including the removal of subsidies, have led to delays in submitting repowering applications or in developers pursuing a lower-risk strategy of life-extension rather than replacing existing turbines with new, more efficient turbines that would increase overall energy output. While recognising this potential challenge, the thesis also helped to specify the potential to increase energy output from existing sites through repowering (see chapter 4), providing benefits in terms of land-use efficiency. Adopting longer-term considerations of energy sites and following a positive approach to repowering, such as in Scotland, could thus be beneficial for the global energy transition in terms of increasing energy generation. Meanwhile, it is also important to consider that the energy transition may bring new, more efficient, technologies that may replace existing technology. In this context, time-limited consents may constitute a useful compromise between flexibility and control, though the research has also shown that inadequate decommissioning provisions may present a challenge.

8.4.2 Questions of justice

Decisions regarding the future of sites, particularly concerning the location and longevity of infrastructure, raise questions regarding responsibility to and the possible impacts on both the current generation and future generations. Of particular importance in this research was how the future is represented and considered, especially as there is often a bias in terms of a focus on the short-term in policymaking (see Boston 2016). This research revealed that in most cases wind farm sites are continuing to operate beyond their original time-limited consent period, despite rhetoric of temporality and reversibility and the apparent assurances provided to local communities (in planning application documents) that they would be removed after the set period. This is reflected in the high success rate of repowering applications (see chapter 4). Sites appear to be granted permission to continue operating either through repowering or life-extension, irrespective of levels of local public response. End-of-life can thus be seen as an opportunity that opens up a range of potentials rather than ensuring infrastructure removal.

Broadly speaking, in substantive terms, it is hard to impute injustice to this outturn given that in many cases local communities are happy for sites to continue beyond their original permitted life, particularly if the community is receiving benefits and as long as the consent is not in perpetuity. However, in some cases communities desire the removal of such infrastructure and here we can see issues arising from the failed promise of temporariness, which could be the basis of perceived procedural injustice (see Sovacool and Dworkin 2015). Cases such as Kirkby Moor (referring specifically to the granting of life-extension at appeal) reveal that communities who oppose continuation of the infrastructure are not always able to influence outcomes.

Moreover, currently in decision-making, there appears to be a lack of consideration of future generations. Keeping options open may be one way of genuflecting towards intergenerational justice, but undue optimism towards market processes facilitating adequate decommissioning might not.

8.4.3 Energy perception and acceptability

Existing research on social acceptance of renewable energy has concentrated overwhelmingly on initial consenting decisions for wind farms, tacitly assuming that this is the critical decision-point shaping the evolution of wind energy capacity into the future. Such research often appears to consider the development and decision-making process in simple binary terms (i.e., the infrastructure was not there and now it is), ignoring the scope for projects to evolve and change over time. Yet as this research has highlighted, keeping consented wind energy capacity in place over time faces numerous challenges and ought to be seen dynamically. While there are a small number of existing studies considering longer time periods (such as Eltham et al. 2008 and Wheeler 2017), these appear to lack consideration of the time-limited nature of developments, possible repowering and life-extension, and the potential consequences on perceptions. This thesis provides a new dimension to such research through demonstrating how end-of-life applications can provide an opportunity for discontent to resurface and opposition to occur. It also demonstrates how in other cases people appear to accept that a site has become a wind farm irrespective of consent durations.

Existing research suggested that familiarity with a development can lead to contentment as people are often more favourable of the infrastructure once it has been built (see Warren et al. 2005; Wolsink 2007; Eltham et al. 2008; Wilson and Dyke 2016). However, this research identified that perceptions of infrastructure do not always change once the development is built, supporting those such as Sovacool (2009b) who suggests that once values are formed regarding energy, they are difficult to change. This thesis also supports Devine-Wright (2005), who suggested that due to the multidimensional nature of familiarity and the contextual nature of wind farms there is unlikely to be a direct linear relationship between experience and public perceptions. Wolsink (2007,1199) noted that while the U-shape curve demonstrates the ‘non static nature of attitudes’ it is ‘by no means a guarantee for improvements in attitudes after construction’ as the ‘effect can only be seen if the existing environmental impact is adequately dealt with in the eyes of the local population.’ This thesis develops this further by demonstrating that there are a host of other factors influencing how attitudes to renewable infrastructure may change over time, most significantly, but not limited to, community relations with the developer, existing benefits from the site, and changes in the surrounding landscape. Public attitudes can also be influenced by how people conceptualise the baseline against which to judge end-of-life applications i.e. if they consider the site to have become a wind farm (as in St Breock) or if they consider the infrastructure as temporary, wanting the site to return to how it was before the development was in place (as in Kirkby Moor). Such considerations of what the baseline should constitute can be seen to have varied amongst the cases and actors.

This thesis addressed another limitation of existing research in that it provides little consideration regarding how the interaction between the public and other social actors can influence renewable energy outcomes (Wolsink 2000; Aitken 2010a; Friedl and Reichl 2016). Through linking social attitudes with the regulatory context and incorporating the views of the range of impacted actors, this thesis revealed how particular interests (predominantly of developers) dominate decision-making. It also demonstrates how intense resistance acting on the LPA can cause delay, but may not disturb broadly presumptive entitlements for consented land uses to remain.

8.4.4 Reversibility

The term reversibility entered the lexicon of debate about the relative sustainability of different energy sources without being clearly conceptualised or unpacked. While reversibility is identified as an inherent quality of onshore wind and solar, regularly the duration of infrastructure has been extended further into the future. In this context, the idea of reversibility can be seen as a tactic for getting support for a scheme (see also Corvellec, 2007), with such assurances regularly accepted by the planning system and a lack of critique at the point of decision-making regarding if it will be achieved in practice. Proponents argue that the impacts of a scheme can be reversed through the removal of all above-ground infrastructure, creating a situation in which the site is considered to be as it was before the renewable energy development was in place. There is a lack of consideration of what may be left below the surface, generally, like the future, this is out of sight and out of mind. However, the complex reality of reversibility is becoming apparent in emerging discussions about which components of closed facilities need to be removed and in potential issues of abandonment. Moreover, reversibility at the end of the operation of the infrastructure is not automatically what is desired by all actors, particularly in cases where residents would support the continuation of use as a wind farm in order to continue receiving community benefits (as evident in Taff Ely).

This thesis supports the perspective of Adam (1994,1998) who maintains that achieving complete reversibility is not possible. It also adds strength to Adam's (1994) argument that machines are not simply abstractable from their surrounding environment, through demonstrating how wind and solar farms comprise a range of entities including, but not limited to the physical land, social interactions, alternative uses and users of the site, the surrounding environment, and policy contexts, rather than simply the wind farm infrastructure. Because sites are complex spaces (see Bonta and Protevi 2004) with the various human and non-human entities changing over time, complete reversibility is impossible (Adam 1994,1998).

8.4.5 Considerations of time within planning

This thesis furthers existing literature such as Graham and Healey (1999); De Roo and Silva (2010); Del Río et al. (2011); Abram (2014) and Moffatt (2014), that suggests that planning needs to explore multiple aspects of time, evidencing the need for expanding such an approach to planning regulation rather than just plan-making. This research supports the arguments of Adam (1994; 1998) that we need to explore the multiplicities of time in social affairs and it has shown the insights gained by doing so. Existing literature identified that planning can often be seen to focus on issues that are having the greatest impact on the near-future in order to achieve political gain and short-term results (Myers and Kitsuse 2000; Van Der Knaap and Davidse 2010). In this context, the conceptualisation of the near-future can be seen to provide a catalyst for action, while in reality the future may be changing (Abram 2014). This can be seen to have occurred in the case of planning for wind and solar farms, with limited consideration being given to end-of-life options. The research revealed that there is a potential challenge in the planning system's invocation of temporary consents for wind and solar infrastructure that rarely, in fact, control development time frames, reflecting ideas of planning creating a 'promise' to the future that often is not kept (see Abram and Weszkalnys 2011).

The findings of this thesis support the views of Abram (2014) and others that planning is more complex than how it is often considered in planning regulation as there are a multiplicity of factors influencing the decision-making context. It demonstrates how planning regulation, through focusing on strict notions of time, can push certain elements outside of consideration (such as through the use of planning conditions) that may return to cause challenges in the future, such as infrastructure abandonment.

8.4.6 The use of Deleuze in planning

Questions have been raised regarding the use of Deleuze in planning, particularly regarding whether Deleuze can be translated into practice or only provide theoretical insights and also what situations it can provide insights for (Abrahams 2016). This research has developed the existing limited application of Deleuze to planning research through applying it to the development control and regulation side of planning. In doing so it has revealed how a Deleuzian perspective can provide useful insights for both the theory and practice of planning regulation. Deleuzian concepts such as assemblages and becomings are non-essentialist (DeLanda 2006) and thus overcome the critique of many planning tools as being essentialist i.e. rigid and unable to account for contextual differences and complexities (Abrahams 2016). Illustrating this, the research has shown how considering the elements influencing the regulation of infrastructure as in processes of flux and becoming facilitates an understanding of what may change over the lifespan of sites, altering the context in which end-of-life decisions are made. A Deleuzian approach can also be seen to enable an exploration of multiple elements of time (see Adam 1994; 1998; 2004) rather than simple, linear notions of time. It facilitates exploration of the multifaceted nature of planning through consideration of the elaborate relationships between human and non-human influences (see Hillier 2008).

This thesis agrees with Hillier (2011) that planning needs to recognise tensions and conflicts rather than suppressing them. The findings demonstrate how through unsettling the fixity of things, such as landscapes, development projects, and time, a Deleuzian approach can facilitate useful insights regarding the range of factors that may influence the regulation of developments and reveal the selectivity and partiality of planning's regulation of change over time. Such insights can be translated into practice through both regulation and developers considering a longer-term, broader approach to energy sites, including consideration of what elements need to be controlled, how local perceptions may change over time and what will happen at the end of the planning consent i.e. considering entities in terms of what they might become. Significantly, this research has demonstrated how considering entities as static, or failing to consider the range of changes occurring over time, may create challenges in the future (illustrated in potential difficulties such as infrastructure abandonment occurring for wind farm sites).

8.5 Limitations and implications for planning practice and further research

There are several limitations to this thesis that provide avenues for future research. While the research aimed to explore the temporal dimensions of the infrastructure, it has its own temporality, being limited by the three-year duration of the PhD. Consequently, for temporal depth it relied on i) selecting cases that reflected different temporal stages, ii) undertaking a document review of previous decisions and public comments iii) retrospective self-reporting in surveys and interviews. It is suggested that future research involves investigating perceptions (of all actors involved) at three key stages of a wind farm's life i) early in its life, ii) when an end-of-life application has been submitted, and iii) after the site has been repowered or life-extended, in order to get a more in-depth understanding of how perceptions may change over time. Moreover, this thesis only looked at one solar case study. However, interviews revealed that permission durations vary significantly between LPAs, further research into solar sites with different permission lengths may provide an interesting exploration of how and why such consent durations vary.

This thesis was undertaken at a time when the oldest wind energy sites were beginning to reach the end of their consent life and when only a small number of sites had repowered or life-extended (see chapter 4). Significantly, over the duration of this thesis, policy for repowering developed in all three countries. It will thus be useful to undertake similar research in the future to explore what trends have emerged over time and how policy has been interpreted. Moreover, as this research revealed a range of potential challenges associated with decommissioning, most significantly the potential for infrastructure abandonment, future research may look in more detail at challenges associated with decommissioning onshore wind farms.

While this research focused on Great Britain, the assessment has relevance in a host of other countries, especially in Europe, where there is evidence of tightening spatial constraints around new onshore wind energy development[316] which makes the dynamics of end-of-life decisions increasingly important. In many places, more intensive exploitation of existing wind power sites will be a central development

[316]Interviews undertaken with wind farm developers, governments and industry bodies between April – September 2018 identified that wind farms in Europe are expected to face tightening constraints due to European environmental and land designations that have occurred since infrastructure has been in place.

trajectory for onshore wind. It will thus be significant to understand how the duration of energy and other infrastructure is treated in other countries. In Great Britain, most of the oldest and largest wind and solar farms are owned by commercial developers, however internationally there are a higher number of wind and solar farms owned by community-level organisations, providing a potentially interesting contrast. Future research may benefit from exploring the influence of different ownership forms on end-of-life decision-making, again in an international context. Additionally, social attitudes research might more specifically investigate the explanatory power of embodiment, age, and affect in shaping attitudes to time in renewable energy consents.

In conceptual terms, this thesis affirms the need to understand the ways in which planning policies consider time and whose interests are being reflected or set aside as a result of the process and terminology used within planning, as suggested by Graham and Healey (1999) and others. This thesis has demonstrated the benefits of looking beyond the linear notion of time to consider multiple temporalities as inspired by Adam (1994; 1995; 1998), in order to explore the complicated range of temporal impacts influencing planning regulation. This is something that needs to be developed further for planning regulation, beyond the context of energy infrastructure. Adopting a Deleuzian approach to research can be seen as a useful means of facilitating this, as discussed above.

8.5.1 Potential implications for policy and practice

Globally, there are lessons to be learnt regarding policy for onshore wind repowering, life-extension, and decommissioning. The research has revealed how a policy absence for life-extension and repowering can create a very difficult decision making context for both developers (regarding whether to submit an application) and local authority planners (regarding assessing applications). As this research demonstrated, there is often a need for clarification on how local authority planners should assess repowering and life-extension applications due to the complicated nature of the applications, the trade-offs involved, and changes in visual impact. Importantly, there is a need for clarification on how the baseline upon which applications are assessed is considered. A supportive policy needs to provide details on what should be considered in such applications, such as greater community benefits through shared ownership and greater environmental enhancements. As this research has shown, end-of-life decisions are an opportunity to revisit the social and environmental judgements embodied in the original consent decision. Having a clear policy in place is important for ensuring that suitable sites are able to continue contributing to renewable energy targets for a longer period and hopefully to a larger extent through increased capacity. However, it should not be assumed that the oldest sites are always the best located, and, thus, such policy needs to occur as part of an overall supportive approach to ensuring that renewable energy development occurs in the most suitable locations, potentially including reviewing the locations of existing sites alongside potential new sites.

A further potentially very significant issue is the possibility of infrastructure abandonment. There are likely to be challenges with existing sites where there is no requirement on any party to remove infrastructure. It shouldn't be assumed that repowering / life extension will address all such issues, as not all sites will be suitable for repowering, and improved decommissioning should not constitute the justification for an end-of-life application. An adequate decommissioning policy requiring the removal of turbines and any associated infrastructure is important for ensuring that such potential issues do not continue in the future. Moreover, this thesis suggests that decommissioning policy should be open to future potentials (i.e. to facilitating a different land use) rather than specifying that the land should be returned to exactly how it was beforehand – recognising that things change over time and thus reverting to the past may not always be desirable or possible.

Additionally, a key issue of policy concern raised by this thesis is the use of time-limited planning consents for onshore wind and solar. While 25-year consents have become the norm for onshore wind, turbines are often capable of working for longer periods. For such reasons, from an energy policy perspective, this thesis recommends the use of conditions based on the operational life of wind and solar farms (i.e., they should be removed once they fail to operate for a set period), rather than using a fixed time-limit. To reduce the need for reliance on enforcement action from local planning authorities, such consents could involve a review after a set period of time.

This thesis also provides recommendations for practice for both developers and planners. For renewable energy developers this research demonstrates the benefits of building good relationships with local communities over the life of schemes, taking on board their feedback, and actively ensuring that they know how to access, and are able to utilise, the community benefit funding. Such measures are important in terms of building trust and a positive relationship between the community and developer and are likely to help foster social acceptance (see Devine-Wright 2007; Walker et al 2010) for end-of-life proposals. In cases where communities were originally assured that the infrastructure would be decommissioned and the land restored at the end of the permission period, developers need to ensure that communities understand the benefits of life-extension or repowering and actively involve them in shaping the scheme.

While a Deleuzian approach recognises the benefits of plans being open to change (Hillier 2008), at least two aspects could make the decision making process easier:

- Additional guidance for local authority planners on the various end-of-life options for the sector; and
- A clear policy approach to repowering and life-extension including confirmation of the aspects that need to be given material consideration and confirmation of the baseline on which applications should be assessed.

More widely, this thesis has revealed that planning practitioners could benefit from adopting a broader temporal perspective – thinking beyond the ‘linear’ notions of regulatory clock time, to consider what may change over the duration of developments, how this should be considered and potentially controlled. Such changes could be achieved through additional training and knowledge sharing.

References

Abrahams, G. 2014. *Deleuze's philosophy and its usefulness to planning : A case study of BRE assessments (Doctoral thesis)*. Cardiff University.

Abrahams, G. 2016. *Making Use of Deleuze in Planning: Proposals for a speculative and immanent assessment method*. Routledge.

Abram, S. 2014. The time it takes: Temporalities of planning. *Journal of the Royal Anthropological Institute* 20, pp. 129–147.

Abram, S. and Weszkalnys, G. 2011. Introduction: Anthropologies of planning—Temporality, imagination, and ethnography. *Focaal—Journal of Global and Historical Anthropology* 61, pp. 3–18.

Adam, B. 1994. *Time and social theory*. Cambridge: Polity Press.

Adam, B. 1995. *Timewatch: social analysis of time*. Cambridge: Polity Press.

Adam, B. 1998. *Timescapes of Modernity: The Environment and Invisible Hazards*. London: Routledge.

Adam, B 2003. Reflexive modernization temporalized. *Theory, Culture & Society,* 20(2), pp.59-78

Adam, B. 2004. *Time*. Polity Key. Polity Press. ed. Cambridge.

Adams, A. and Cox, A.L 2008. Questionnaires, in-depth interviews and focus groups. In: Cairns, P. and Cox, A. L. eds. *Research Methods for Human Computer Interaction*. Cambridge: Cambridge University Press, pp. 17–34.

Aitken, M. et al. 2008. Locating 'power' in win power planning processes: the (not so) influential role of local objectors. *Journal of Environmental Planning and Management* 51(6), pp. 777–799.

Aitken, M. 2010a. Why we still don't understand the social aspects of wind power : A critique of key assumptions within the literature. *Energy Policy* 38(4), pp. 1834–1841.

Aitken, M. 2010b. Wind power and community benefits: Challenges and opportunities. *Energy Policy* 38(10), pp. 6066–6075.

Alexander, E.R. 2005. Institutional Transformation and Planning: From Institutionalization Theory to Institutional Design. *Planning Theory* 4(3), pp. 209–223.

Allen, C.D. 2011. On Actor-Network Theory and landscape. *Area* 43(3), pp. 274–280.

Allmendinger, P. 2002. Towards a Post-Positivist Typology of Planning Theory. *Planning Theory* 1(1), pp. 77–99.

Andersen, P.D. et al. 2014. Recycling of wind turbines. In: *DTU International Energy Report 2014: Wind energy—drivers and barriers for higher shares of wind in the global power generation mix.* Technical University of Denmark (DTU), pp. 91–97.

Antrop, M. 2000. Background concepts for integrated landscape analysis. *Agriculture, Econsystems & Environment* 77, pp. 17–28.

Ardente, F. et al. 2008. Energy performances and life cycle assessment of an Italian wind farm. *Renewable and Sustainable Energy Reviews* 12(1), pp. 200–217.

Bailey, E. et al. 2016. Using a narrative approach to understand place attachments and responses to power line proposals: The importance of life-place trajectories. *Journal of Environmental Psychology* 48, pp. 200–211.

Barry, J. et al. 2008. Cool Rationalities and Hot Air: A Rhetorical Approach to Understanding Debates on Renewable Energy. *Global Environmental Politics* 8(2), pp. 67–98.

Batel, S. and Devine-Wright, P. 2015. Towards a better understanding of people's responses to renewable energy technologies: Insights from Social Representations Theory. *Public Understanding of Science* 24(3), pp. 311–325.

Bazeley, P. 2004. Issues in Mixing Qualitative and Quantitative Approaches to Research. In: Buber, R. et al. eds. *Applying qualitative methods to marketing management research*. Palgrave Macmillan, pp. 141–156.

Belisle, P. 1998. Digital recording of qualitative interviews. *Quirk's Marketing Research Review* 12(18), pp. 60–61.

Bell, D. et al. 2005. The 'social gap' in wind farm siting decisions: Explanations and policy responses. *Environmental Politics* 14(4), pp. 460–477.

Bell, F.G. and Genske, D.D. 2000. Restoration of derelict mining sites and mineral workings. *Bulletin of Engineering Geology and the Environment* 59(3), pp. 173–185.

Bender, B. 2002. Time and Landscape. *Current Anthropology* 43(S4), pp. S103–S112.

Bickerstaff, K. 2012. "Because we've got history here": nuclear waste, cooperative siting, and the relational geography of a complex issue. *Environment and Planning A* 44, pp. 2611–2628.

Blowers, A. 2017. nuclear's wastelands part 1 – landscapes of the legacy of nuclear power. *Town and Country Planning* (August), pp. 303–308.

Bonta, M. and Protevi, J. 2004. *Deleuze and Geophilosophy a guide and glossary.* Edinburgh University Press.

Bonta, M.A. 2001. Mapping Enredos of Complex Spaces . A Regional Geography of Olancho, Honduras. *LSU Historical Dissertations and Theses. 264.*

Bosnjak, M. and Tuten, T.L. 2003. Prepaid and Promised Incentives in Web Surveys. *Social Science Computer Review* 21(2), pp. 208–217.

Boston, J. 2016. *Governing for the future: Designing democratic institutions for a better tomorrow.* Emerald Group Publishing.

Boucher, S. and Whatmore, S. 1993. Green gains ? planning by agreement and nature conservation. *Journal of Environmental Planning and Management* 36(1), pp. 33–49.

Bowen, G.A. 2009. Document Analysis as a Qualitative Research Method. *Qualitative Research Journal* 9(2), pp. 27–40.

Brannen, J. 2005. Mixing Methods : The Entry of Qualitative and Quantitative Approaches into the Research Process. *International Journal of Social Research Methodology* 8(3), pp. 173–184.

Bristow, G. et al. 2012. Windfalls for whom ? The evolving notion of 'community ' in community benefit provisions from wind farms. *Geoforum* 43(6), pp. 1108–1120.

Brittan, G.G. 2001. Wind, energy, landscape: Reconciling nature and technology. *Philosophy & Geography* 4(2), pp. 169–184.

Bryman, A. 2006. Integrating quantitative and qualitative research: how is it done? *Qualitative Research* 6(1), pp. 97–113.

Buijs, A. et al. 2012. Understanding people's ideas on natural resource management: Research on social representations of nature. *Society and Natural Resources* 25(11), pp. 1167–1181.

Burchell, B. and Marsh, C. 1992. The effect of questionnaire length on survey response. *Quality and Quantity* 26(3), pp. 233-244.

Campbell, J.L. et al. 2013. Coding In-depth Semistructured Interviews : Problems of Unitization and Intercoder Reliability and Agreement. *Sociologia Ruralis* 43(2), pp. 294–320.

Campbell, S. 1996. Planning: Green cities, growing cities, just cities? Urban planning and the contradictions of sustainable development. *Journal of American Planning Association* 62, pp. 296–312.

Campbell, S. 2003. *Case Studies in Planning: Comparative advantages and the problem of generalization (University of Michigan Working Paper)*. Available at: www.caup.umich.edu/workingpapers. [Accessed 20 May 2017]

Carcary, M. 2009. The Research Audit Trial – Enhancing Trustworthiness in Qualitative Inquiry. *Electronic Journal of Business Research Methods* 7(1), pp. 11–24.

Clyde Mitchell, J. 1983. Case and situation analysis. *The sociological review* 31(2), pp. 187–211.

Cohen, J.J. et al. 2014. Re-focussing research efforts on the public acceptance of energy infrastructure: A critical review. *Energy* 76, pp. 4–9.

Cope, M. 2010. Coding transcripts and diaries. In: Clifford, N.J., French, S. and Valentine, G. ed. *Key Methods in Human Geography.* 2nd ed. Thousand Oaks, CA: Sage, pp. 440–452.

Corbin, J.M. 2008. *Basics of qualitative research: Techniques and procedures for developing grounded theory.* 3rd ed. London: Sage.

Corvellec, H. 2007. Arguing for a license to operate: The case of the Swedish wind power industry. *Corporate Communications* 12(2), pp. 129–144.

Couclelis, H. 2005. 'Where has the future gone?' Rethinking the role of integrated land-use models in spatial planning. *Environment and Planning A* 37(8), pp. 1353–1371.

Couper, M.P. 2000. Web surveys, a review of issues and approaches. *Public Opinion Quarterly* 64, pp. 464–494.

Cowell, R. 1997. Stretching the limits: environmental compensation, habitat creation and sustainable development. *Transactions of the Institute of British Geographers* 22(3), pp. 292–306.

Cowell, R. 2007. Wind power and 'the planning problem': the experience of Wales. *European environment* 17(5), pp. 291–306.

Cowell, R. et al. 2011. Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. *Journal of Environmental Planning and Management* 54(4), pp. 539–557.

Cowell, R. 2017a. Decentralising energy governance? Wales, devolution and the politics of energy infrastructure decision-making. *Environment and Planning C: Politics and Space* 35(7), pp. 1242–1263.

Cowell, R. 2017b. Siting dynamics in energy transitions. How generating electricity from natural gas saves cherished landscapes. In: Bouzarovski, S. et al. eds. *The routledge research companion to energy geographies.* Taylor & Francis., pp. 167–183.

Cresswell, T. 2014. *Place: An Introduction*. John Wiley & Sons.

Dale, V.H. et al. 2011. The land use-climate change-energy nexus. *Landscape Ecology* 26(6), pp. 755–773.

Damborg, S. and Krohn, S. 1999. On public attitudes towards wind power. *Renewable energy* 16(1–4), pp. 954–960.

Davidsson, S. et al. 2012. A review of life cycle assessments on wind energy systems. *The International Journal of Life Cycle Assessment* 17(6), pp. 729–742.

Davies, J. 1972. *The evangelistic bureaucrat.* London: Tavistock.

Davoudi, S. 2012. The legacy of positivism and the emergence of interpretive tradition in spatial planning. *Regional Studies* 46(4), pp. 429–441.

DeLanda, M. 2002. Deleuze and the Use of the Genetic Algorithm in Architecture. *Architectural Design* 71(7), pp. 9–12.

DeLanda, M. 2006. *A new philosophy of society: Assemblage theory and social complexity.* A&C Black.

Deleuze, G. and Guattari, F. 1988. *A Thousand Plateaux: Capitalism and Schizophrenia*. Bloomsbury Publishing ed.

Deleuze, G. and Guattari, F. 2004. *EPZ Thousand Plateaus*. A&C Black.

Dent, C. 2009. Copyright, governmentality and problematisation: An exploration. *Griffith Law Review* 18(1), pp. 129–150.

Denzin, N.K. 1978. *The Research Act: A Theoretical Introduction to Sociological Methods.* New York: McGraw-Hill.

Devine-Wright, H. and Devine-Wright, P. 2009. Social representations of electricity network technologies: exploring processes of anchoring and objectification through the use of visual research methods. *The British journal of social psychology* 48(2), pp. 357–373.

Devine-Wright, P. 2005. Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy* 8(2), pp. 125–139.

Devine-Wright, P. 2007. *Reconsidering public attitudes and public acceptance of renewable energy technologies : a critical review published by the School of Environment and Development, University of Manchester*. Available at: http://www.sed.manchester.ac.uk/research/beyond_nimbyism/.[Accessed 22 November 2016]

Devine-Wright, P. 2009a. Fencing in the bay? Place attachment, social representations of energy technologies and the protection of restorative environments. In: Bonaiuto, M. et al. eds. *Urban Diversities, Biosphere and Well Being: Designing and Managing Our Common Environment*. Hogrefe and Huber, pp. 227–236.

Devine-Wright, P. 2009b. Rethinking NIMBYism: The Role of Place Attachment and Place Identity in Explaining Place-protective Action. *Journal of Community & Applied Social Psychology* 19, pp. 426–441.

Devine-Wright, P. and Howes, Y. 2010. Disruption to place attachment and the protection of restorative environments: A wind energy case study. *Journal of Environmental Psychology* 30(3), pp. 271–280.

Dillman, D.A. 1991. The design and administration of mail surveys. *Annual Review of Sociology* 17, pp. 225–249.

Dû-blayo, L. Le 2014. How Do We Accommodate New Land Uses in Traditional Landscapes ? Remanence of Landscapes, Resilience of Areas, Resistance of People. *Landscape Research* 36(4), pp. 417–434.

Ellis, G. et al. 2007. Many ways to say 'no', different ways to say 'yes': Applying Q-Methodology to understand public acceptance of wind farm proposals. *Journal of Environmental Planning and Management* 50(4), pp. 517–551.

Ellis, G. et al. 2009. Expanding wind power: A problem of planning, or of perception? *Planning Theory & Practice* 10(4), pp. 523–532.

Eltham, D.C. et al. 2008. Change in public attitudes towards a Cornish wind farm: Implications for planning. *Energy Policy* 36(1), pp. 23–33.

Elwood, S.A. and Martin, D.G. 2000. "Placing" Interviews: Location and Scales of Power in Qualitative Research. *The Professional Geographer* 52(4), pp. 649–657.

ESRC 2018. Framework for research ethics. Available at: https://esrc.ukri.org/funding/guidance-for-applicants/research-ethics/ [Accessed: 6 July 2018].

Esterberg, K.G. 2002. *Qualitative methods in social research*. Boston: McGraw-Hill.

Evans, A. et al. 2009. Assessment of sustainability indicators for renewable energy technologies. *Renewable and Sustainable Energy Reviews* 13(5), pp. 1082–1088.

Fadie, B. 2017. Debunking More Myths on Wind Energy. MEIC. 11 May. Available at: https://meic.org/2017/05/debunking-more-myths-wind-energy/ [Accessed: 20 August 2018].

Fast, S. et al. 2015. The changing cultural and economic values of wind energy landscapes. *The Canadian Geographer* 59(2), pp. 181–193.

Fast, S. and Mabee, W. 2015. Place-making and trust-building: The influence of policy on host community responses to wind farms. *Energy Policy* 81, pp. 27–37.

Ferrell, S.L. and DeVuyst, E.A. 2013. Decommissioning wind energy projects: An economic and political analysis. *Energy Policy* 53, pp. 105–113.

Fielding N.G. and Fielding J.L. 1986. *Linking Data: qualitiative research methods*. London, England, U.K.: Sage Publications Ltd.

Firestone, J. et al. 2018. Reconsidering barriers to wind power projects: community engagement, developer transparency and place. *Journal of environmental policy & planning* 20(3), pp. 370–386.

Flyvbjerg, B. 2006. Five Misunderstandings About Case-Study Research. *Qualitative Inquiry* 12(2), pp. 219–245.

Foroughmand Araabi, H. 2014. Review: Deleuze and research methodologies: The impact on planning. *City* 18(4–5), pp. 589–593.

Foucault, M. 1991. *The Foucault effect: Studies in governmentality.* University of Chicago Press.

Foucault, M. and Deleuze, G. 1977. Intellectuals and power. *Language, counter-memory, practice: Selected essays and interviews*, pp. 205–17.

Friedl, C. and Reichl, J. 2016. Realizing energy infrastructure projects - A qualitative empirical analysis of local practices to address social acceptance. *Energy Policy* 89, pp. 184–193.

Fthenakis, V. and Kim, H.C. 2009. Land use and electricity generation: A life-cycle analysis. *Renewable and Sustainable Energy Reviews* 13(6–7), pp. 1465–1474.

Fugleberg, J. 2014. Abandoned Dreams of Wind and Light. Atlas Obscura. 08 May. Available at: https://www.atlasobscura.com/articles/abandoned-dreams-of-wind-and-light [Accessed: 20 July 2018].

Gaber, J. and Gaber, S. 1997. Utilizing Mixed-Method Research Designs in Planning: The case of 14th Street, New York City. *Journal of Planning Education and Research* 17, pp. 95–103.

Gagnon, L. et al. 2002. Life-cycle assessment of electricity generation options: The status of research in year 2001. *Energy Policy* 30(14), pp. 1267–1278.

Gailing, L. 2012. Dimensions of the Social Construction of Landscapes - Perspectives of New Institutionalism. In: *Proceedings of the Latvian Academy of Sciences -Section A: Humanities and Social Sciences*., pp. 195–205.

Gailing, L. and Leibenath, M. 2013. The Social Construction of Landscapes: Two Theoretical Lenses and Their Empirical Applications. *Landscape Research* 40(2), pp. 123–138.

Gehlbach, H. and Barge, S. 2012. Anchoring and Adjusting in Questionnaire Responses. *Basic and Applied Social Psychology* 34(5), pp. 417–433.

Gibbs, G. 2018. *Analyzing qualitative data*. 6th ed. Sage.

Giddens, A. 1979. *Central Problems in Social Theory*. London: Macmillan.

Gipe, P. 1995. *Wind Energy Comes of Age*. Wiley, Chichester.

Gläser, J. and Laudel, G. 2013. Life With and Without Coding : Two Methods for Early - Stage Data Analysis in Qualitative Research. *Forum: Qualitative Social Research* 14(2), pp. 1–25.

Goodin, R. 1992. *Green political theory.* Cambridge Polity Press.

GovUK 2018. *UK energy in brief 2018*. Available at: www.gov.uk/government/collections/uk- energy-in-brief#2018. [Accessed 27 May 2019]

Graham, S. and Healey, P. 1999. Relational concepts of space and place: Issues for planning theory and practice. *European Planning Studies* 7(5), pp. 623–646.

Greenhouse, C.J. 1989. Just in Time: Temporality and the Cultural Legitimation of Law. *Yale Law Journal* 98(8), pp. 1631–1651.

Greenhouse, C.J. 1996. *A moment's notice: Time politics across cultures.* Ithaca, N.Y: Cornell University Press.

Greider, T. and Garkovitch, L. 1994. Landscapes, The Social Construction of Nature and the Environment. *Rural Sociology* 59(1), pp. 1–24.

Gross, C. 2007. Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. *Energy Policy* 35(5), pp. 2727–2736.

Groves, R.M. 2004. *Survey errors and survey costs*. (Vol. 3). John Wiley & Sons.

Guillemin, M. and Gillam, L. 2004. Ethics, Reflexivity and "Ethically Important Moments" in Research. *Qualitative Inquiry* 10(2), pp. 261–280.

Haggett, C. 2011. Understanding public responses to offshore wind power. *Energy Policy* 39(2), pp. 503–510.

Hanley, N. et al. 2009. The impacts of knowledge of the past on preferences for future landscape change. *Journal of Environmental Management* 90(3), pp. 1404–1412.

Harrison, D. and Nichols, A.L. 1997. Environmental adders in the real world. *Resource and Energy Economics* 18(4), pp. 491–509.

Harvey, D. 1996. *Justice, Nature and the Politics of Difference*. Oxford: Blackwell.

Harvey, D. 2001. Heritage Past and Heritage Present: Temporalities, Meaning and the Scope of Heritage Studies. *International Journal of Heritage Studies* 7(4), pp. 319 – 338.

Healey, P. 2006. *Urban complexity and spatial strategies: Towards a relational planning for our times.* Routledge.

Heffron, R.J. et al. 2015. Resolving society's energy trilemma through the Energy Justice Metric. *Energy Policy* 87, pp. 168–176.

Hernandez, R.R. et al. 2014. Environmental impacts of utility-scale solar energy. *Renewable and Sustainable Energy Reviews* 29, pp. 766–779.

Hicks, D. 2016. The Temporality of the Landscape Revisited. *Norwegian Archaeological Review* 49(1), pp. 5–22.

Hillier, J. 2008. Plan(e) Speaking: a Multiplanar Theory of Spatial Planning. *Planning Theory* 7(1), pp. 24–50.

Hillier, J. 2011. Strategic navigation across multiple planes: Towards a Deleuzean-inspired methodology for strategic spatial planning. *Town Planning Review* 82(5), pp. 503–527.

Himpler, S. and Madlener, R. 2012. *Repowering of Wind Turbines : Economics and Optimal Timing. FCN Working Paper No. 19*. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2236265. [Accessed 3 November 2016]

Hindmarsh, R. and Matthews, C. 2008. Deliberative speak at the turbine face: Community engagement, wind farms, and renewable energy transitions, in Australia. *Journal of Environmental Policy and Planning* 10(3), pp. 217–232.

Hirsh, R.F. and Sovacool, B.K. 2013. Wind Turbines and Invisible Technology: Unarticulated Reasons for Local Opposition to Wind Energy. *Technology and Culture* 54(4), pp. 705–734.

Hoggart, K. et al. 2002. *Researching Human Geography*. London: Arnold.

Hopkins, P.E. 2007. Positionalities and Knowledge : Negotiating Ethics in Practice. *ACME: An international E-Journal for Critical Geographies* 6(3), pp. 386–394.

van der Horst, D. 2007. NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies. *Energy Policy* 35(5), pp. 2705–2714.

Hulshorst, W. 2008. *Repowering and used wind turbines - report for Leonardo Energy*. Available at: https://studylib.net/doc/18907971/repowering-and-used-wind-turbines. [Accessed 2 November 2016]

Ibarra, J.M.N. and De las Heras, M.M. 2005. Opencast mining reclamation. In: *Forest Restoration in Landscapes*. New York: Springer, pp. 370–378.

Ingold, T. 1993. The temporality of the landscape. *World Archaeology* 25(2), pp. 152–174.

Ingold, T. 2000. *The perception of the environment: essays on livelihood,dwelling and skill*. Routledge.

IPCC 2018. Summary for Policymakers. In: Masson-Delmotte, V., P. et al. eds. *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change*. Geneva, Switzerland: World Meteorological Organization.

IRENA 2017. *Renewable Power: sharply falling generation costs*. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/IRENA_Sharply_falling_costs_2017.pdf. [Accessed 4 August 2019]

IRENA 2018. *Global Energy Transformation: A Roadmap to 2050*. Available at: https://www.irena.org/publications/2018/Apr/Global-Energy-Transition-A-Roadmap-to-2050. [Accessed 4 August 2019]

IRENA 2019a. *Renewable capacity highlights*. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Mar/RE_capacity_highlights_2019.pdf. [Accessed 4 August 2019]

IRENA 2019b. *Renewable Capacity Statistics*. Available at: https://www.irena.org/publications/2019/Mar/Renewable-Capacity-Statistics-2019. [Accessed 4 August 2019]

Jaber, S. 2013. Environmental Impacts of Wind Energy. *Journal of Clean Energy Teachnologies* 1(3), pp. 251–254.

Jacobs, M. 1991. *The Green Economy. Environment, Sustainable Development and the Politics of the Future.* London: Pluto Press.

Jacquet, J. and Stedman, R. 2014. The risk of social-psychological disruption as an impact of energy development and environmental change. *Journal of Environmental Planning and Management* 57(9), pp. 1285–1304.

Jenkins, K. et al. 2016. Energy justice: A conceptual review. *Energy Research & Social Science* 11, pp. 174–182.

Jessop, B. 1990. *State Theory: Putting the Capitalist State in Its Place*. Penn State Press.

Jick, T.D. 1979. Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly* 24(4), pp. 602–611.

Jobert, A. et al. 2007. Local acceptance of wind energy: Factors of success identified in French and German case studies. *Energy Policy* 35(5), pp. 2751–2760.

Johansson, M. and Laike, T. 2007. Intention to respond to local wind turbines: The role of attitudes and visual perception. *Wind Energy* 10(5), pp. 435–451.

Johnson, R.B. and Onwuegbuzie, A.J. 2004. Mixed Methods Research : A Research Paradigm Whose Time Has Come. *Educational Researcher* 33(7), pp. 14–26.

Johnston, R. 1998. Approaches to the perception of landscape. Philosophy, theory methodology. *Archaelogical Dialogues* 5(1), pp. 54–68.

Karakosta, C. et al. 2013. Renewable energy and nuclear power towards sustainable development: Characteristics and prospects. *Renewable and Sustainable Energy Reviews* 22, pp. 187–197.

Kellett, J. 2003. Renewable Energy and the UK Planning System. *Planning, Practice & Research* 18(4), pp. 307–315.

Klass, A. 2012. Renewable Energy and the Public Trust Doctrine. *UC Davis Law Review* 45, pp. 1021–1073.

Van Der Knaap, W. and Davidse, B. 2010. While Time Goes by ; Dealing with Time and Multi-Dynamics in Spatial Planning and Design. *Resource Management, energy and planning* , pp. 438–439.

Kontogianni, A. et al. 2014. Planning globally, protesting locally: Patterns in community perceptions towards the installation of wind farms. *Renewable Energy* 66, pp. 170–177.

Kooij, H.J. et al. 2018. Between grassroots and treetops: Community power and institutional dependence in the renewable energy sector in Denmark, Sweden and the Netherlands. *Energy Research & Social Science*, 37, pp.52-64.

Kramer, G.J. and Haigh, M. 2009. No quick switch to low-carbon energy. *Nature* 462, pp. 568–569.

Krippendorff, K. 2004. Reliability in Content Analysis: Some Common Misconceptions and Recommendations. *Human Communication Research* 30(3), pp. 411–433.

Krogh, C.M. 2011. Industrial Wind Turbine Development and Loss of Social Justice? *Bulletin of Science, Technology & Society* 31(4), pp. 321–333.

Kvale, S. 2007. *Doing interviews*. Thousand Oaks, CA: Sage.

Lash, S. and Urry, J. 1994. *Economies of Signs and Space.* London: Sage.

Lee, M. 2017. Knowledge and landscape in wind energy planning. *Legal Studies* 37(1), pp. 3–24.

Legacy, C. 2017. Infrastructure planning: in a state of panic? *Urban Policy and Research* 35(1), pp. 61–73.

Longhurst, R. 2003. Semi-structured interviews and focus groups. In: Clifford, N. et al. eds. *Key methods in geography*, pp. 117–132.

Longhurst, R. 2009. Interviews: In-Depth, Semi-Structured. In Kitchin, R. and Thrift, N. eds. *International Encyclopedia of Human Geography*, pp. 580–584.

Macgill, S.M. 1987. *The politics of anxiety*. London: Pion.

MacKay, D. 2008. *Sustainable Energy-without the hot air.* UIT Cambridge.

Madanipour, A. 2010. Connectivity and contingency in planning. *Planning Theory* 9(4), pp. 351–368.

Marshall, T. 2002. The re-timing of English regional planning. *Town Planning Review* 73(2), pp. 171–195.

Marshall, T. and Cowell, R. 2016. Infrastructure, planning and the command of time. *Environment and Planning C: Government and Policy* 34(8), pp. 1843–1866.

Massey, D. 2005. *For space*. Sage. Thousand Oaks CA.

Massey, D. 2006. Landscape as a provocation: Reflections on moving mountains. *Journal of Material Culture* 11(1–2), pp. 33–48.

Mauthner, N.S. and Doucet, A. 2003. Reflexive Accounts and Accounts of Reflexivity in Qualitative Data Analysis. *Sociology* 37(3), pp. 413–431.

McGowan, F. and Sauter, R. 2005. *Public opinion on energy research: a desk study for the research councils*. Available at: http://www.epsrc.ac.uk/SiteCollectionDocuments/Publications/reports/EnergyAttitudesDeskStudySussex2005.pdf. [Accessed 4 December 2016]

McHaina, D.M. 2001. Environmental Planning Considerations for the Decommissioning, Closure and Reclamation of a Mine Site. *International Journal of Surface Mining, Reclamation and Environment* 15(3), pp. 163–176.

McKenzie Hedger, M. 1995. Wind power: challenges to planning policy in the UK. *Land Use Policy* 12(1), pp. 17–28.

McLaren Loring, J. 2007. Wind energy planning in England, Wales and Denmark: Factors influencing project success. *Energy Policy* 35(4), pp. 2648–2660.

Milbourne, P. and Mason, K. 2017. Environmental injustice and post-colonial environmentalism: Opencast coal mining, landscape and place. *Environment and Planning A* 49(1), pp. 29–46.

Miles, M.B. and Huberman, M. 1994. *Qualitative data analysis: An expanded sourcebook*. Sage.

Mitchell, C. 1996. Renewable generation – success story? In: Surrey, J. ed. *The British Electricity Experiment Privatisation: the Record, the Issues, the Lessons*. Earthscan, pp. 164–184.

Moffatt, S. 2014. Resilience and competing temporalities in cities. *Building Research & Information* 42(2), pp. 202–220.

Möller, B. 2010. Spatial analyses of emerging and fading wind energy landscapes in Denmark. *Land Use Policy* 27(2), pp. 233–241.

Munday, M. et al. 2011. Wind farms in rural areas : How far do community benefits from wind farms represent a local economic development opportunity ? *Journal of Rural Studies* 27(1), pp. 1–12.

Musall, F.D. and Kuik, O. 2011. Local acceptance of renewable energy-A case study from southeast Germany. *Energy Policy* 39(6), pp. 3252–3260.

Myers, D. and Kitsuse, A. 2000. Constructing the future in planning: A survey of theories and tools. *Journal of Planning Education and Research* 19(3), pp. 221–231.

Myerson, J. and Green, L. 1995. Discounting of delayed rewards: Models of individual choice. *Journal of the experimental analysis of behavior* 64(3), pp. 263–76.

Nadaï, A. and Van Der Horst, D. 2010. Introduction : Landscapes of Energies. *Landscape Research* 35(2), pp. 143–155.

Németh, J. and Langhorst, J. 2014. Rethinking urban transformation : Temporary uses for vacant land. 40, pp. 143–150.

Neuman, W.L. 2011. *Social Research Methods: Qualitative and quantitative approaches.* London: Pearson.

Nijnik, M. et al. 2008. Public evaluation of landscape content and change: Several examples from Europe. *Land Use Policy* 26(1), pp. 77–86.

Nye, D.E. 1999. *Consuming power: a social history of american energies*. MIT Press.

Nyseth, T. et al. 2010. Planning beyond the horizon: The Tromsø experiment. *Planning Theory* 9(3), pp. 223–247.

Opdenakker, R. 2006. Advantages and Disadvantages of Four Interview Techniques in Qualitative Research. *Forum: Qualitative Social Research* 7(4), pp. 1–9.

Ortlipp, M. 2008. Keeping and Using Reflective Journals in the Qualitative Research Process. *The Qualitative Report* 13(4), pp. 695–705.

Otto, A. and Leibenath, M. 2014. The interrelation between collective identities and place concepts in local wind energy conflicts. *Local Environment* 19(6), pp. 660–676.

Owen, A.D. 2004. Environmental externalities, market distortions and the economics of renewable energy technologies. *The Energy Journal* 25(3), pp. 127–156.

Owen, A.D. 2006. Evaluating the costs and benefits of renewable energy technologies. *Australian Economic Review* 39(2), pp. 207–215.

Owens, S. and Cowell, R. 1994. Lost land and limits to growth. *Land Use Policy* 11(3), pp. 168–180.

Palmer, D. et al. 2019. The future scope of large-scale solar in the UK : Site suitability and target analysis. *Renewable Energy* 133, pp. 1136–1146.

Parkhill, K.A. et al. 2014. Landscapes of Threat ? Exploring Discourses of Stigma around Large Energy Developments. *Landscape Research* 39(5), pp. 566–582.

Pasqualetti, M.J. 2000. Morality, Space, and the Power of Wind-Energy Landscapes. *Geographical Review* 90(3), pp. 381–394.

Pasqualetti, M.J. et al. 2002. *Wind power in view: Energy landscapes in a crowded world*. Academic Press.

Pasqualetti, M.J. 2004. Wind Power: Obstacles and Opportunities. *Environment: Science and Policy for Sustainable Development* 46(7), pp. 22–38.

Pasqualetti, M.J. 2011. Opposing Wind Energy Landscapes: A Search for Common Cause. *Annals of the Association of American Geographers* 101(4), pp. 907–917.

Patti, D. and Polyak, L. 2015. From practice to policy: Frameworks for temporary use. *Urban Research and Practice* 8(1), pp. 122–134.

Pearce, D. et al. 2013. *Blueprint 1: for a green economy*. Routledge.

Pidgeon, N. et al. 2008. *Living with Nuclear Power in Britain: A Mixed-methods study.Working Paper. Cardiff University*.

Power, S. and Cowell, R. 2012. Wind Power and Spatial Planning in the UK. In: Szarka J., Cowell R., Ellis G., Strachan P.A., W. C. ed. *Learning from Wind Power. Energy, Climate and the Environment Series.* London: Palgrave Macmillan, pp. 61–84.

Price, L. and Kendall, A. 2012. Wind Power as a Case Study: Improving Life Cycle Assessment Reporting to Better Enable Meta-analyses. *Journal of Industrial Ecology* 16, pp. S22–S27.

Prior, L. 2003. *Using documents in social research.* Sage.

Purcell, M. 2013. A new land: Deleuze and Guattari and planning. *Planning Theory & Practice* 14(1), pp. 20–38.

Qu, S.Q. and Dumay, J. 2011. The qualitative research interview. *Qualitative Research in Accounting & Management* 8(3), pp. 238–264.

Raco, M. et al. 2018. Slow cities, urban politics and the temporalities of planning : Lessons from London. *Environment and Planning C: Politics and Space* 36(7), pp. 1176–1194.

Raymond, C.M. et al. 2010. The measurement of place attachment : Personal, community, and environmental connections. *Journal of Environmental Psychology* 30(4), pp. 422–434.

Rein, M. and Schön, D. 1996. Frame-critical policy analysis and frame-reflective policy practice. *Knowledge and policy* 9(1), pp. 85–104.

RenewableUK 2019. *Onshore Wind The UK's Next Generation*. Available at: https://www.renewableuk.com/store/ViewProduct.aspx?ID=13831512. [Accessed 14 August 2019]

Resnik, D. 2011. What is ethics in research & why is it important. *National Institute of Environmental Health Sciences* 1(10), pp. 49–70.

Ricci, M. et al. 2010. Engaging the public on paths to sustainable energy : Who has to trust whom ? *Energy Policy* 38(6), pp. 2633–2640.

Del Río, P. et al. 2011. Policies and design elements for the repowering of wind farms: A qualitative analysis of different options. *Energy Policy* 39(4), pp. 1897–1908.

Ritchie, J. and Spencer, L. 2002. Qualitative data analysis for applied policy research. In: Huberman, M. and Miles, M.B. eds. *The qualitative researcher's companion.* Sage, pp. 305–329.

Robbins, P. and Marks, B. 2010. Assemblage geographies. In: Smith, S. et al. eds. *Sage Handbook of Social Geographies.* London: Sage, pp. 176–194.

Roffe, J. 2010. Multiplicity. In: Parr, A. ed. *The Deleuze Dictionary Revised Edition*. Edinburgh University Press., pp. 181–182.

De Roo, G. and Silva, E.A. 2010. *A planner's encounter with complexity.* Farnham: Ashgate.

RTPI 2016. *Planning and tech, planning for the growth of the technology and advanced manufacturing sectors.* Available at: https://www.rtpi.org.uk/media/1720882/Planning and tech - 1.3.16.pdf. [Accessed 24 May 2018]

Rydin, Y. 2013. Using Actor–Network Theory to understand planning practice: Exploring relationships between actants in regulating low-carbon commercial development. *Planning Theory* 12(1), pp. 23–45.

Scannell, L. and Gifford, R. 2010. Defining place attachment: A tripartite organizing framework. *Journal of Environmental Psychology* 30(1), pp. 1–10.

Scheidel, A. and Sorman, A.H. 2012. Energy transitions and the global land rush : Ultimate drivers and persistent consequences. *Global Environmental Change* 22(3), pp. 588–595.

Schlosberg, D. 2017. *Defining Environmental Justice. Theories, Movements, and Nature*. Oxford: Oxford University Press.

Scott, J.C. 1998. *Seeing like a state: How certain schemes to improve the human condition have failed.* Yale University Press.

Seager, T.P. et al. 2009. Land use and geospatial aspects in life cycle assessment of renewable energy. In: *2009 IEEE International Symposium on Sustainable Systems and Technology*., pp. 1–6.

Selman, P. 2010. Learning to Love the Landscapes of Carbon-Neutrality. *Landscape Research* 35(2), pp. 157–171.

Solomon, B.D. and Krishna, K. 2011. The coming sustainable energy transition : History, strategies, and outlook. *Energy Policy* 39(11), pp. 7422–7431.

Sovacool, B.K. 2009. The cultural barriers to renewable energy and energy efficiency in the United States. *Technology in Society* 31(4), pp. 365–373.

Sovacool, B.K. 2016. How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research and Social Science* 13, pp. 202–215.

Sovacool, B.K. and Dworkin, M.H. 2015. Energy justice: Conceptual insights and practical applications. *Applied Energy* 142, pp. 435–444.

Sowers, J. 2006. Fields of Opportunity : Wind Machines Return to the Plains. *Great Plains Quarterly* 26(2), pp. 99–112.

Stedman, R.C. 2002. Toward a social psychology of place: Predicting behavior from place-based cognitions, attitude, and identity. *Environment and Behavior* 34(5), pp. 561–581.

Stoecker, R. 1991. Evaluating and rethinking the case study. *The sociological Review* 39(1), pp. 88–112.

Strachan, P. et al. 2015. Promoting community renewable energy in a corporate energy world. *Sustainable Development* 23(2), pp. 96–109.

Sustainable Energy Ireland 2003. Attitudes towards the Development of Wind Farms in Ireland. Available at: http://www.sei.ie/../uploads/documents/upload/publications/Attitudes_towards_wind_.pdf. [Accessed 12 January 2017]

Svobodova, K. et al. 2011. The role of familiarity with the landscape in visual landscape preferences. *Journal of Landscape Studies* 4(1), pp. 11–24.

Swanwick, C. 2009. Society’s attitudes to and preferences for land and landscape. *Land Use Policy* 26, pp. 62–75.

Teddlie, C. and Yu, F. 2007. Journal of Mixed Methods Research. *Journal of Mixed Methods Research* 1(1), pp. 77–100.

van Teijlingen, E.R. and Hundley, V. 2001. The Importance of Pilot Studies. *University of Surrey social research update* 35.

Terkenli, T.S. 2001. Towards a theory of the landscape : the Aegean landscape as a cultural image. *Land Use Policy* 57, pp. 197–208.

Termorshuizen, J.W. and Opdam, P. 2009. Landscape services as a bridge between landscape ecology and sustainable development. *Landscape Ecology* 24(8), pp. 1037–1052.

Thrift, N. 1996. New urban eras and old technological fears: reconfiguring the goodwill of electronic things. *Urban Studies* 33(8), pp. 1463–1493.

Upham, P. et al. 2009. Public Attitudes to Environmental Change: a selective review of theory and practice. A Research Synthesis for The Living with Environmental Change Programme. Available at: www.lwec.org.uk/sites/default/files/001_Public%25 20attitudes%25 20to%25 20en vironmental%25 20change_final%25 20report_301009_1. pdf. [Accessed 14 December 2016]

Upham, P. et al. 2015. Towards a cross-paradigmatic framweork of the social acceptance of energy systems. *Energy Research & Social Science* 8, pp. 100–112.

Varun et al. 2009. LCA of renewable energy for electricity generation systems-A review. *Renewable and Sustainable Energy Reviews* 13(5), pp. 1067–1073.

Venables, D. et al. 2009. Living with nuclear power: A Q-method study of local community perceptions. *Risk Analysis* 29(8), pp. 1089–1104.

Walker, G. et al. 2010. Trust and community: Exploring the meanings, contexts and dynamics of community renewable energy. *Energy Policy* 38(6), pp. 2655–2663.

Warren, C.R. et al. 2005. 'Green On Green': Public perceptions of wind power in Scotland and Ireland. *Journal of Environmental Planning and Management* 48(6), pp. 853–875.

Warren, C.R. and Mcfadyen, M. 2010. Does community ownership affect public attitudes to wind energy ? A case study from south-west Scotland. *Land Use Policy* 27, pp. 204–213.

Weiss, N.A. and Weiss, C.A. 2015. *Introductory statistics.* 10th ed. Pearson Education.

Welstead, J. et al. 2013. *Scottish Natural Heritage : Research and guidance on restoration and decommissioning of onshore wind. Scottish Natural Heritage Commissioned Report No. 591*.

Van Wezemael, J.E. 2008. The Contribution of Assemblage Theory and Minor Politics for Democratic Network Governance. *Planning Theory* 7(2), pp. 165–185.

Wheeler, R. 2017. Reconciling Windfarms with Rural Place Identity: Exploring Residents' Attitudes to Existing Sites. *Sociologia Ruralis* 57(1), pp. 110–132.

Wiles, R. et al. 2008. The Management of Confidentiality and Anonymity in Social Research. *International Journal of Social Research Methodology* 11(5), pp. 417–428.

Williams, D.R. and Vaske, J.J. 2003. The Measurement of Place Attachment : Validity and Generalizability of a Psychometric Approach. *Forest Science* 49(6), pp. 830–840.

Wilson, G.A. and Dyke, S.L. 2016. Pre- and post-installation community perceptions of wind farm projects: the case of Roskrow Barton (Cornwall, UK). *Land Use Policy* 52, pp. 287–296.

Windemer, R. 2019. Considering time in land use planning: An assessment of end-of-life decision making for commercially managed onshore wind schemes. *Land Use Policy* 87

Wolsink, M. 1989. Attitudes and expectancies about wind turbines and wind farms. *Wind Engineering* 13(4), pp. 196–206.

Wolsink, M. 2000. Wind power and the NIMBY-myth: Institutional capacity and the limited significance of public support. *Renewable Energy* 21(1), pp. 49–64.

Wolsink, M. 2007a. Planning of renewables schemes: Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. *Energy Policy* 35(5), pp. 2692–2704.

Wolsink, M. 2007b. Wind power implementation: The nature of public attitudes: Equity and fairness instead of 'backyard motives'. *Renewable and Sustainable Energy Reviews* 11(6), pp. 1188–1207.

Wolsink, M. 2018a. Co-production in distributed generation: renewable energy and creating space for fitting infrastructure within landscapes. *Landscape Research* 43(4), pp. 542–561.

Wolsink, M. 2018b. Social acceptance revisited: gaps, questionable trends, and an auspicious perspective. *Energy Research and Social Science* 46, pp. 287–295.

Wood, S. 2009. Desiring Docklands: Deleuze and Urban Planning Discourse. *Planning Theory* 8(2), pp. 191–216.

Woods, M. 2003. Conflicting Environmental Visions of the Rural: Windfarm Development in Mid Wales. *Sociologia Ruralis* 43(3), pp. 271–288.

Yin, R.K. 1993. *Applications of Case Study Research*. Sage.

Yin, R.K. 1994. *Case Study Research: design and methods*. 2nd ed. Beverly Hills: Sage Publications.

Yin, R.K. 2003. *Case Study Research. Design and Methods*. 3rd ed. Sage.

Yun, G.W. and Trumbo, C.W. 2000. Comparative response to a survey executed by post, e-mail, & web form. *Journal of Computer-Mediated Communication* 6(1)

Zhang, J. et al. 2011. Land use-based landscape planning and restoration in mine closure areas. *Environmental Management* 47(5), pp. 739–750.

Ziegler, L. et al. 2018. Lifetime extension of onshore wind turbines: A review covering Germany, Spain, Denmark, and the UK. *Renewable and Sustainable Energy Reviews* 82, pp. 1261–1271.

Appendix A: Development of codes used for analysis

Before undertaking analysis a description and example of each code was also produced.

Level 1	Level 2	Level 3
Repowering	-Positive experiences of repowering -Challenges of repowering	-Assessment of change in turbine height for repowering -Consideration of the baseline for assessing repowering applications
Life-extension	-Positive experiences of life-extension -Challenges of life-extension	-Infrastructure maintenance -life-extension as part of longer term strategy -Life extension as lower risk
Decommissioning	-Challenges of decommissioning -Ease of decommissioning -Level of infrastructure removal	-Concerns regarding infrastructure abandonment -Facilitating a future use of a site
Policy	-Policy change -Policy gaps -Policy challenges	-Attempts to change policy -Impact of policy uncertainty -local level policy -Calls for new policy or guidance
Time	-Arguments of temporariness -Evidence of temporariness -25-year life span	-Evidence of increasing lifespan of turbines -Desire for longer consent periods -Knowledge of duration of consent
Reversibility	-Arguments of reversibility -Evidence of reversibility -Evidence of reversibility not being possible	-Examples of irreversible changes to the site -Reversibility as part of justification for the site -Expectations of reversibility - Use of similar terms: impermanent', 'fixed-term' 'restored'
Economics	-Subsidies	-Economic changes influencing strategies - Sites as investment assets

Developer-community relations	-Positive developer-community relations -Negative developer-community relations	-Community benefit funds -Strategies of increasing developer-community relations -Local trust in the Developer -Communication between community and the Developer
Familiarity	-Familiarity increasing positive perceptions of the infrastructure -Familiarity not increasing positive perceptions of the infrastructure -Familiarity not occurring	-Preference for continuing existing site over a new site -Expectations of familiarity influencing developer strategy -Anchoring
Landscape change	-Physical landscape change -Social landscape change	-Cumulative impact of other wind farms -Landscapes as subject to multiple uses -Increase in site constraints -Change in landscape designations -Longer-term landscape considerations -Change in perceptions of wind farms
Site constraints	-Planning challenges	-Difficulties in obtaining replacement parts -Grid access

Appendix B: Example of question guide used for interviews

This example was for a wind farm developer in St Breock, the question guides varied depending on the technology in question (Wind / Solar), the type of participant (e.g. developer, LPA, planner, community member, Government) and the details of the case.
These questions were used as a guide to help structure the interview.

Please can you tell me about your experience of the repowering application for this site?

Were you involved in many discussions with the local authority before submitting the application?

Did you face any challenges in relation to the application during the planning process? How were these challenges overcome?

The original permission for this site was 'permanent' did this influence your strategy?

It seems from the councils' website that the previous owner successfully gained permission to repower the site in 2002, did this influence your strategy? Did you do anything differently?

In your opinion had the nature of the site / policy context changed over the 25-year period? If so, how did this impact the application?

Do you think it is difficult to assess the visual impact and acceptability of having a smaller number of larger turbines compared to a larger number of smaller turbines?

Is there much guidance on this?
Do you think there needs to be any additional guidance?

Why do you feel that this site got rather a lot of public support?

Do you have any experience of other repowering or life-extension applications?

Did anything happen differently?

When do you normally start considering end-of-life decisions for a site?

When would you consider life-extension, is this just if repowering fails?

What would you expect to happen to repowered sites in the future?

What are your views about the way that the planning system handles end-of-life issues/repowering issues?

What is your opinion of the 25 year planning period for onshore wind and solar? Do you consider such projects as temporary?
Why?

Do you feel that it would be better if planning permission was permanent rather than temporary?

Do you think that the development may face less opposition as a ‘temporary’ application rather than permanent?

Do you feel that national planning policy is clear on end-of-life considerations for wind farms or has it created any difficulties?
(Both in terms of the policy approach for repowering, life-extension and decommissioning)

Do you agree with the approach taken that repowering should be treated as a new application?

Do you think that public opinions are given adequate consideration in end-of-life decision-making for onshore wind?
What weight is given to public opinion?
What is your opinion of the suggestion made within the Scottish onshore wind policy statement that repowering offers the opportunity to promote community and local energy through community stakes in commercial energy schemes? Do you think this is achievable?

In your opinion how can the end of life process be improved? Do you feel that any changes should be made to the process for repowering / asset life extension and decommissioning?
Do any changes need to be made to policy?

Regarding decommissioning, do you think that aftercare and legacy issues will present an issue for decommissioned sites?

What are your experiences of the conditions attached to permissions, do you feel that they are appropriate? e.g. land restoration conditions.

Appendix C: list of interview participants

The names of participants have been kept anonymous.

Location	Position / Role
UK Government	UK Government policymakers
Welsh Government	Welsh Government policymakers
Scottish Government	Scottish Government policymaker responsible for Scottish Onshore Wind - Policy document.
UK Renewable Trade Association	Head of policy
Scottish Natural Heritage	Onshore wind expert
St Breock	Local Authority planner (Cornwall)
St Breock	Wind farm developer (retired, submitted original application)
St Breock	Wind farm Developer (submitted repowering application)
St Breock	Local community representatives
Taff Ely	Local Authority planner (Rhondda Cynon Taf)
Taff Ely	Wind farm developer
Taff Ely	Local community representative
Taff Ely	Representative from Local opposition group
Kirkby Moor	Local Authority planner (South Lakeland)
Kirkby Moor	Wind farm developer
Kirkby Moor	Local community representatives
Windy Standard	Wind farm developer
Windy Standard	Wind farm planning agent
Windy Standard	Local community representatives
Pitworthy solar farm	Local Authority planner (Torridge)
Pitworthy solar farm	Original solar farm developer
Pitworthy solar farm	Owner of the solar farm
Pitworthy solar farm	Local community representative
Pitworthy solar farm	CPRE Devon

Appendix D: Copy of survey questions

This is a copy of the survey questions for St Breock.
The questions differed slightly in the case of Kirkby Moor in order to understand perceptions of the life-extension application. Additionally, there was not a question comparing the schemes in Kirkby Moor as at the time of the research the original wind farm was still operational.

Overview questions

1. How many years have you lived in this area?

………………………

2. What is the post code of the property where you live?

…………………..

3. Which age category are you in?

a)	Under 18 years	☐	e)	50 – 59 years	☐
b)	18 – 29 years	☐	f)	60 – 69 Years	☐
c)	30 – 39 years	☐	g)	70 – 79 Years	☐
d)	40 – 49 years	☐	h)	80 years and over	☐

4. How frequently do you see St Breock wind farm?

a)	Most days	☐
b)	Once a week or less	☐
c)	Once a month or less	☐
d)	Never	☐

5. Please rate your agreement with the following statements. 1 is strongly agree, 5 is strongly disagree, as indicated on the scale below:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
I support wind energy in the UK.	1	2	3	4	5
I am willing to sacrifice views of the landscape in order to increase renewable energy.	1	2	3	4	5
There is an urgent need to address climate change.	1	2	3	4	5
Wind farms play an important role in addressing climate change.	1	2	3	4	5
Wind turbines are not appropriate in Cornwall.	1	2	3	4	5

I support renewable energy in the UK.	1	2	3	4	5
I feel that St Breock wind farm should not have been built.	1	2	3	4	5

6. Please answer the following statements about your home location using the same scale:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am very attached to this place.	1	2	3	4	5
This place plays a central role in my lifestyle.	1	2	3	4	5
This place is special to me.	1	2	3	4	5
One of the major reasons I live where I do is because of the surrounding landscape.	1	2	3	4	5
Living here says a lot about who I am.	1	2	3	4	5
The things I do here I would not enjoy doing as much somewhere else.	1	2	3	4	5
I do not intend to move away from this area in the future.	1	2	3	4	5

Questions about the original St Breock wind farm

7. Were you living in this area at the time of the original planning application in 1990-1992? If Yes, please continue with Q8. If no, please go to Q10.

Yes □ No □

8. On a scale of 1 to 5 did you support or oppose the original (11 turbine) St Breock wind farm before it was built?

Strongly Supported	Supported	Neutral	Opposed	Strongly Opposed
1	**2**	**3**	**4**	**5**

8(a) Please explain why you supported or opposed the proposal, including whether you submitted a comment / letter to the local planning authority:

9.Did your perception change subsequent to the building of the original wind farm?

Yes, more positive ☐

Yes, more negative ☐

No, it remained the same ☐

9(a) If your perception changed subsequent to the building of the wind farm please explain why below:

Questions about the repowering application

10. Were you living in this area at the time of the repowering application in 2012? If yes please continue with Q11, if no please go to Q13.

Yes ☐ No ☐

11. On a scale of 1 to 5 did you support or oppose the planning application for the repowering of St Breock wind farm in 2012?

Strongly Supported	Supported	Neutral	Opposed	Strongly Opposed
1	2	3	4	5

Alternatively, please tick the box if you were unaware of the application ☐

11(a). Please explain your reasons for your response including whether you submitted a comment / letter to the local planning authority:

12. Did your perception change subsequent to the building of the repowered wind farm?

Yes, more positive ☐

Yes, more negative ☐

No, it remained the same ☐

12(a) If your perception changed subsequent to the building of the repowered wind farm please explain why:

13. On a scale of 1 to 5 do you support or oppose the operational repowered wind farm now?

Strongly Support	Support	Neutral	Oppose	Strongly Oppose
1	2	3	4	5

14. What have been the positive impacts (if any), to you and this area, of St Breock wind farm?

15. What have been the negative impacts (if any), to you and this area, of St Breock wind farm?

16. Were you aware that the planning permission for the repowered St Breock wind farm is for a period of 25 years?

Yes □
No □

Please add any further comments below:

17. If you were living in this area at the time that the original (11 turbine) scheme was operating, do you prefer the repowered or original wind farm? If you were not living here please select 'not applicable'

Not applicable □
I prefer the original (11 turbine) wind farm □
I prefer the repowered (5 turbine) wind farm □
I do not have a preference □

17(a) Please explain the reason for your response:

18. Please rate your agreement with the following statements, 1 is strongly agree, 5 is strongly disagree, as indicated on the scale below:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Local people are adequately compensated for living near wind farms.	1	2	3	4	5
Wind farm developers care about the opinion of local residents.	1	2	3	4	5
Wind farms should only have planning permission for 25 years.	1	2	3	4	5
I trust wind farm developers.	1	2	3	4	5
Local people's opinions are given adequate consideration during the planning process for wind farms.	1	2	3	4	5
I would support wind farms having permanent planning permission.	1	2	3	4	5
A smaller number of larger turbines is better than a larger number of smaller turbines.	1	2	3	4	5
All wind farms should be removed after 25 years.	1	2	3	4	5
25 years is a temporary period.	1	2	3	4	5
Wind farms create economic benefits for the local community.	1	2	3	4	5
I would like the St Breock wind farm to be returned to farm land as soon as possible.	1	2	3	4	5
Local people can influence the outcome of wind farm repowering applications.	1	2	3	4	5
Wind farms create social benefits for the local community.	1	2	3	4	5

19. Would you be willing to participate in a follow up telephone or face to face interview to discuss your responses and opinions in more detail?

Yes ☐ No ☐
If yes, please leave your contact telephone / email below:

…………………………………………………………….
END OF QUESTIONNAIRE. Thank you for taking the time to complete this questionnaire

Appendix E: Participant information sheet

The text below was used for a wind energy case studies, the wording varied slightly for solar.

Managing (Im)Permanence: end-of-life challenges for the wind energy sector

This participant information sheet provides information explaining why this study is being undertaken and what it will involve for you. Please take time to read this document and contact the principal researcher, Rebecca Windemer, to ask about anything that is not clear using the contact details provided at the end of this document.

What is the purpose of the study?

This research project aims to explore how the duration of wind farms are considered in the development and planning process, including what timeframes matter to different actors when considering the impacts of the infrastructure and how this influences end-of-life decision-making (such as extending the operational life or complete removal of the infrastructure) as well as exploring strategies such as site extension. It seeks to understand how plans are made for the end of life of the infrastructure, including what factors are controlled, over what timeframes and why.

The overall aim of the research is to be able to increase our understanding of how decision-making surrounding the end of life of wind farms occurs and what the consequences are for all parties.

Why have I been invited to take part?

You have been selected for this research due to your involvement with the selected case study. The research aims to include participation from local authorities, developers, landowners and the public as well as advisory bodies and policy makers.

Who is doing this research and why?

This interview will form part of a PhD project exploring end-of-life decision-making for wind farms. The research is funded by the Economic and Social Research Council (ESRC) and Cardiff University. The research is undertaken by Rebecca Windemer.

What do I have to do?

You will be asked to participate in a face to face interview. I will ask for your permission to record the interview using a digital voice recorder, the interviews will be transcribed and stored anonymously. If you do not give permission, then the interview will not be recorded and instead I will make notes.

How long will it take?

I am going to ask you a number of questions regarding of end-of-life decision-making for onshore wind and your opinions of current and emerging policy. The interview is expected to take approximately 30 - 45 minutes.

Do I have to take part?

No, it is up to you to decide. If you do agree to participate please sign the consent form to show that you agree to take part. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

Will I be required to attend any sessions and where will these be?

The interview will be undertaken at a location that is convenient for you. The interviews will be carried out face to face where possible. In circumstances where this is not possible they may be carried out via skype or telephone.

Is there anything I need to do before the interview?

No there is nothing that you need to do before the interview.

What personal information will be required from me?

We do not require any personal information.

Are there any risks in participating?

Given the nature of the research topic, we do not foresee any risks from participation.

Will my taking part in this study be kept confidential?

Measures will be taken to ensure confidentiality and data security during the collection, storage and analysis of data. These measures are as follows: If permission is given, the interviews will be recorded using a digital voice recorder. These will be transcribed and analysed using a coding system to ensure the anonymity of respondents. The cases will be named, but you will not. Once transcribed, the digital recordings will be deleted. Active data will be stored on a secure University drive.

What will happen to the results of the study?

The results will be analysed and discussed in Rebecca's PhD thesis and possibly in articles published in academic journals. Your responses will be anonymised. The anonymous data will be held in a secure university database and may be used to inform future research. If you wish to receive a copy of the research results, please contact Rebecca using the details at the bottom of the information sheet.

If I have some more questions who should I contact?

Please contact Rebecca Windemer using the details at the bottom of this document.

What if I am not happy with how the research was conducted?

Please contact the Cardiff University School of Planning and Geography Research Ethics Officer: Dr Gareth Enticott / EnticottG@cardiff.ac.uk

This project has been subject to ethical review, according to the procedures specified by the University Research Ethics Committee, and has been given a favourable ethical opinion for conduct.

Researcher Contact details
Rebecca Windemer, Cardiff University / windemerr@cardiff.ac.uk

Appendix F: Participant consent form

Managing (Im)Permanence: end-of-life challenges for the wind and solar energy sectors

I have read and agree to the arrangements described in the accompanying Participant Information Sheet.

I understand the purposes of the project and what will be required of me and any questions I have had have been answered to my satisfaction.

I understand that my responses will be anonymised.

I understand that participation is entirely voluntary and that I have the right to withdraw from the project any time and that this will be without detriment.

This application has been approved by the University Research Ethics Committee.

Name (print): ………………………………………………………………………………

Signed: ………………………………………………………………………………

Date: ………………………………………………………………………………

Appendix G: Public survey place attachment results

Kirkby Moor

Kirkby Moor, summary of responses to place attachment statements

Statement	% agree or strongly agree	% disagree or strongly disagree	% neutral
I am very attached to this place	98.5	0	1.5
This place plays a central role in my lifestyle	95	1	4
This place is special to me	95	0	5
One of the major reasons I live where I do is that Kirkby Moor is near by	49	16	35
Living here says a lot about who I am	72	8	20
The things I do here I would not enjoy doing as much somewhere else	71	14	15
I do not intend to move away from this area in the future.	86	6	8

Kirkby Moor, Principle Component Analysis, place attachment

A Principle Component Analysis (PCA) is used to reduce data through identifying strong intercorrelations (Dunteman,1989). The factor analysis identified one component to be used 'this place is special to me'.

	Component 1
This place is special to me.	.849
The things I do here I would not enjoy doing as much somewhere else.	.846
I am very attached to this place.	.837
Living here says a lot about who I am.	.810
This place plays a central role in my lifestyle.	.800
One of the major reasons I live where I do is that Kirkby Moor is nearby.	.740
I do not intend to move away from this area in the future.	.675

St Breock

St Breock, summary of responses to place attachment statements

Statement	% agree or strongly agree	% disagree or strongly disagree	% neutral
I am very attached to this place	96	0	4
This place plays a central role in my lifestyle	93	0	7
This place is special to me	88	1	11
One of the major reasons I live where I do is because of the surrounding landscape	91	4	5
Living here says a lot about who I am	70	5	25
The things I do here I would not enjoy doing as much somewhere else	59	10	31
I do not intend to move away from this area in the future.	83	5	12

A PCA was undertaken identifying one component (I am very attached to this place).

St Breock, Principle Component Analysis, place attachment

	Component 1
I am very attached to this place.	.892
This place is special to me.	.889
This place plays a central role in my lifestyle.	.846
Living here says a lot about who I am.	.785
The things I do here I would not enjoy doing as much somewhere else.	.754
One of the major reasons I live where I do is because of the surrounding landscape.	.741
I do not intend to move away from this area in the future.	.635

Appendix H: PCA calculations

Kirkby Moor, perception of duration and temporality

Three questions measured respondent's perception of duration and temporality of the wind farm. A principal component analysis (PCA) identified that these could be represented by the component 'I would support wind farms having permanent planning permission.'

	Component
	1
I would support wind farms having permanent planning permission.	-.868
All wind farms should be removed after 25 years.	.802
Wind farms should only have planning permission for 25 years.	.781

Kirkby Moor, component matrix, perceived benefits of wind farms

Three questions measured respondent's perceived benefits of windfarms. A PCA identified that these could be represented by the component 'wind farms create social benefits for the local community'

	Component
	1
Wind farms create social benefits for the local community.	.898
Wind farms create economic benefits for the local community.	.894
Local people are adequately compensated for living near wind farms.	.835

St Breock, component matrix, perceived benefits of wind farms

Three questions measured respondent's perceived benefits of windfarms. A PCA identified that these could be represented by the component 'wind farms create economic benefits for the local community'.

	Component 1
Wind farms create economic benefits for the local community.	.934
Wind farms create social benefits for the local community.	.933
Local people are adequately compensated for living near wind farms.	.839