UNDERSTANDING TECHNOSCIENTIFIC CITIZENSHIP IN A LOW-CARBON SCOTLAND

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DEDICATION

.....to the kindest man I ever knew - my Dad,

Martin Young (1935 – 2012)

....and to my postgrad mentor and - for this studentship – referee,

Stephen Regan (1962-2010)

Athair agus oide, beirt Éireannach go smior, a bhí ina réalt eolais domsa

ABSTRACT

Public engagement with science and technology is a vibrant topic of interest in the United Kingdom, offering promises of democratic and informed governance and a supportive and trusting public. In this context, the idea of 'scientific citizenship' is gaining ground, though it remains nebulous in both theory and practice with contested, overlapping and unarticulated representations of its origins, meaning and purpose. The aim of this thesis is to unpack the notion of scientific citizenship, in particular, questions relating to: who counts as a scientific citizen, what rights do they have as citizens and how are scientific citizens meant to engage with science.

This aim is achieved exploring the status of scientific citizenship in the context of public engagement with science activities and low-carbon transition strategies in Scotland. With some of the most ambitious greenhouse gas emissions reduction targets in the world, the generation and use of energy in Scotland is a pervasive and technology-intensive area of public policy where one can anticipate varying rationales for involving the public. This thesis draws on a wide empirical field that constitutes public engagement with low-carbon technologies in Scotland, and considers practice and policy in the light of relevant literatures.

I draw on three particular fields of scholarship to develop a novel conceptual framework that shaped the empirical investigation. Scholarship around science and publics from science and technology studies (STS), public responses to renewable energy developments from social science research and the social and political theories on the nature of citizenship were synthesised to a typology outlining five archetypes of the scientific citizen, each invoking differing understandings of publics, rights and modes of participation. The empirical phase drew on a qualitative enquiry of interviews, observation and document analysis across policy, commercial and civil sectors of society.

In response to the question of what scientific citizenship means, I argue that only when all three dimensions of membership, rights and participation are fulfilled or pursued simultaneously can the idea be invoked, and three such nexus are outlined. The idea of *technoscience and cultural citizenship* offers a way of reconceptualising popular science communication activity that is at risk of being dismissed as manifestations of an outdated 'deficit model' of publics and science. *Technoscience and material citizenship* offers a route into questions of governance, making the case that the materiality of a project makes a profound difference at the point of implementation, when consensus may not be possible and the rights of multiple publics to be recognised and to participate will need to be carefully negotiated. And finally, as a counterpoint, the idea of *technoscience and anticipatory citizenship* provides a space around emerging technologies for ongoing debates about the effectiveness of public dialogue and the relative roles of emergent and created publics.

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As a mature student from a ‘non-traditional’ background I come to a social science PhD with some surprise, yet the circumstances have roots stretching back over many years. I feel this is an opportune moment to sincerely thank Mick and Lucy Haime, Maria and Amanda for opening up their home to me so many years ago, for giving me the safety and stability needed for a love of scholarship to take root, become established and flourish. Without you, this document simply would not be here and my life would have been very different.

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Contents

Understanding Technoscientific Citizenship in a Low-Carbon Scotland

CHAPTER 1 Introduction

1.1. Background and Introduction

Public engagement with science and technology is a topic of lively debate in the United Kingdom, which variously promises democratic and informed governance or a compliant and trusting public. An idea of 'scientific citizenship' has gained ground, as scholars and stakeholders have grappled with the tensions involved in achieving the putative benefits of scientific and technological innovation. There is much at stake. Different parts of civil society look to influence the implementation of technologies that have the potential to change lives, corporations constantly seek to maximise opportunities with minimal social risk and policymakers navigate long and short-term societal benefits amongst a range of competing interests. However, the concept of scientific citizenship has no single definition and is a relatively under-developed idea. Different scholars examining science-in-society have alluded to the concept in different ways. Some have focussed on the problem of a public role in governing science (e.g. Irwin 2001, Mejlgaard and Stares 2009), some the interface between the individual act and the common good (e.g. Felt 2003) and others to the complexity of the citizen in a knowledge-rich society (Michaels and Brown 2005). Whilst these accounts refer to citizenship in their findings, none have taken it as the core empirical question or conceptual focus.

Nevertheless, the idea of scientific citizenship is also of interest to policymakers as a benchmark by which the efficacy of public engagement activities might be measured, and this is the origin of the ESRC/Government Collaborative studentship that was the vehicle for this research. Originally

envisaged by The Scottish Government as a study of how engagement formats shape scientific citizenship, it quickly became apparent that scientific citizenship as a concept was not sufficiently developed for use as a benchmark. Lacking definition and of uneven use, understanding this core concept became the focal point of the research. To ground a potentially very conceptual piece of work in an issue of policy relevance to Scotland (and hence the funder), I chose the low-carbon transition as an empirical context. It was my hope that this challenge was sufficiently rich in detail and activity to be able to approach it through a number of practical routes and do justice to the idea of *citizenship* as much as *science*.

Academically, this study adds to the literature of public engagement with science, within the field of science and technology studies (STS). I present various manifestations of scientific citizenship, and I propose to develop and test a framework that can be used as the basis for debating and exploring scientific citizenship in a consistent but adaptable way. The particular aim of this thesis is to apply ideas of membership, rights and participation to unpack the nebulous term 'scientific citizenship' in the context of Scotland's transition to a low-carbon economy.

1.1.1 Science and the Public

The idea of engaging a non-specialist British public with science has a long heritage, stretching back to the industrial revolution and thinkers such as Joseph Priestley, Humphry Davy, Michael Faraday and many more throughout the 19th century engaged publics with their science. In its simplest form, this communication is a process of translating scientific output into a format that is digestible by a non-expert audience, for educational purposes, to stimulate or satisfy public interest in science and technology, and occasionally to drive a particular political agenda.

However, in the last 30 years observers have noted a lack in this one-way model of communicating science (Irwin and Wynne 1996, Sturgis and Allum

2004, Ziman 2007:294). Sustained economic growth and increased funding (both public and private) for scientific research have broadened and deepened the fundamental knowledge base from which applied technologies are developed in the UK. Over this period UK society has seen quantum changes in transport, energy, communication, food and healthcare technologies that are more widespread and personalised, designed for greater efficiency and lower environmental impact. Such innovations allow consumers to exercise choice and citizens to question the fundamental bases and rationales for scientific research. A series of high profile controversies including a scare over the safety of the measles-mumps-rubella vaccine that led to reduced take-up, concerns over the safety of BSE-infected meat in the human food chain, and protests against trials of genetically modified crops have raised perceptions within policy and science that the public mistrusts new science and technology (House of Lords 2000).

Learned institutions and ultimately policymakers concluded that one approach to addressing this perceived tension between science and the public lay in the nature of the communication activities that intersect the boundary between these two worlds. Traditionally the nature of this boundary work had been one of unidirectional, top-down communication of 'finished' science, where complexity and uncertainty were downplayed or not reported at all. This process of dissemination was deemed to be the solution to what was considered to be a question of ignorance and trust. The public were seen to be routinely sceptical of scientific innovation and indeed scientists, because they did not adequately understand how science worked or the potential benefits it could bring. The greater the amount of knowledge that could be instilled, the less deficient the public would be, and the more open they would become to new innovations (The Royal Society 1985, Sturgis and Allum 2004). This 'deficit model' of public understanding of science has become a central analytical model in the field and is an ongoing point of reference, debate and critique.

In place of the deficit model, scholars and science policy practitioners have proposed that communication should be more dialogic and upstream, such that publics are involved in new technologies at an earlier, more formative stage when their opinions might carry more weight before particular technological trajectories became locked in. Upstream engagement was seen as a more effective means of achieving consensus between public and innovators (Wilsdon and Willis 2004). So initiatives including citizens panels, juries, dialogues, consultations and town hall meetings resulted. They aimed at creating a space where scientists and publics could meet and were often designed, facilitated and analysed by intermediaries such as science centres, universities and professional institutions, and later science festivals, professional science communicators and dialogue facilitators who would develop 'audiences', provide venues, design exhibits, translate technical information and help ensure the sponsor's objectives were met. Newer forms of mediation in which participants are (at least in principle) able to interact are of particular interest to scholars in the field of science and technology studies (STS) within which this study is located (Irwin 2001, Backstrand 2003, Elam and Bertilsson 2003, Rowe and Frewer 2005, Irwin 2006, Wynne 2006, Evans and Plows 2007, Lezaun and Soneryd 2007,Stirling 2008, Davies et.al.2009). Some of these scholars have been associated with promoting the new model of engagement and have also critically examined its implementation.

These two communication models – the deficit model and upstream engagement - have not been accepted uncritically. Indeed the pursuit of consensus through dialogue is not considered as the right – or only - answer to addressing variable public responses. Over a corresponding time period, the way that citizens participate has also changed, as digital technologies facilitate increasingly individual means of disrupting traditional theories and practices of democracy. Instead, the nature of democratic participation itself has changed as we see less activity in formal voting and more in civic activity, campaigning, protest, activism and online participation (Dalton 2008). The

notion that consensus necessarily is a desirable state of affairs in modern society has also been challenged, given the benefits that can often be gained through conflict such as the transformation of power relations (Mouffe 1999). Furthermore, the difficulties in achieving the kind of 'idealised talk' necessary for consensus building have been described as a significant constraint by sociologists who highlight inherent power differentials between participants (e.g., Bourdieu 2000).

In Britain today, there is an expanding 'knowledge society', an ongoing drive to engage the public with science and an evolving democratic landscape. In the context of growing technological interaction in social life and an increased role for science in political decision-making the idea of an informed and engaged public holds considerable appeal. In practice, this is heavily underpinned by the idea that such engagement would lead to more receptive publics, and this has had a lasting influence on studies and discussions of public engagement. A more rounded idea of the scientific citizens counters the notion of a receptive, unquestioning public and proposes a public capable of and able to play an active role in science and technology's influence on society. This has often been translated as a move upstream towards dialogue. In this thesis, I challenge this translation by pointing out the limitations to citizenship at a point when a technology is still 'unformed' and by reconsidering the assumptions inherent in dialogue as input to governance.

The assumptions bound up in the conceptual step that relates citizenship to dialogue are multiple, not least that an oppositional public response is amenable to consensus. It moves into the shadows situations where plurality and antagonism are both structural and persistent. The view that dialogue is an effective means to solicit and negotiate public response contains assumptions about the nature and effectiveness of representation in the public and the legitimacy of the process itself. The emphasis on upstream decision points also implies that problems lessen as technologies approach the point of implementation. I open these assumptions up to scrutiny, and examine their implications in the light of a large-scale, technology-intensive public policy

initiative in Scotland. These assumptions involve concerns that resonate with some of the core concerns of any study of citizenship itself. Who is involved? What processes lead to their involvement? And how do they exercise their voice? A systematic configuration of scientific citizenship and a way of debating it has been lacking in science-society debates to date.

Against this backdrop, this thesis develops a distinctive way of considering the relationship between science and society through the conceptualization and reconfiguration of the term 'scientific citizenship'. I use the example of Scotland's wide-scale and ambitious pursuit of a low-carbon society as my context. A slender strand of scholarship on perspectives of scientific citizenship has emerged over the last 15 years (e.g., Bickerstaff et.al. 2010, Elam and Bertilsson 2003, Felt 2003, Horst 2007, Irwin 1995, Irwin 2001, Mejlgaard 2009, Michaels and Brown 2005, Weldon 2004).

Citizen Science by Alan Irwin was one of the earliest studies of the landscape in social conflict (Irwin 1995). In this landmark work he looks at the relationships between the public, science and the environment and spells out a two-sided challenge. On the one hand he highlights the fact that time-honoured concerns of citizenship – equality, power and class – feature in every case of science and public that one cares to look at. This poses a direct challenge to what he calls 'Enlightenment-led' models of participation where an assumed lack of knowledge on the part of the public is a hurdle to be surmounted. Irwin goes on to point out that expert or transferred knowledge is of no utility if the structural ability to change local conditions is absent. On the other hand, Irwin notes that established approaches to understanding citizenship have a blind spot when it comes to questions of knowledge and expertise, and "*whilst such questions overlap with matters of empowerment and democracy, they also bring a new element into focus: the linkage between ways of knowing and of acting*" (Irwin 1995:178) which have become a central issue in the study of public engagement with science.

Irwin further developed this line of reasoning with an exposition of scientific citizenship in 2001, this time in the discursive context of the UK's 'Public Consultation on Developments in the Biosciences' (Irwin, 2001). This work draws attention to questions of who participated and who set the boundaries and is frequently cited for its critical assessment of the consultation exercise itself. Irwin also draws attention to the importance of context in a way that has received less attention. Consistent with his earlier work, Irwin directly highlights the importance of local conditions and context in negotiating science and technology, and points to the difficulty of incorporating this grounded approach in typical policymaking institutions. These are themes I take forward here. I ask how the specific features of context can be understood theoretically, and how contextually sensitive work might be made generalisable enough to be useful for policymaking.

1.1.2. An Introduction to Scotland's low-carbon transition

The empirical work of this thesis investigates science-society relations using empirical data collected from public participation practices in Scotland's transition to a low-carbon economy. The Scottish project is attractive for its social and economic importance and in a sense for its mundanity. Apart from a couple of exceptions (e.g., Walker et.al. 2010), research on public engagement with science and the governance of science has tended to focus on science in the abstract, or emergent technologies (Barben et.al. 2008, Corner et.al. 2012, Irwin 2001, Stirling 2008). In this context a study of mundane, tangible technologies holds appeal.

The issue of energy is a policy priority for the Scottish National Party (SNP), elected to power with a majority in May 2011. This is a policy-intensive area in Scotland, and there are ongoing initiatives in national, regional and local planning, strategic decisions on nuclear capacity, subsidy schemes for preferred energy inputs and state-sponsored market interventions such as the Saltire Prize, which will award a £10M prize to the project showing the most

commercial potential from entrants who can generate 100GW energy continuously to July 2017 using only the power of the sea. The ability of Scotland to better exercise its energy leadership was reified in *Scotland's Future*, the SNP's manifesto for independence, launched in November 2013.

> *"With an independent seat in the EU, adding our voice to those of other nations with high ambitions on climate change, we can present evidence of effective action within Scotland and argue directly for our European neighbours and other developed nations to share Scotland's ambition of reducing greenhouse gas emissions. We can also show that other nations can share the economic benefits of making an early transition to a low carbon economy".*
>
> Scotland's Future (TSG 2013d:12)

Almost two-thirds of all of the EU's proven reserves of oil, an eighth of the EU's natural gas and almost 70% of the United Kingdom's coal reserves are in Scottish land or waters. Regardless of the relative strength of energy reserves, the devolved Scottish Government has set ambitious renewable energy targets, pursues them relentlessly and revises them upwards on a regular basis. The most recent targets anticipate that 100% Scotland's electricity requirement will be met by renewable sources by 2020, although this is a 100% equivalence target – it is not suggested that all fossil fuel and nuclear generation will have ceased. As well as offering energy security and decreased carbon dioxide emissions, renewable energy offers the promissory allure of job creation not only in urban areas but – through tidal and wave technology – also in rural areas. Scotland is frequently cited as having the highest renewable energy potential in the EU as a result of its natural resource base (primarily wind, wave, tidal and sometimes biomass) from which it draws renewable energy. Much of the recent growth has been in onshore wind power which have been

developed so rapidly in Scotland and England that the term 'windrush' is commonplace, particularly amongst opponents.

The transition to a low-carbon economy has not been painless and numerous obstacles have emerged. The issue of energy costs in the United Kingdom is at least as salient as questions about which technologies might most reliably reduce CO_2 emissions. Over 5.5 million UK households spend more than 10% of their income on fuel and are classified as 'fuel poor'. In 2004, there were 12 operational wind farms in the UK and average annual energy bills were £522. Today, with 355 operational wind farms average bills have risen to £1,300 for energy each year. As wind farms have multiplied, energy bills have more than doubled (Acheson 2012). Windpower is not the sole or even major cause of rising energy bills, but the fact that this "free" energy is not shared with those who can quite literally *see* it being generated is very apparent to the 900,000 (>33%) Scottish households classed as being 'fuel-poor'.

However, arguments that raise fuel poverty are said to be unbalanced and to generate scepticism around the future benefits of current investment in renewable technologies. Recent House of Commons research (not released into the public domain) determined that the subsidy paid to renewables developers through the Renewables Obligation Scheme has nudged 100,000 UK households into fuel poverty. Though they would not otherwise be there, the actual increase on costs per household is comparatively small at £18.20 per year (Carbon Brief 2012).

Renewable energy development occurs through the market, and is facilitated by Government subsidy, feed-in price guarantees and carbon certificates to reduce the regulatory and market risks to companies in the sector. These Government interventions are sites of a considerable contestation and perverse effects (Mitchell and Connor 2004). For example, in including co-fired biomass as a renewable technology the subsidy actually incentivizes expansion of new fossil fuel capacity. At the same time at the start of the scheme there were cases in which existing hydroelectric schemes in Scotland

were downgraded in capacity in order to become eligible for the subsidy. Initially, it was envisaged that the cost of renewable energy to consumers would fall. This has not proven to be the case, partly because savings are not passed on directly (a core assumption) and partly because consumers are paying for capacity that is not yet commissioned. As well as the perverse effect of the subsidy, lack of investment in grid upgrades has limited the amount of renewable energy that can be distributed regionally and nationally (House of Lords 2008, clause 122); in fact, distributed renewable projects require substantially costly upgrades to the electricity transmission and distribution network which are not generally factored into forecast unit costs, so the full economic costs of this type of investment is frequently understated.

Against this complex landscape there are a range of points where publics could reasonably be expected to engage with the adaptation to a low carbon society. These include negotiation of how local and regional spaces are shaped within the planning system, projects to encourage adoption of micro-generation technologies (e.g., Abi-Ghanem and Haggett 2011), reduce energy demand (e.g., Ockwell, Whitmarsh and O'Neill 2009), and more formal consultations about emergent technologies such as biomass, carbon capture and storage (CCS) or synthetically engineered biofuels (for example, through Sciencewise – the UK's centre of expertise in public dialogues for science). As well as sensitivity to landscape disruption, public antagonism reflects a wide range of issues that questions the capacity of renewable technologies to deliver the Government's carbon reduction targets, the alleged distorting effects of current policy interventions, the contested role of regional and local planning processes and concerns related to technological lock-in as developers of renewable energy technologies (RETs) pursue economies of scale. Such objections have been dismissed as 'NIMBY' (Not In My Back Yard) responses, and a literature that deconstructs the 'NIMBY' framing of public response has emerged around a number of these points (Devine-Wright 2010, Devine-Wright 2011b, Douglas 2010, Ellis et.al.2007, Walker and Cass 2007, Walker et. al. 2010, Upham 2011).

In this context a number of threads emerge that resonate with the idea of scientific citizenship: a society shaped by a technology-led transition; new publics involved and rising up in protest; multiple sources of debate; the assertion and granting of rights for participation; and the variety of sites for participation. Despite this, such features have not previously been brought together in a coherent discussion of scientific citizenship. It is to this gap that I now turn.

1.2. Rationale for Research

The analysis in this work is grounded in a literature of public engagement, relevant parts of which are summarised in Chapter 2. However, that literature has not made a substantial transition into discussions of scientific citizenship leaving a number of gaps to which this thesis contributes. Here I outline three such gaps in order to provide a rationale for this research.

The first lies in a lack of clarity as to what scientific citizenship means. Previous research has alluded to citizenship in the context of science, but these studies have been unsystematic, not generally drawn from a firm base of citizenship studies, and not presented in a format for ready critique, adaptation and application. Consequently a primary element of the rationale for this research is to identify, develop and evaluate a conceptual framework for scientific citizenship.

The second gap in previous research relates to the relative absence of studies of scientific citizenship around mundane technologies. The tendency to discuss public engagement in the context of general science or emerging technologies has shaped the field substantially. The relative absence of physically present technologies, even those that are already present and visible such as RETs, directs debates and conceptual models towards discursive techniques that are reliant on practices designed by experts and draw on publics that have been 'created' for a specific purpose.

And finally, a third gap that I aim to fill in this work relates to the current context in Scotland. An ambitious policy environment is helping to shape the

development of an extremely fast-growing renewable energy sector. The importance of energy to Scotland's political future makes it a topic of public and private importance. This has never been more so than at the time of writing, as Scotland engages in a referendum on possible independence. Yet there are also signs that the picture of public engagement with science and renewable energy in Scotland looks very different to that which the literature paints. The difference between practice and literature is fertile ground for my research.

1.3. Conceptual Grounding

This thesis approaches the topic of scientific citizenship from the perspective of public engagement with science, within the field of science and technology studies (STS). However, there are significant gaps in this literature in informing my question and so I reach beyond STS to draw on studies of social and political theories in the broader sense of citizenship (e.g., Bellamy 2008, Calhoun 2007, Dalton 2008, Eriksen and Fossum 2000, Firth 2013, Janoski 1998, Stevenson 2003, Turner 1990).

Their work outlines various readings of the evolution of the idea of citizenship across more than two millennia. From the *demos* of Ancient Greece through to the mobility of the European Union, citizenship has been challenged and shaped by the context of the day, and the prevailing structures of democracy. The earliest forms of citizenship and democracy have continued to shape our current understandings. The republican idea from the Greek model describes the rule of the people, a search for consensus and a distrust of rulers who do not come from 'normal backgrounds'. Much of this thinking is present in proposals for public deliberation around science as a form of governance. The Roman model is at one end of a lineage that has a liberal tradition of citizenship at the other. This model describes an assemblage of explicitly ratified rights that emerge as different interest groups struggle to have their voices heard in parity with others.

Importantly, the republican and liberal models differ in questions of *who* should be included in decision making and what *rights* they should hold. In the last 150 years, Western citizenship has increasingly engaged with questions of the civil, political and social. This has included accounts of membership and exclusion that continue to be debated today, along with the incorporation of ideas of a welfare system as a focal point for the expansion of our understanding of rights. In modern times, the growth of identity-based politics and a global movement of labour and goods have begun to challenge the relationship between citizenship and the nation state.

Whilst narratives of citizenship can be read in different ways, there is a consistent role for evolving notions of membership and rights. A general post-Millennial shift in citizen politics is challenging understandings of *how* people participate. Bellamy (2008) offers a conceptual framework that facilitates an empirical exploration of scientific citizenship structured on three dimensions: membership, rights and participation.

The first dimension of membership expands the traditional interpretation of a citizenry as those bounded to a particular state by nationality or residence. Whilst some STS scholars have pursued this interpretation, particularly in the consideration of representation in quantitative work or deliberative dialogue (e.g. Sturgis and Allum 2004), I make the case in this work for evoking more fluid and overlapping ideas of "membership" than the strictly political definition allows for (e.g. Barnes et.al. 2003, Mahony 2010, Mohr, Raman and Gibbs 2013). In particular, sociological ideas of constructed publics open up the possibility of considering how publics are created and emerge across a technology's wider socio-technical network, how membership operates amongst them and who is excluded and included.

The second element of rights examines how they are assigned and seized, and what responsibilities are undertaken, by whom in order to sustain those rights (e.g. Janoski 1998, Jasanoff 2011). It incorporates the premises that the granting of a right is frequently inadequate in and of itself, and that the opening up of

rights creates responsibilities for other actors if the right is to be exercised fully. Ideas of procedural and outcome justice also play a role as for example in how fragile or flawed processes can undermine even codified rights, and how ideas of plurality overlap with the exercise of rights in a just way (e.g. JRF 2012, Walker 2011).

The third element of participation draws largely on STS work that has examined public understanding of science, public engagement with science, and the relationships between publics and renewable energy. Consequently, the case is made for considering participation from different points of view - as an audience member at a science communication event; as an electoral vote for the SNP who argued for a 'green Scotland'; as formal participation in the planning system; as a consumer of low carbon technologies; as community carbon reduction programmes; or as active opposition to specific schemes. Looking widely at different types of participation reveals the modes citizens actively seize (in contrast to the modes they are given), and incorporates participation across the development cycle of a new technology.

1.4. Research Aim and Questions

In summary, this research aims to unpack the notion of scientific citizenship and to illuminate analytical and practical insight for contemporary understandings of science–society using the empirical example of Scotland's low-carbon transition. I pursue five research questions within this aim:

1. How has Scottish science engagement evolved so far, who are the key actors, and how do they understand their roles in science and society?
2. How can we begin to understand the territories a scientific citizen inhabits?
3. What rights and responsibilities are being ascribed to or asserted by scientific citizens, how effectively are they enacted and under what circumstances do they become contested or expanded?

4. What modes of participation can scientific citizens be said to practice and how do subject matter and participation mechanism shape one another?
5. How are membership, rights and participation synthesised to produce an effective nexus for the performance of scientific citizenship? What are the policy implications for future ways in which publics will engage with both 'science-in-general' and specific science, engineering and technology policy priorities, and future science engagement and low-carbon transition strategies of the Scottish Government?

1.5. Summary of Research Methods

The methodological design stems from a recognition that citizenship is a socially constructed phenomenon, experienced by members of society in different ways at different times. Consequently this is an interpretive study that draws on a qualitative mapping exercise, qualitative ethnographic fieldwork and documentary analysis to develop a meaningful account of scientific citizenship. Specifically, it draws on 24 interviews with elite policy and public engagement actors (broadly defined), 34 brief discussions with members of the public in attendance at public engagement events, 12 participant observations at public engagement events, 4 visits/tours at public facilities and analysis of 11 core documents.

Perhaps the more unconventional element of the sampling strategy for fieldwork is that it was approached in a top-down manner, using purposive sampling to explore as many different examples of publics, events and participation modes as possible (Jupp 2006:244-5) . This purposive sampling was combined with pattern-building analysis to extend the work beyond description and make it usable beyond the specific data included (Larsson 2009). As most events were public, access was largely unproblematic; in terms of interviewees some commercial respondents declined to be interviewed but the data that was gleaned in this area was rich in detail and utility and could

be validated through observations from other perspectives. Two interviewees requested that they see their quotes before publication, and I have honoured this.

This extensive fieldwork started early in the project and continued through its life (April 2010 – January 2013). It takes advantage of events in a timely manner and was able to quickly orient the work in the nature of events actually taking place. Findings from the empirical work were coded manually. Findings were pattern-matched against the typology of citizenship modes developed from the literature review and preliminary findings from the mapping exercise and then, on subsequent iterations, analysed thematically against a citizenship lens that includes membership, rights and participation. Comparing the modes of citizenship discerned in practice with the emphases found in academic literature was an important element of this work, allowing me to look beyond traditional disciplinary bounds.

1.6. Structure of the Thesis

This thesis is structured to develop a thorough, contextualised account of scientific citizenship in Scotland as it pursues a low-carbon economy. After my introduction, Chapter 2 will ground the thesis conceptually with a wide-ranging review of relevant academic literatures. Section 2.1 initiates this narrative with the specific context of science-society relations, paying particular attention to the genealogy of 'public engagement', a broad term commonly employed to encompass a wide range of participatory modes. Section 2.2 asks what we know of the public's relationship with renewable energy, uncovering some of the key parameters of support and uses this to explore what has been described as a paradox in public attitudes to renewable energy. Section 2.3 returns to ask what is meant by the term 'citizenship'. A review of citizenship theories will anchor the work in a sociological context, and develops a case for the particular research methods I used, along with a rationale for the subsequent structuring of the empirical work. Finally, Section 2.4 will delineate the gap between these literatures, clearly stating the research

aim and proposing an embryonic typology for scientific citizenship that will be tested and developed through the remainder of the thesis.

Chapter 3 sets out the agenda for the empirical work by describing and justifying a research plan that addresses the research questions. To begin, Section 3.1 outlines the methodological approach that underpins the thesis and describes how theory and data are connected. Section 3.2 describes my methods used and sources of data, commenting on sampling, access, ethics, dependability and analysis. In section 3.3. I conclude the chapter with a reflection on being an interdisciplinary researcher in this space.

The thesis then moves on to focus on empirical examples of public engagement and draws conclusions about the prospects for scientific citizenship. Structured around an existing framework for citizenship that was described in 2.3.3 (Bellamy 2008), the data chapters (4, 5 and 6) each consider one of three dimensions of citizenship. In each chapter, I draw on examples from the fieldwork to propose models of citizenship that emerge around each dimension.

Chapter 4 asks what scientific citizens might be citizens *of*? What is their 'territory'? How is their collective nature manifest and what are the limits of that nature? Would scientific citizens identify themselves in similar ways to the ways in which policymakers or commercial actors identify them? All these questions are anchored around **membership**.

Chapter 5 moves on to consider examples of **rights and responsibilities**. What rights do scientific citizens have and how evenly are these manifest? What happens when the rights of one group of citizens is in conflict with another's? Do responsibilities flow from these rights or is there a disjoint? Who articulates rights and responsibilities, and who speaks for those currently 'invisible'?

Finally, Chapter 6 turns to the question of **participation**. What might scientific citizens *do*? What modes of participation have been facilitated by

policymakers and commercial actors? Which modes do citizens themselves seize and under what conditions? What do these mechanisms tell us about the roles ascribed to publics, experts and mediators?

In the discussion in Chapter 7, I synthesise what has gone before in order to consider prospects for scientific citizenship. What can it offer? Who might it benefit? Under what circumstances could it be most helpful? I highlight common strands that run through the examples and three possible nodes of scientific citizenship are proposed: science, technology and cultural citizenship, material citizenship and anticipatory citizenship.

I conclude the thesis (Chapter 8) by summarising the main arguments, and I delineate the contribution of each chapter in understanding scientific citizenship. I explore policy implications for Scotland's low-carbon transition and for public engagement practice more broadly. Finally, I reflect on the contribution that the work has made to an understanding of the possible role of citizenship in science-society relations, and I make some recommendations for future work.

CHAPTER 2 Literature Review: A Journey from Public Engagement with Science to Scientific Citizenship

2.1.Public Engagement

2.1.1. Public Understanding of Science (PUS)

The start of the academic study of publics and science might reasonably be considered to be the (PUS) movement in the 1980s, characterised by the survey as a popular research tool. By asking members of the public questions designed to test their knowledge of scientific fact and the scientific process, answers could be coded as correct or incorrect and their scientific awareness measured quantitatively. Questionnaire designers and policymakers considered that aggregated data could provide an indication of how 'scientifically literate' the population was (Durant et.al. 1989).

That the public should have a basic understanding of abstract scientific process, fact and vocabulary was considered to have inherent normative and instrumental value. Firstly, there exists a view that promoting scientifically literate forms of citizenship would be good for society and the economy and the UK's leading learned scientific institution went so far as to describe this idealised citizen as one who benefitted from enhanced practical skills, making better decisions and increased employability, capable of participating not only in Government-led decision making processes but in Western society as a whole (Royal Society 1995). Secondly, there is an underlying assumption that knowledge of scientific process and fact engenders a positive attitude towards science in general, with a consequent conclusion that negative attitudes arise solely from inadequate knowledge and can thus be addressed through education. This construct, named the '*deficit model*' (Irwin and Wynne 1996) has been highly influential and is still prevalent today, albeit often implicitly.

However, the deficit model as an explanation for public behaviour is not completely borne out by empirical observation. In surveys to explore the supposed causality between attitude and knowledge, a generally favourable

attitude towards science is weakly correlated with increased performance in the knowledge scales, this generally positive attitude toward science was not indicative of a positive attitude towards a specific scientific topic (Evans and Durant 1995). In fact, more knowledgeable respondents were less positive towards contentious topics (such as human embryology) than those who appeared less knowledgeable. Aside from these specific findings, the survey methodology that formed a key foundation of the deficit model faced more generic difficulties in establishing its generalisability, in both the manner in which science and publics are treated as homogenous masses and also in the artificiality of the knowledge extraction process. Far from people being "…repositories of knowledge – cognitive containers in which we can rummage around…" (Gregory and Miller 1998), it is apparent that people are aware of the knowledge they have, they know where their information comes from, automatically apply a judgement as to its veracity and interpret it within their own personal, moral, subjective context to determine its meaning (e.g., Irwin and Michael 2003, Wynne 1996). However, the power of quantifiable data is alluring, and attitude and knowledge surveys are still carried out at both European and national levels (e.g., DIUS 2010, European Commission 2010). The more recent academic work has evaluated whether surveys can be sufficiently honed to be able to detect issues of context such as the political, cultural and economic elements usually explored by qualitative means (Sturgis and Allum 2004) and explored the relationship between ideology and attitude (e.g., Zia and Todd 2010) in work on attitudes to climate change.

Considering the deficit model in citizenly dimensions suggests a somewhat Spartan, unbalanced picture of scientific citizenship which is expressed largely through the medium of sanitized scientific fact flowing from professional scientists to seemingly unknowledgeable lay publics. For example, in its December 2009 Advice Paper to the House of Commons Science and Technology Committee, the Royal Society of Edinburgh (RSE) concluded that the main weakness in the UK's biotechnology capability was its ability to scale-up technological innovations from the laboratory to the field and one of

the primary barriers for this is public opposition. The UK Government is accused of being unduly passive in the face of public opposition to a breadth of opportunities, that its position was 'hostile' and that a lead should be taken in 'informing public opinion'.

The paper concludes:

> *"The RSE recommends a sustained campaign of public relations, promoting the public benefits that can be delivered by genetic modification, Synthetic Biology and stem cell research and undertaken with principled rules for engagement. This will have to be very different from the flawed public engagement of the 1990s, and will be vital to breaking down debilitating public opposition."*
>
> (RSE 2009)

Encapsulated as the *public education* model of scientific citizenship (Callon, 1999), publics are only differentiated by their level of scientific literacy, gained by ingesting scientific fact distributed through compulsory education and public education initiatives. Lay knowledge is considered little more than unusable, subjective anecdote, a 'contaminant' of the clean knowledge generated within the profession; a scientist talking about risk is qualitatively different to publics talking about risk. When disruptions to this relationship occur it is thought to be because the public have fallen victim to irrational, emotional thinking, and further or more intensive (re)education is therefore considered key to restoring trust. Publics and science come together only indirectly, mass-mediated by the state (delegated to academia or the media) or by firms, who meet our needs as consumers. In its most restrictive sense, the public education model is seen to tell citizens what to think - publics have the right to usable uncontested fact, and are given the responsibility of acting in accordance with that fact and seeking further information from accredited sources if doubt or uncertainty remains, and this is the limit to the participation required of them. Elam and Bertilsson (2003) draw out its

evolved from – the '*advanced consumer*' model – where scientific communication is enabling rather than prescriptive. Here, the role of public information is to aid citizens in forming their own opinion on more dynamic, emergent areas of science.

This position has the deficit model of public understanding of science at its heart. There is an overt and generalized framing of public concern as the reason behind a lack of commercial applications; public views are an obstacle to be overcome, which might be brought to a sympathetic view by an upbeat PR bombardment and an unspecified process of engagement. It is also clearly implied that the Society sees the process of public engagement as one of winning the public over, and that a refined method will achieve this ultimate ambition.

The frequency of science-based leisure activities above and beyond public talks and themed television programmes suggests that some citizens are genuinely excited by science and seek out a more interactive format inside science shops, museums, science centres and through more culturally based projects such as Science Festivals and Cafés Scientifiques. It is this space – the interactive consumption of science in the exercising of choice – to which I now turn.

2.1.2. Citizens as Consumers of Science

Whilst this area of science is a broad, innovative and active one, with new mediating forms emerging on a regular basis, academic study has largely focused on the museum or science centre. The ability of citizens to access scientific collections through museums has a long pedigree, stretching back at least 200 years to the individual and civic collections of technology embodied in the Conservatoire National des Arts et Métiers (founded in 1794). Science museums are a permanent fixture in the landscape of publics accessing science, fulfilling public education as well as curatorial roles. More recently, from these amenities has emerged a new type of facility with curation

exchanged for entertainment and topicality – the science centre (Davis 2004, Friedman 2010).

There is good evidence that both museums and science centres are far more than neutral presenters of scientific history or concepts. Technology historians have noted the understanding that 'traditional technologies' such as the shaping of metals, wood and textiles belong in folk (rather than science) museums and despite their prevalence these everyday technologies are discounted and perceived to be somewhat backward in an environment where science is slavishly promoted as new and of the future (Edgerton, 2008). Where celebrations of the past do form an important part of the museum offering, the result is an emphasis on 'finished' (and successful) science, with no room for failures or missed opportunities (Durant, 2004). The active framing role of the science museum has been noted empirically; whilst visitors leave science centres with new scientific knowledge, they are more likely to see science as a consensual, comprehensive and certain process, suggesting the exhibits and activities are mediating the messiness of science into something more clinical and stable (Rennie and Williams, 2002).

There are several possible cultural and practical reasons why museums gravitate towards presenting stabilised scientific fact as opposed to engaging directly in contested areas. Firstly, the impact of commercial sponsorship in science museums has been repeatedly noted as an influencing factor in their reluctance to engage with controversial topics (Butler 1992, Gregory and Miller 1998, Arnold 1996, MacDonald 2004 quoted in Delicado 2009). The representation of controversial, fluid issues directly challenges the deficit model of the understanding of science, in that the 'facts' are far from certain and the 'transmission process' is complicated by the contingent nature of the knowledge (MacDonald and Silverstone 1992). In her comprehensive study of the question, Delicado attributes the source of the deficit model in science museums and centres as not simply historically based, representing some outmoded view of science communication, but as a natural effect of the focus of museums on children. By targeting children as the primary audience of such

facilities, an emphasis is placed on education and entertainment rather than debates about disagreements, power relations and public attitudes (Delicado 2009).

How straightforward it is for science centres to adapt and embrace a more adult, dialogic relationship with the public is unclear, and some studies have examined emergent strategies that have precisely this aim. Based on an experiment in the Gallery of Research in Vienna on the topic of GM food, Yaneva, Rabesandratana, and Greiner (2009) argue that a fundamentally different type of exhibit is required to effectively communicate contentious topics and advocate the use of installation art to disrupt the characterisation of visitors as passive recipients by challenging them visually, spatially and emotionally. In a study of the Dana Centre at London's Science Museum, Davies et. al. 2009 highlight that not all value is created between the exhibits (or facility) and the visitors. Alternative benefits of dialogue even when not directly linked to policy-making include aspects of social learning, where new information and behaviours are learned by watching other people, rather than by direct absorption of information. So, value is created between visitors and the Centre acts in a facilitative role.

Whilst the literature on museums and science centres is well grounded, it is not representative of the range of activities in which adults can enjoy science within culture, perhaps as a leisure activity. Alternatives include Cafés Scientifiques, science festivals, science-themed theatre, Bright Clubs, Skeptics in the Pub and so on. Whilst quite diverse these activities all aim to communicate science in novel formats, often in an interactive manner and – crucially – by taking science into cultural environments already familiar and comfortable to the public, such as pubs, cinemas, public buildings, parks and theatres. Whilst recognised as an important part of the programme of science-society meeting points (Burchell et. al. 2009), the Café Scientifique format is proving of interest in contexts such as air pollution (Brimblecombe and Schuepbach 2006) and paediatrics (Price 2010), yet the role and performance of these types of events has received scant academic analysis.

Despite its diversity, the interactive nature of this form of public engagement is readily apparent, and it is clear that there exists a vibrant cultural space within which citizens elect to spend time exploring science. There is space here to imagine a citizen who remains quite distinct from the institutionalized and professional performance of science but nevertheless takes on a responsibility of actively seeking opportunities for engagement through adult-oriented activities. The most explicit conceptualization of the citizenship aspects of active consumer science might be taken from Barry (2000) who considers that the individual's identity is primarily established through mechanisms of consumption. The active consumer takes responsibility for seeking out science-oriented events, but in return anticipates a right to be able to access mature face-to-face interactions with scientific institutions that are interesting, exciting and engaging enough for them to be chosen as an activity above all the competing leisure activities on offer.

Whilst STS scholars may note the similarities to the public education (deficit) model in its constructions of publics, science and bases of expertise, Barry distinguishes the active consumer model with a recognition that science carries a responsibility to make itself exciting and engaging, and that a failure to do so will lead to the natural response of it being marginalised by large sections of the population. In this, we can start to detect what would become a growing emphasis on 'interaction'. Recent scholarship has started to focus on the role of both affect and materiality (Davies 2013, Marres and Lezaun 2011) in ideas of interaction.

The active consumer is active in attending science events and interacting with speakers (e.g., Café Scientifique, lectures at the Royal Geographic Society, debates at Science Festivals and, in particular, events at science centres aimed at them specifically such as those at the Dana Centre, London or the Reclaim series at Sensation in Dundee). As part of his broader deconstruction of the notion of active scientific citizenship, Barry highlights the problems in equating adults interacting with exhibits with some attitudinal or cognitive change in daily life, and draws attention to the 'perishable' nature of such

activities in that they need ongoing reinforcement. Indeed, other researchers have observed that adult audiences in science centres are better engaged through a focus on research outcomes rather than mimicking idealised laboratory experiments (Hodder 2009).

As deficit and consumer-based models dominated the late twentieth-century science and society landscape, societal and academic discourses began to diverge quite significantly from the public education model of public understanding of science. Firstly, a series of events in the public sphere clearly highlighted that publics were quite capable of asserting their voice on their own terms. In 1990, concern that there would be consequences for human health during the BSE crisis led to heated public debate and vocal calls for safety measures from the public. Politicians delayed bans on infected beef products entering the human food chain and the UK Minister for Agriculture, Fisheries and Food and made sweeping statements as to its safety. By the time the causation mechanisms were established, publics felt seriously misled, and criticism emerged as to how scientific uncertainty had been communicated. Later the same year the House of Lords Select Committee on Science and Technology published it's report, *Science and Society* which contrasted the hostility generated by the BSE 'fiasco' with the opportunities presented by a public interested in science at a time of exciting developments (House of Lords 2000). The case of BSE occurred alongside even more vociferous public responses regarding the triple measles-mumps-rubella (MMR) vaccine and increasingly active protests regarding genetically modified (GM) crops. It seemed clear that citizens were capable of acting unpredictably and firmly when fully engaged in an issue of their choosing, and their mode of engagement was often at odds with the idea that their concerns could be addressed by providing further information. When data was forthcoming, but its source was distrusted, the deficit model had little to offer by way of insight to ensure supportive public responses when science spilled over into the social world.

Secondly, the frugality of the deficit model of scientific citizenship became the focus of considerable academic research seeking to uncover how people accommodate scientific knowledge and what meaning it holds for them. The difference between generalised science - which one may be supportive of and yet feel distant from – was contrasted with particular instances of technoscience[1] where Callon's 'spillover' is very evident, as understanding science becomes entangled with feelings of social identity (Michael, 1992). In this sense, the work reflects Evans & Durant's finding regarding the discontinuity between attitudes to science in general, and attitudes to particular technologies. The challenge that the scientific process can pose to citizens' conceptions of their own identities has also been illuminated in the seminal case study of sheep farmers in Cumbria (Wynne, 1996).

Thus the unidirectional trust inherent in notions of 'public understanding of science' faced serious challenge, and scepticism regarding science policy and institutionally endorsed information became visible and significant. The 'BSE crises' (as it became known) is reported to have acted as a catalyst for policy interventions which have continued to the present day, encouraging outwardly sensitive directions in scientific research (Irwin, 2009). Contemporaneous policy documents encouraged the involvement of publics earlier in the research process, for example in the promotion of upstream engagement in nanotechnology (RS/RAE 2004). This report called for *face-to-face* dialogues between members of the public and scientists at a stage before key technological decisions have been made and positions adopted.

2.1.3. Public Engagement with Science (PES)

The value of upstream engagement of the public in science can be described in terms of three distinct (but frequently overlapping) rationales: normative,

[1] I draw on the idea of *technoscience* in its visionary sense, in order to promote the idea of a regime of knowledge, social context and material culture not readily amenable to fixed labels of science, technology and engineering. In this way, I hope to offer a more readable text that purposefully avoids specious specificity.

substantive and instrumental (Fiorino 1990, Stirling 2008). That citizens are enveloped by science, and live with its uncertainties as well as benefits is a core citizenship argument already recounted - it is only 'proper' that publics have the opportunity to influence the direction developing technologies take. Substantively, some stakeholders argue that members of the public possess knowledge that is unique and pertinent, so a better research result is delivered through dialogue and engagement (the epistemic aspects of publics and science are more fully explored in the following section). Furthermore, the research process is further improved as scientists themselves undertake a new form of reflection following exogenous challenges and input. The final argument for upstream engagement is linked directly to the processes of legitimisation and enrolment – that by making more consensual choices upstream, publics will be more trusting, more ready and more able to adopt (or co-exist) with new technologies. What is particularly interesting about processes of dialogue – and has proved fertile ground for later reflection and evaluation – is that all of these rationalities can be operating concurrently by various participants.

By the end of the Millennium, the scale of public engagement initiatives was significant with activity concentrated in Europe. Process models being introduced and evaluated have included referenda, surveys, consensus-building activities and citizens panels (Buccini and Neresini 2008) and by 2005 more than 100 different mechanisms for public participation in science had been identified (Rowe and Frewer, 2005). In Summer 2008 one such public consultation event in Edinburgh explored public views behind stem cell research. The workshop was part of a series of three, each held in five locations across the UK and organised by the Biotechnology and Biomedical Sciences Research Council, the Medical Research Council and Sciencewise - the government's public dialogue resource centre. The project recruited 200 members of the public (Bhattachary 2008) who attended a series of deliberative workshops on topics including visions of stem cell science, sources of stem cells and stem cell applications. A sub-set provided their

views for quantitative analysis by Q-methodology in order to develop typified profiles which were characterised as confident supporters, pro-life critics and selective accepters. The final report describes participants who are supportive of an ongoing process of engagement which they feel is important, and highlights that public engagement should not be seen as a singular event to legitimise decisions already made, instead advocating an upstream role in influencing research directions. This consultation is just one of a series that have been taking place over the last decade, including the 'Public Consultation on Developments in the Biosciences' (see Irwin 2001) and the prominent *GM Nation?* public debate which has become the topic of extensive evaluation (e.g., Irwin 2006, Elam et. al. 2007, Rowe et. al. 2008).

Critical PES

This and other public dialogues and consultations which have taken place over the last decade provide a rich seam for reflection, in which a number of critiques are emerging as current topics of debate. One of the most prominent proponents of this type of critique is Alan Irwin, who has conducted in-depth studies of a number of biotechnology-based public consultations. His careful analysis of the *GM Nation?* debate led to his 2006 paper 'The Politics of Talk'. In this, Irwin describes how new forms of dialogue are constrained by "an uneasy blend of old and new assumptions" that arises from policymakers being selective in adapting their work in light of emergent findings from contemporaneous dialogues. Of particular relevance is the significant impact of the way the public is imagined, even when this is contradicted by experience, and Irwin draws out areas in which the new suggested benefits of dialogue might be contested. As well as challenging the assumed relationship between talk and trust, Irwin challenges the allure of dialogic consensus. The normative limitations of such exercises have been explored in terms of the inherent difficulties in using processes that rely on forms of 'idealised talk' that are difficult – if not impossible – to achieve in practice (Mouffe 1999, Bourdieu 2000).

Separate to Irwin's critique and more in line with the traditional analytical lines of science and technology studies, the definition and role of expertise in contemporary public dialogue continues to receive attention. In dialogues and consultations that are conceived on substantive grounds (i.e., that lay input is necessary for a better, more democratic result), the notion of 'lay expertise' continues to be challenged, carrying with it the inherently difficult questions of how far one should take the concept and exactly who can be consulted with in a meaningful way (Collins and Evans 2002). In public engagement projects based on normative or instrumental bases, Bäckstrand (2003) also delineates some practical constraints. Firstly, she poses the challenge of how feasible it actually is to extend the democratic reach of citizens into the profession of science, and what impact this would have on the scientific process itself – even the most 'scientifically literate' public would reach a point of not being able to engage further without diverting significant levels of scientific effort and time from production to explanation, fundamentally changing the speed and nature of the scientific endeavour. A further consequence of this, Bäckstrand suggests, is that whilst publics are more naturally positioned to challenge and debate the application of science and technology, that they are much less well-equipped to engage in the production of scientific expertise means the dialogic agenda will always be selected (and hence pre-framed) by the scientific establishment.

In the context of medical genomics, Evans and Plows (2007) contest the overgeneralised construct of 'lay expertise' as being too imprecise, suggesting a disaggregation – a recognition that for any one issue at any one time there is a normative role for a public without expertise that is distinct from the substantive role that publics with lay expertise fulfill. However, this type of categorization of publics is itself highly material to the engagement exercise and unsurprisingly has attracted considerable thought on, for example, the roles of general and more specific publics in healthcare (Martin 2009). Michael (2009) clearly draws out some of the tacit attributes ascribed to a large, anonymous, homogenous 'public-in-general' as opposed to a more

immediate, discrete, stake-holding 'public-in-particular' and recounts some of the ways in which both groups are used rhetorically and how the authenticity of each can be challenged. This imagining of publics has been explored empirically in the context of renewable energy in the UK (Barnett et al 2010), showing how a persistent narrative of public hostility to renewable energy has shaped operations across the sector (Walker et al 2010). In the context of genetic technology in Austria, Felt and Fochler (2010) expounded the performative effects of audience construction, describing how publics can adopt or reject the identity placed on them.

A particular outcome of this potential imagining of disinterested non-expert publics is the appeal such neutral publics present to policymakers. Irwin highlights the use of publics as social research subjects in his analysis of the 'Public Consultation on Developments in the Biosciences' (2001), and progresses this in 'Politics of Talk' to describe how the views of the 'innocent' citizen – one who is ignorant and unaware in relation to the topic at hand, where one member of the public might be interchangeable with another - are preferred over those of participants who are already engaged (typically activists, who often cease to be considered 'public' instead being described as 'stakeholders' (e.g., Burchell et. al. 2009, Chilvers 2010). This focus on participants without prior interest has also been criticized in light of the high cost of participation (in terms of time and effort) for citizens – the less engaged or interested the participant is in the research, the higher the cost of their participation (Kleinman, Delborne and Anderson 2011). The final area of critique in relation to 'blank slate' participants is when the shift in their opinion becomes the object of study (Lezaun and Soneryd 2007). This emphasis on 'mobility of publics' is problematic in that it embeds the instrumental facets of the exercise (that publics are to be convinced, or won over) and does not seem to take equal account of the mobility of sponsors.

In discussing deficit model ideas of public understanding of science in section 2.1.1., I touched on Callon's public education model of science and citizens (Callon 1999). In that paper, Callon outlines three models to describe the role

of lay people in scientific knowledge: public education, public debate (discussed here) and the co-production of knowledge model (in section 2.1.4.). Callon's second model of publics and science is that of *public debate* (comparable to the *public sphere model* (Barry, 2000) or *deliberation* model (Elam and Bertilsson, 2003)). In recognising the limitations of a purely scientific standpoint in answering complex policy questions of technoscience, policy processes become open to more voices. Enter the public, and some recognition that the population at large is not homogenous. Publics, by their heterogeneous nature, have contrasting and competing points of view, influenced not only by values but by situated knowledge individuals have gained in the course of their lives and work. Disruption in the science-public relationship here is not because of an intellectual or cognitive deficit; instead, dispute arises because important participants have not adequately been given a voice. In response to this perceived need to bring publics and scientists together for enriched strategies, a vast array of mechanisms to talk and consult emerged, all with the aim of increasing the number of actors having an input into the applications and directions of technoscience (for an example of the scale of this kind of 'talk', see Rowe and Frewer 2005).

The models of scientific citizenship seen thus far have relied largely on generalised ideas of publics: as subjects whose knowledge levels can be quantified, as consumers of marketised science, as impartial participants in democratic processes or as subjects of opinion research. What all of these models have in common is the allocation of scientific knowledge to 'experts' who reside in the domain of professionalized science production and a public discretion to engage in the matter of science which, although available in a variety of formats, involves topics already laid down by institutions and policymakers. Having described deficit and deliberative models of public engagement with science, I move on to examine the area Irwin described in 2001 as "…space for a qualitative and localized model…", where engagement is examined and assessed within the context of its construction.

2.1.4. Epistemic Citizens as Co-Makers of Scientific Knowledge

I have drawn on the work of Michel Callon in proposing two models of publics and science: public education and public debate. The final model of publics and science described by Callon is that of *co-production of knowledge* (Callon 1999). This has significant commonality with the *co-operative research model* (Barry 2000), *the ethno-epistemic assemblage* (Irwin and Michael 2003*)*, the *radical/pluralistic model* (Elam and Bertilsson 2003) and the *emergent concerned group* (Callon 2007). Callon considers this a step change from the preceding archetypal forms of engagement–citizens are involved in the production of knowledge which impacts them and a real attempt is made to fuse the universal knowledge of institutionalised science with situated knowledge that accounts for local conditions. This conception builds on studies regarding lay expertise (Wynne 1996) and accounts of citizen science (Irwin 1995). In this model, the personal identity of the lay actor becomes closely bound up with the processes and outputs of science, and citizenship is explicitly spoken of, for example in communities of AIDS patients who successfully accessed and worked alongside traditional biomedical experts in the research and treatment of their condition in 1980's San Francisco (Epstein 1996) or in the identities assumed (and rejected) by people with muscular dystrophy in France (Callon and Rebaharisoa 2004). French muscular dystrophy association AFM gathered its own evidence base of the disease through photographs, interviews and video and was able to use this epistemic authority to influence the prevailing research model (Callon and Rebaharisoa 2008). Similarly, the UK Alzheimer's Society's 150-strong Quality Research in Dementia network has forged a role for patients and carers to relate their everyday experiences with the disease and play an active role in the management of the Society's research budget (Stilgoe and Wilsdon 2009). These ethno-epistemic assemblages not only extend disease epistemology through the inclusion of new knowledge sources and processes but speed up the translation of research results which might otherwise be impeded by commercial considerations or the academic publishing cycle.

Although not exclusive, it is clear that the ethno-epistemic assemblage has found a ready home in case studies associated with biomedical research. Despite the fact that Irwin and Michael originally elucidated their concept with the case of local pollution in Jarrow, the assemblage concept has very rarely been used to describe science-society interactions that have a greater base in engineering or non-biomedical issues. This could be explored more fully, alongside a more thorough analysis of the role of artefacts in an assemblage. Whilst the idea of an artefact does not sit comfortably with the 'ethno-' element of the assemblage, there is an established history of considering networks of people and artefacts as interactive and fluid constituents' in research associated with socio-technical assemblages and actor-network theory, e.g. Latour 1979. What the bounds of the ethno-epistemic assemblage as an analytical tool might be is an interesting question for further study.

A critical point in considering this model of citizenship is the collective action, the recognition that groups of interested parties coalesce to recognise a problem, mobilise interested and empowered 'third parties' to address a particular problem and along the way make a new heterogeneous networked community – it is a highly pro-active, bottom-up form of citizenship where issues are selected by citizens themselves and outputs are produced and used within the group. Participants seek to exercise their right to contribute their unique knowledge to the more established processes of science, and in return commit time and resources and – in the case of healthcare cases – move themselves into a more public sphere.

Irwin and Michael are explicit in their recognition of the role of the intermediary in the assemblage, binding this heterogenous network of interested parties who have varying levels and types of expertise. The intermediary, they say, is an "expert in communications or publicity skills of various kinds", operating in the space at the boundary of different fields of expertise. These spaces have been conceptualised as a 'trading zone' (Collins, Evans and Gorman 2007), an integration of models of boundary work and

interactional expertise. Whilst the idea of the trading zone is normally applied to collaborative interdisciplinary science and technology research within institutions, Gorman has extended the idea to Epstein's case of AIDS activists (Epstein 1996), describing the trading zone here as one which extends beyond institutional boundaries to encompass the self-educated activists (Gorman 2005) where the idea of a network facilitator with interactional expertise can facilitate a common language between parties.

Thus far, our understanding of scientific citizens has been largely cast as a role which co-operates with the institutions that govern the production of science. Whether considering the scientifically illiterate citizen who needs educating into more 'rational' behaviour, consumers of science as a leisure activity, a citizen with a valid voice to be drawn out for consideration through consultative dialogue, or an engaged co-producer of knowledge in a focussed alliance, these models configure potential citizens in locations where they can constructively interact with the establishment. There remains a fifth type of citizenship which is self-made and fully 'engaged' – the activist.

2.1.5. Scientific Citizens Making Themselves

Activists

As citizens who take direct action to bring about some form of societal change, activists are amongst the most engaged members of society, albeit typically on a discrete topic. The tactics deployed by activists to gain access to – and legitimacy within – science-public networks has been studied in a number of contexts. In the case of breast cancer research and genomics, Parthasarathy (2010) identified an activist's need to break through the 'expertise barrier' which would have otherwise excluded them and a range of strategies were deployed, from introducing new types of knowledge to challenging the way current data are used. Within the more formalized voluntary sector, civil society (in the guise of NGOs) in environmental science exhibits three main strategies: reframing, epistemic networks and technology

transfer (Jasanoff 1997). This type of active citizen also plays an important role in challenging which areas of science are left 'undone' according to the professional and social norms observed by scientists themselves (Frickel et.al. 2010).

However, despite what one might consider laudable citizenly credentials, activists systematically find themselves outside the more legitimate forms of consultation – they are considered too emotional for science communication, seen only as seeds for the ethno-epistemic assemblage (Elam and Bertilsson 2003) and not innocent enough to represent the public in formal dialogues (Evans and Plows 2007). As for representativeness, Douglas Parr (Chief Scientist, Greenpeace) highlights that participation is an inherently political exercise (Stilgoe 2006). The act of participating has value in itself, when eligible members of the public vote at an election, the Electoral Commission does not canvass those who did not turn out in an effort to derive the 'real' mood of the population. There is a preference in the literature for considering activists as *resisting* technologies or institutional framings which is something of a shortcoming, and this binary position is made quite explicit by Joyce Tait in examining public reaction to GM crops in Europe, "…throughout the history of scientific endeavour there have always been tensions between those who work to promote a scientific understanding of the world and those who would constrain or prevent it…" (Tait 2009). However, even the most active of protestors (for example in spoiling GM 'trials') have motivations that are underpinned as assertions of citizenship – acting on behalf of society as a whole rather than for personal interest (Szerszynski 2005). However, there are areas of activism in the civil sector that focus on promoting particular technological paths or issues. This aspect of activists – as supporters of behaviour and knowledges that might be associated with 'good science' is reviewed in the context of environmentalism and water literacy (Lee and Roth 2003). Here, activists were observed as communicating water usage in a manner that was embedded in a broader cultural context including community, ethics, citizenship and local issues.

In considering the roles of active civil society in the mediation of science, there is a real danger of over-generalisation. Given some activists' priorities of causing enough disruption to bring about some reflexivity (rather than developing a cogent robust argument that withstands the tests of scientific thresholds), it is unsurprising that there is little appetite for enrolling these actors into policy-making processes. Instead, whether battling the perceived influence of corporations on GM policy or using science as a weapon against an irrational and superstitious public, activists play an important role in challenging 'structural inequalities' from the outside by inspiring action through the use of irony, disruption, emotion and slogans rather than considered discourse, and as such they are considered unlikely to be able to make useful contribution to 'micro-deliberation' (Young 2001). However, some activists may have agendas which align with those of the state, and may have put considerable effort into developing well-argued positions. The implications for citizenship of this disparate group – who they speak for, how their energies can be harnessed and their voices heard – are wide and far-reaching, yet the literature (and policymakers) are not inclined to consider activism as a form of engagement on a par with more traditional types.

It is certainly true that activist groups - and indeed social movements - operate as intermediaries between scientific knowledge and lay publics, and that at an organisational level, activist groups do develop specific contextual knowledges and their ability to 'speak the language of science' (termed *interactional expertise* by Collins and Evans 2002) is crucial in gaining access to policymakers and resource managers (e.g., Epstein 1996, Evans and Plows 2007). It is therefore noteworthy that the knowledge critical to enabling activist groups becomes the basis of their disqualification from so-called 'public processes', particularly given Evans and Plow's observation that scientists and activists are both attempting to reach a lay public, and they both have inherent value positions. Consequently, how activists mediate scientific data in the context of this research, what their aims might be and how they affect them is an area worthy of further attention. However, I would like to

move beyond the concept of activists as individuals and small groups, and bring in that to which the activist seeks to engender: a wider counterpublic.

Counterpublics

The idea of the counterpublic (or *subaltern public*) is rooted in a feminist challenge to Jurgen Habermas' theorisations of the public sphere. Habermas had conceptualised the public sphere as a zone of social life to which all citizens had access, a discursive space where social problems could be identified and opinions formed that ultimately leads to the influence of political action (Habermas 1974). However, this soon came under critique as commentators observed the dominance of white males in such public discussion spheres, and the level of exclusion associated with the social networks with which discussions took place. The counterpublic was proposed as an alternative space of their own making, where disregarded groups - marginalised on grounds of, for example, race or gender –could have their own concerns heard (e.g., Fraser 1992).

In building the idea of the counterpublic, Fraser points to the experience of these groups as being one that is characterised by wide scale inequality. How then (asks Fraser) can ideas of the 'common good' do anything but propagate structures and systems that facilitate domination? Fraser went on to include the work of political scientist Jane Mansbridge in highlighting what is excluded when issues are determined on the basis of deliberation, and how structurally dominant groups tend to benefit disproportionately from deliberative processes (Mansbridge 1991). Here, the counterpublic steps into focus as a space and means by which disempowered sections of society can reap the benefits of collective power through consolidation and training, often out of view of formal power systems (Fraser 1992). This is reminiscent of the Roman democratic tradition, the proletariat fighting for a voice amongst the bourgeoisie.

In characterising conflict Schulze-Fielitze (2005) also locates protest with minority groups (including value minorities) and entrenchment. However, there are consequences to characterising conflict from "the outside". Wind farm protestors have long been characterised via the NIMBY model, suggesting that siting of infrastructure is a simply a matter of negotiation – more recent research is uncovering ideas of meaning held in landscapes, making this a conflict of fundamental values and identity rather than interests to be balanced. Similarly, David Hess (2011) puts forward a technoscientifically-grounded theory of counterpublics as those that emerge to contest official policy positions, often from 'subordinate social positions', another definition based on exclusion.

To get maximum flexibility from the concept, and to better reflect the nuanced substance of the counterpublic, here I adopt an approach consistent with Robert Asen, who frames counterpublics as emergent groups who position themselves against wider publics (Asen 1990). This does not necessarily position counterpublics as inherently oppositional, and Michael Warner describes them as "…formed by their conflict with the norms and contexts of their cultural environment" (Warner 2002:63). These are both consistent with Fraser's (1992) original observations that Habermas' 'public sphere' was not a space of equality, free from power structures, but instead a space where hegemony had replaced dominance, where ideology was the thing to be resisted, rather than coercive power (Fraser 1992). The nuance here is how we will come to conceptualise the idea of 'marginalised groups' in the context of technoscience, particularly given that expanding ideas of counterpublics away from marginalised positions arguably (and ironically) begins to erode the role of systematic oppression that is foundational to the idea of the counterpublic, the very aspect that distinguishes it from a social movement (Cox and Foust 2009).

I aimed in this summary of counterpublics to describe what they are, so that when we come to them in empirical framings they can be recognised; what causes them to emerge is a different question, one which Barry claimed

comprised the technical as much as the political (Barry 1999). The role of the technical in shaping engagement of publics is an issue to which I now turn, focussing more closely on the context of renewable energy technologies.

2.2. Renewable Energy and Society

In this next section I discuss some issues related to social responses to renewable energy in the UK. I begin by outlining the policy context before highlighting policy levers that have had particularly impact on social response. I then move on to critically review two dominant modes of understanding public responses: the informational deficit model popular with policymakers, and the NIMBY model popular with developers. I will then move on to describe a couple of approaches that offer more insight into controversies around renewable energy – place attachment and socio-technical networks – before concluding with a discussion as to how decision-makers might move forward in the face of longstanding conflict.

2.2.1. Renewable Energy in the UK

The last 25 years have seen fundamental change in the UK energy market, in terms of its liberalisation from state ownership and a reorientation towards less carbon-intensive sources. In 2003 the UK Government produced a major energy 'White Paper' that sought to position climate change at the heart of the country's energy strategy. This White Paper linked climate change with an over-reliance on fossil fuels and went on to lay out a strategy for a new – low carbon – energy base that was less carbon-intensive, more secure, affordable for society's poorest and delivered from a market that was competitive for companies, industries and households (DTI 2003).

Although specific delivery mechanisms associated with renewable energy had existed in the UK since 1990, by the time of the 2003 Energy White Paper renewable energy sources still represented less than 3% of the UK's total energy mix. Numerous policy instruments had been put in place simultaneous to market liberalisation – such as the Non Fossil-Fuels Obligation (NFFO) in

1989 and the Renewables Obligation (RO) in 2002 - which required power distributors to buy energy from nuclear and renewable sources (Mitchell 1995). Whilst the RO was considered more successful than the NFFO for deploying renewable technologies, it is considered as having a strong inclination towards production of electricity by large companies by way of economies of scale (Mitchell and Connor 2004).

Mitchell and Connor recount how these early market interventions have shaped the emerging industry, having social impacts some of which continue to pose challenges today. For example, the original NFFO in 1990 had been designed as a policy solution of finite length to support the nuclear power industry in the absence of private sector investors, and as such was cleared through the European Commission which agreed an end date of 1998. So, renewable entrants to the scheme were compensated from the time of plant commissioning to the scheme's end date. Consequently it was in the interests of developers to commission plants as quickly as possible in environments where revenue would be maximised. Secondly, the RO rewards companies for contracted capacity even if a plant is not commissioned because of – for example – difficulties in obtaining planning permission or connecting to the grid. So, policies in this developing market created an investment environment that favoured technologies with fast lead-in times, low entry costs and speculative claims for capacity that had no flexibility for subsequently changing location. The resultant "windrush" stimulated an organised response from some concerned parts of the public that is still present and is widely accepted as having slowed the deployment of onshore wind (Mitchell and Connor 2004) and has had a comparable impact on the emerging bioenergy industry (Upreti, Bishnu and van der Horst 2004).

So, before turning to examine public attitudes and responses to renewable energy use in the UK, there are significant policy factors in operation. Firstly, the RO is not singularly effective in promoting renewables growth and unanticipated consequences persist. In including co-fired biomass it would appear that new fossil fuel capacity is being incentivised, and at the start of the

scheme there were cases of existent large hydroelectric schemes in Scotland being downgraded in capacity in order to become eligible for the subsidy. Secondly, it was envisaged that the cost of renewable energy to consumers would fall. This has not proven to be the case, partly because savings are not passed directly on (a core assumption) and partly because consumers are paying for capacity that is not commissioned. As well as the perverse effect of the subsidy, generators have commented that lack of investment in grid upgrades has limited the amount of renewable energy that can be distributed regionally and nationally (in fact, large renewable projects require substantially higher upgrades to the electricity transmission and distribution network which are not generally factored into forecast unit costs, so the full economic costs of this type of investment is frequently inaccurately portrayed).

As well as increased renewable energy, the 2003 Energy White Paper envisaged the low-carbon energy system as being delivered through greater energy efficiency and cleaner industrial processes. By the second quarter of 2011, around half-way to the White Paper's 2020 horizon, renewable accounted for 9.7% of total supplied energy - half of which was coming from wind (RenewableUK 2011). Whilst some of the problem of non-commissioned renewable capacity is due to the distortive effects of subsidy schemes, there was an emerging view that widescale public disengagement and some (largely local) opposition to specific developments was slowing down the country's ability to achieve its targets.

In December 2010 the Scottish Government published "Low Carbon Scotland: Public Engagement Strategy" (The Scottish Government 2010). The strategy has tripartite objectives originating in 2009's Climate Change (Scotland) Act: informing people about Scotland's low carbon targets, encouraging them to play a part in achieving them and identifying actions that Scottish people can take to make that contribution; and as a result it is quite narrowly framed. Aside some small confirmation of existent encouragement in micro-generation schemes there is no mention of the generation sector so no opportunity is

presented to consider what the priorities of Scottish people might be – instead, the strategy lays down a consistent message to be given to the Scottish population and encourages them to take measures such as upgrade their boiler, not waste food and consider public transport. The strategy was almost immediately criticised as having been rushed, uninclusive and uninnovative and it stands in contrast with the more strategic "Facing Up to climate change: breaking the barriers to a low-carbon Scotland" published by the RSE a few months later (Royal Society of Edinburgh 2011). This report highlighted the many areas that would benefit from civil society input and called for the opening of a deliberative space where solutions could be debated. Indeed, what civil society might be thinking about climate change and renewable energy has been the subject of much speculation and research, and it is to this I shall now turn.

2.2.2. Public 'Acceptance' of Renewable Energy

Given the shape of this early renewable industry, and the sometimes unanticipated effects subsidy schemes have had, it is perhaps unsurprising that much of the empirical literature on renewable energy and society focuses on onshore wind developments, and there is a significant body of research exploring public attitudes towards wind and reasons for opposition. Precursors to studies in this field often start from the basis that despite reported public support rates for wind energy at 80% (DTI 2006), only a quarter of contracted wind power is actually commissioned (Bell, Gray and Haggett 2005). It is interesting to note that a good deal of the research in this area seeks to explain this gap by exploring oppositional publics, yet as seen in the preceding section there have been significant incentives in the policy environment to encourage contracted capacity even in the absence of commissioned plant.

Perhaps the most influential conceptualisation in recent years is the model of the social acceptance of renewable technology developed by Wustenhagen,

Wolsink and Burer (2007). Here, social acceptance is viewed as three-dimensional, incorporating market acceptance (not only to householders but to investors and between firms), community acceptance (including understandings of procedural and distributional justice) and socio-political acceptance (such as institutional trust). The interplay of factors affecting the latter two dimensions is considered to offer some insight into the apparent mismatch between publics who support renewable technologies in general yet oppose specific configurations. Alasti (2011) successfully applied this framework for social acceptance to the case of biofuels in Europe, finding that public acceptance of biofuels is hampered in particular by socio-political issues: the heterogeneity of the industry makes it somewhat opaque and confusing, and concerns remain as to whether this type of technology is truly sustainable and what its impact on food production might be.

However, the dominant mode of public engagement – and one reflected in policy documents such as the Scottish Government's Public Engagement strategy for Low-Carbon Scotland – relies on the idea that behaviour can be changed by providing more information. The so-called 'deficit model of public understanding' (Irwin and Wynne 1996) persists even in the face of what is now a significant body of work demonstrating its inefficacy (e.g., Eden 1996, Evans and Durant 1995, Gregory and Miller 1998, Irwin and Michael 2003, McKenzie-Mohr 2000, Wynne 1996). Indeed, when information comes from sources seen as partial (such as developers) it can work to opposite effect by promoting distrust and hardening antagonistic opinion. A more sociologically-grounded exploration of publics and their attitudes and behaviours to energy indicates that technological infrastructure and social customs interact and change over time and that the nature of conflicts inherent in the energy sector means that they are wider than those able to be resolved rationally by "facts" (Owens and Griffill 2008). In the face of this research, what is surprising about public action and information flow is not that citizens fail to quickly adopt policy-compliant action, but that policymakers keep expecting them to do so.

2.2.3. NIMBY Models of Public Acceptance

An alternative framing of the failure of citizens to embrace (or to vigorously oppose) renewable technologies even in the light of surveys indicating generalised public support is to conclude that the inconsistency is rooted in self-interest. This idea lies behind the conceptualisation of the 'NIMBY' (Not In My Back Yard), popular in planning literature and with developers since the 1990s (e.g., Dear 1992, Schively 2007). NIMBY has traditionally been taken to describe a position that recognises the need for a particular development but is opposed to its close proximity. However, there is some inconsistency in the use of the term and it is often used to describe any and all local opposition. Although it persists in both general and academic discourse, the NIMBY model as a way of understanding public reaction came under critique almost as soon as it started to be used (see Burningham, Barnett and Thrush 2006 for a comprehensive literature review). Here, I outline four areas where the NIMBY characterisation can be identified as lacking: conceptualisation of publics, lack of empirical support, its pejorative and performative nature and its lack of explanatory power.

Firstly, 'NIMBY' publics are often constructed in ways that are inconsistent with other research on publics and technologies. Citizens are cast as ignorant (rather than the engaged, informed but discriminating citizens described in research by – for example - Irwin and Wynne (1996), and as selfish and irrational (conveniently ignoring the fact that selfishness is perfectly rational in the free market (Hunter and Leyden 1995)). The very fact that the phrase NIMBY places resistant publics as the 'problem to be solved' is also considered problematic, with LULU (Locally Unwanted Land Use) considered a better focal point, placing emphasis back on to the facility itself.

Secondly, the NIMBY model of understanding publics in planning environments is unsupported when tested empirically. Comparative attitudes of local and unaffected populations regarding a proposed wind development

in England were explored quantitatively to evaluate claims of NIMBY as a suitable model (Jones and Eiser 2009). Rather than observing distinct attitudinal differences in the two populations, local concerns proved to focus largely on uncertainty regarding proposals rather than specific siting concerns, suggesting that long-term dialogic community engagement would be critical to addressing local opposition. Similar findings have been seen in Poland; whilst respondents close to target development areas are generally less favourable towards wind energy in general, there is within the target population a bimodal distribution – scepticism is not the consensus view (Eiser, Aluchna and Jones 2010). It would be interesting to know whether this is also the case in the UK, where attitudinal surveys also indicate that those living close to wind farm developments are less supportive of wind as a renewable energy (DTI 2006). As a further development on this theme, efforts have been put into ascertaining how big a 'backyard' might be – what is local? A survey in the UK on this topic indicated that participants most favour offshore locations with onshore location varying according to how visible they would be – once a planned structure was expected to be out of sight it was considered by participants in general rather than specifically local terms (Jones and Eiser 2010). This is not to say that simply siting windfarms offshore (i.e., out of the 'backyard') is unproblematic or a panacea to the problematic history of onshore wind power. In one of the earliest studies of the politics and perceptions of offshore windfarms, it was found that similar problems are encountered at both types of location – particularly in the hardening of opinion that occurs in the absence of a constructive developer-community relationship (Haggett 2008). In an examination of the key assumptions in the literature Aitken (2010b) goes further and critiques a series of core assumptions present when the place of wind power in society is being studied. Aitken challenges the repeated assertions that: the majority of UK society supports wind power, that disagreement is therefore abnormal, that challengers are knowledge deficient, that the purpose of engaging with opposition is to overcome it and that trust is the key dimension in resolving antagonism. Aitken appeals to researchers to be more reflective in their

normative positions on wind power, so that a more balanced literature might be developed which does influence policy and planning processes.

Thirdly, it is noted that the NIMBY language is both pejorative and performative. Black, poor or developing communities are not generally characterised as 'self-serving NIMBYs'; rather the term seems limited to being used in a derogatory and superficial manner for more affluent populations (Ellis et. al. 2007). Recent research has also highlighted the performative effect of the NIMBY model – in constructing publics as an 'ever-present danger' to development projects, a series of behaviours occurs that can exacerbate the very procedural behaviours that alienate local communities (Devine-Wright 2011b, Walker et al 2010).

Finally, classifying local publics as NIMBYs offers no explanatory power and no constructive policy routes to pursue, whereas alternative conceptualisations offer opportunities to actually explain opposition: resistance can be understood as being a result of specific features of the decision-making process, contextually generated, and (in a neo-Marxist analysis) symptomatic of deeper social conflict where assumptions of local vs. societal benefits and place vs. profit are challenged. It is to these alternative areas of research – relationship with place and integrated technology/societal systems – that I now turn.

2.2.4. Understanding Relationships with Place

Although NIMBY models have been demonstrated as deficient in explaining public relationships with renewable technologies, alternative theoretical models are emerging. Drawing on the interdisciplinary field of environmental psychology, inhabitants of villages living close to what is thought to be the world's first tidal converter connected to the national grid – in Northern Ireland – have been the subject of mixed-method research in order to explore emotional reaction to the installation (Devine-Wright 2011a). Devine-Wright proposes the concept of 'place attachment' as a more insightful method to

explore public reaction to renewable technology than the heavily critiqued NIMBY model. Place attachment is a concept developed in social (or environmental) psychology that explores the bond between people and places, depicted as an emotional connection usually built-up over time that is more than a simple appreciation of beauty – place attachment is not so much about *liking* as it is about *meaning*.

Concepts of place attachment have also been used to explain local reactions to offshore windfarms (Woolley 2010) and at the 'Wave Hub' project in Cornwall, UK (McLachlan 2009a). Public responses are described as combinations of what both place and the technology symbolises which combine to eventually lead to a position of objection or support. For example, place carries meaning bound up in economic vulnerability, being locally owned, its role as a resource or site of nature whereas technology carries meaning associated with a contested energy source, as well as the development's local, commercial, pioneering, experimental, industrial and naturalistic aspects. The degree of authenticity in the project's 'green' status, whether it is considered significant or precedent, experimental or pioneering, industrial or natural all fed into the development of disposition in the local community (McLachlan 2009b).

Pasqualetti (2011) reflects that recent acceleration of the path towards renewable energy futures has formulated a transition path that involves significant public resistance. As well as geothermal and solar energy cases in the US and Mexico, Pasqualetti examined the case of wind power in Scotland. Through the cases, he draws out a common thread of public concern that has roots in resistance to a changing landscape and disruptions to established ways of life. Development planning consultations traditionally have a technical focus, and Pasqualetti suggests that more constructive engagements between publics and technology might be had if renewable energy projects were framed as primarily social projects with a technical component rather than (as is traditional) the other way around.

Whilst empirical evidence of the role of place attachment in ambivalent attitudes towards renewable energy schemes is growing, whether it generally engenders pro- or anti-environmental behaviours has also been the subject of study (Scannell and Gifford 2010). This research suggests that civic and natural dimensions of place attachment should be considered separately, as natural (but not civic) place attachment was predictive of pro-environmental behaviours.

Clearly, this type of insight offers routes into meaningful understanding of – and engagement with – local communities that is simply not possible through NIMBY approaches. However, in some contexts and with some technologies it is the very opposite of the local which can lead to opposition and cynicism.

2.2.5. Understanding Wider Socio-technical Networks

As mentioned earlier in work on biofuels (Alasti 2011) and neo-Marxist analysis, sometimes conflict occurs because of more distant consequences of local energy decisions. These types of conflicts only become visible and understandable when one recognises both the essential nature of energy to the modern human experience, and the complex and far-reaching character of human/technology interactions involved in what can be portrayed as local energy decisions. In one sense, any specific renewable energy development can be considered a project of 'socioware' – a combination of actors, social organisation and heterogenous technologies (Walker and Cass 2007) and this conceptualisation in itself is helpful in considering the multiple variables operating dynamically in any one context, only parts of which are visible to other parts of the network.

An example of this is in grids. Devine-Wright (2010) explored how renewable energy technologies have knock-on impacts on transmission and distribution networks that are social, economic and technical, although few studies have looked at public beliefs about electricity supply networks. In interviews and focus groups, Devine-Wright found that electricity networks are represented as technologies rather than organisations, that they are understood in visible

(e.g., cables and wires) as opposed to systemic concepts (e.g., networks), and that transmission and distribution network operators are invisible. Participants were also found to be under the impression that Government ministers were regularly involved in decision making that local residents have little influence over. Participants exhibited strong support for burying power lines regardless of cost, mirroring the findings of research to evaluate the cost: benefit ratio of burying power lines as opposed to overhead distribution technologies (Navrud et al 2008). Here, a group of public participants deliberated over the costs and aesthetic benefits of burying power cables and determined a cost:benefit ratio of 3:1. Through questionnaires – including scenarios where participants prioritised limited resources – researchers found that participants prefer to spend money burying cables in order to preserve the landscape. Once impacts on human health and wildlife were factored in, the likelihood of support for burying cables is expected to rise further. Given this combination of partial (in)visibility and low expectations of participation around electricity transmission and distribution it is unsurprising that commissioning regularly proves to be a further source of public opposition and delays (see, for example, the contentious Beauly-Denny line in Perthshire, Scotland (Cotton and Devine-Wright 2010, Douglas 2010)). So, public response can start to be understood not simply as attitudes to a 'technology-in-principle', but as a more complex response to the choices that have already been made elsewhere in terms of – for example - specific configurations and sites.

Notions of distributive justice – where the social costs of renewable energy are expected to be evenly distributed across society – have also been shown to be important in renewable energy. Communities may be impacted by large-scale infrastructure developments when they are near neither the renewable resource nor the centre of demand, and on a more local scale citizens are ready to express concerns as to the costs their local communities may have to pay through the disruption caused by new generating plant even in the face of

excessive and 'profligate' demand elsewhere in their country (e.g., Upham 2011).

However, energy can equally be understood as a global network of technologies, fuel sources and publics both local and far-flung and in the case of renewable energy this is readily apparent in biofuel technologies which pose particular problems to their broader socio-technical networks, with impacts on peoples, the natural environment and food. The expansion of biomass as a source of renewable energy presents difficulties in areas of contested land use such as Amazonia. Given large growth in Brazilian agriculture, demand for land for biomass can be expected to exceed that made available in Brazilian environmental policy by 2020 (Walker 2011). This is likely to stimulate an interest in agricultural intensification in Amazonia, the world's largest and most diverse tropical rainforest. A well-recognised consequence of growing biomass for energy use is the appropriation of land that would otherwise be used for growing food. This exacerbates shortages of food and fuel and in the USA use of corn for ethanol has increased meat, cereal and dairy prices by 10-30% (Pimental et. al. 2009). These types of concerns associated with biofuels have stimulated research into 'second generation' or 'advanced' biofuels (such as cellulosic ethanol or algae fuel) that are produced using techniques that do not encroach on land otherwise used for food. Currently a handful of second generation biorefineries across Europe and Canada will reach commercial production status in the next few years

A final question relating to the 'rush to renewables' – that again draws on systems much broader than the specific locality - relates to the concern that renewable energy can be interpreted as an effort to maintain an unsustainable growth model. In common with the neo-Marxist research described earlier, it can be argued that Governments, the media, scientists and green organisations are jointly failing to challenge the coming reliance of job growth on economic growth (Speth 2011). Speth – co-founder of the Natural Resources Defense Council – feels that climate change has been so politicised that issues of social justice and reform are losing momentum. The prospective

technology most seeking to preserve the status quo is probably carbon capture and storage (CCS), and as interest in the technology grows so have efforts to communicate this controversial technology to publics. In a full-scale enrolment exercise, research in the USA seeks to apply social marketing techniques to target populations (Wong-Parodi et al 2011). This research used open ended participant interviews to develop messages embedded in an 'emotionally self-referent' framework to promote the technology by appealing to residents' core values. Whilst labelling this as public engagement might generally be considered to be a misnomer, it is indicative of the high stakes involved in renewable energy. In the UK, it would appear that nascent CCS technologies have become the ticket by which policymakers and society can continue to talk about new-build fossil-fuel power generation (e.g., Schaps 2012); indeed, proposals for co-fired generation capacity around the Firth of Forth combine both CCS proposals for coal burn and subsidy reliance for biomass aspects.

2.2.6. Moving Forward Amongst Controversy

Having explored unhelpful modes of understanding and dealing with publics, and having identified more promising routes, it is clear that there remain complex and potentially intractable differences in understanding specific configurations of renewable technology 'sociowares'. So how do we move forward in a way that maximises the opportunities and benefits in renewable energy whilst minimising disruption and conflict? Here, I highlight three areas that could bear fruit for researchers, policymakers and developers: better understanding of attitudes and behaviours, exploring the available range of public engagement mechanisms and reconceptualising the role of the public.

Firstly, a better understanding of what shapes attitudes is crucial, along with how they relate to behaviours and how they change over time. Examination of the discourse between wind farm proponents and opponents is suggestive of little constructive relationship between the two positions. A rhetorical analysis of the pro- and anti-discourse coalitions surrounding a proposed onshore wind farm in Northern Ireland illustrates the discursive interdependence

between the two positions, each of which consist of coalitions of partners around a theme and multiple positions within each. Opposition discourse themes include sacrifice and disempowerment, lack of trust, a language of war and conflict as well as industrialisation and commercialisation of the environment (Barry, Ellis & Robinson 2008). This is in contrast to supportive discourse themes that include assumptions of and imperatives towards consensus, an 'opposition' to be 'overcome', elicitation of rational, knowledge-based scientific evidence, ecological modernisation and talk associated with the urgency and threat of climate change. Alternative communication approaches grounded in axiological empathy might be thought of as a useful pre-cursor to other forms of engagement. A further innovation in understanding the diversity of public attitudes is the developing use of Q methodologies. This is a more insightful exploration of public motivations than the NIMBY model and is gaining ground particularly when used in conjunction with deliberative processes. Examples include a stakeholder dialogue on energy options from biomass in the Netherlands (Cuppen et.al. 2010), wind farm conflicts in Northern Ireland (Ellis, Barry & Robinson 2007) and wind power implementation in the UK, Netherlands and Germany (Wolsink and Breukers 2010).

Secondly – and the source of much hope in resolving conflict – is the idea of public engagement. A comprehensive mapping exercise of solicited public engagement in renewable energy was undertaken on behalf of RCUK (Chilvers et.al. 2005). In this, a breadth of activity relating to energy was surveyed, mapped and classified into five modes of public engagement: information provision, open consultation, targeted consultation, stakeholder deliberation/dialogue and citizen deliberation/dialogue. Unsurprisingly the majority of projects contained elements of education and information provision or open consultations. Active citizen engagement at the time was somewhat sparse, and of the 97 projects mapped, 19 targeted specific groups of publics in consultation and only 5 contained elements of deliberation and/or dialogue with groups of publics, four of which took place from within

academia: underground coal gasifications, UK bioenergy scenarios, consultation for the 2003 Energy White Paper, the South East England Participatory Energy Appraisal, and a project conducted as an ESRC postdoctoral fellowship to develop a toolkit for citizen involvement in renewable energy decision-making. Whilst some innovative engagement exercises were recounted, it was noted that these generally took place within the restrictions of a particular technology, and there was a shortage of activity and research that considered energy challenges in an integrated manner and the consequent competing assumptions and trade-offs.

The idea of 'upstream engagement' – a temporally-limited dialogue of the sort seen around other emergent technologies in the UK – is appealing to academics. Whilst the practical end of public engagement in renewable energy projects has traditionally taken place through the local authority planning process, research showing that greater local involvement prompts greater acceptance rates has caused a number of scholars to promote the use of more formal, comprehensive or upstream engagement mechanisms (e.g., Haggett 2011, Woolley 2010). The limits of upstream engagement with an emergent technology have been explored in the context of hydrogen energy where difficulties of sharing quite complex and contingent technical information, challenges in identifying exactly who should be involved and what these participants are seen to represent proved problematic, alongside a critique of the possible, probable or even desirable scenario that upstream engagement would lead to rejection rather than acceptance (Flynn, Bellaby and Ricci 2011). As part of that study, panel deliberations in Teeside on hydrogen storage showed the difficulties in giving participants a realistic sense of how this might impact their lives, and what the opportunities and risks might be. It was proposed that the most sensible way to do this is to provide alternative scenarios which – by their nature – necessitate a whole systems approach that is not the usual approach in this sort of upstream engagement, framed as it is by the designers of the process. Barry and Ellis (2011) go further, and propose that the consensus-seeking processes inherent in deliberation are artificial and

have largely proved ineffective. They propose agonistic-pluralist models of deliberation and decision-making; although less predictable this more republican model of decision-making may lead to greater net results by asking broader questions and allowing communities to decide for themselves how to meet local targets, for example by reducing energy demand rather than having wind turbines.

Clearly, the more upstream engagement is moved, the less likely it is to resolve any of the issues that are associated with specific siting decisions and technology configurations. Perhaps instead, publics and communities could be engaged more constructively during project development when the specifics are able to be discussed and compromises might be made. In the UK, public involvement with all but the largest energy projects generally takes place during the process in which the developer seeks planning permission to make the new installation. Co-ordinated by local authorities, formal consultations with affected communities regarding the potential impact of the proposed facility take place. Whilst the consultation is compulsory is it fraught with difficulty as a method of effective public engagement, particularly when public concerns prove oppositional to Government policy (as they often do for renewable energy). In the case of a Scottish wind development, power was subtly deployed to restrict publics' participation as expert and lay bases of knowledge remained unreconciled. This is not to say publics are completely disempowered, and their active management of their own role is acknowledged (Aitken 2010a). Social resistance to new onshore wind development is not a phenomenon confined to the UK, and international comparisons of the Netherlands, UK and Germany have consistently shown that policymakers and project developers do not fully understand the nature of local concerns (Breukers and Wolsink 2007). Here, it is suggested that public participation in project planning and the facilitation of local ownership is a more reliable way of evoking the multiple concerns that take place at the local level. In earlier work, again in Scotland, Aitken contrasts the relative power exerted by different types of knowledges in quite distinct stages of the

planning approval process – in the early stages local input is welcome and arguably lay knowledge carries significant power while the appeals process is dominated by expert formalised knowledge and local contributors are unable to participate (Aitken 2009). Whilst this constructs deceptively clear boundaries between these different types of knowledge, Aitken observes that public participants using the language of the expert also helps portray these knowledge bases as quite different things. A further impact of the UK's planning process and the prioritisation of formal expertise in any public enquiry process is that local objectors do not actually have as much impact as is frequently stated. An analysis of objection letters and the official report of the appeal into a windpower application in the UK showed that the influence of local opposition extended only as far as delaying the project (Aitken, McDonald and Strachan 2008).

Whether or not the local community are able to exert any real influence over the planning process is an important factor in how legitimate the implemented project is considered to be. A deeper study of the planning consultation process – in particular perceived fairness - took place in research examining windfarm siting in Australia. Using an approach based in procedural justice principals, a sense of justice (in terms of outcome favourability, outcome fairness and/or procedural fairness) was material to an outcome being perceived as legitimate. Whilst different groups of public participants proved sensitive to different aspects of justice, a *process* perceived as being fairer was more likely to lead to outcomes being considered acceptable (Gross 2007). The recent protocol for public engagement with wind energy developments in Wales sets out what it considers good practice between developers, local authority, statutory consultees and the local community (CSE 2007). Unfortunately this protocol places explicit emphasis on the need for an evidence-based process (supported by "material facts") and makes the developer the 'engager' and the local community the 'engagee'. This runs contrary to a number of research insights described herein, in particular

the relative roles of expert and lay knowledges and power relations (Aitken, McDonald & Strachan 2008, Aitken 2009, Aitken 2010a).

Conflict regarding the siting and development of onshore wind generation has brought about an interest in community benefits - financial or material 'gifts' directed at the population most impacted by the development. A range of benefits have been observed in practice around a number of different technologies, and public participants report ambivalent attitudes around these benefits which might equally be considered part of the negotiation package, a 'right' for those who will be disadvantaged, or a bribe for oppositionalists or decision-makers (Cass, Walker and Devine-Wright 2010). Certainly community benefits have largely been understood as having an instrumental rationale – that (for example) wind developers undertaking to rebuild the local community hall is likely to make the proposed scheme more acceptable and thereby will move more easily through to planning permission. Cowell, Bristow and Munday (2011) question this alleged causation, finding that local influence over windfarm proposals remains an over-riding issue in social acceptability, and that community benefits can be seen as straightforward compensation for disruption and loss of amenity rather than the benefit having any more profound effect on 'hearts and minds'.

Given the limitations of upstream engagement, and the barriers inherent in the planning process, some engagement frameworks have instead recommended much longer-term engagements with communities that better reflects the dynamic aspects at play. Walker et. al. (2011) proposed a comprehensive framework of the actors, networks, processes and expectations at play in any public engagement with renewable energy technologies. The framework depicts renewable energy actors in networks interacting with public actors in places via a range of mechanisms – written, verbal, designed, spontaneous. This place of busy interaction and expectation is further described as occurring within a landscape of place and community, regional policy, national policy and market influences (comparable to Wustenhagen, Wolsink & Berger's (2007) three-dimensional view of social acceptance).

Whilst Walker et.al.'s layered framework is complex, the authors suggest it offers four insights missing from the usual depictions of public-technology engagement: it is symmetrical (examining both public and supply side), it captures expectations, it is dynamic and it is contextualised.

Allied to ideas of longer-term, deeper community engagement is the idea of reconceptualising publics or communities. Traditionally considered consumers, there is considerable momentum behind an alternative role for publics as *co-providers*. In evaluating the impact of community ownership of wind turbines on public attitudes, Warren and McFadyen (2010) surveyed inhabitants of renewable energy projects on the islands of Gigha (where the installation was community owned) and Kintyre (privately owned). They found that although significant differences in opinion could be noted, these were not of oppositional viewpoints. Instead, whilst visual impact was a noted impact in both populations, in both it was described in positive terms (more positively on Gigha, who have dubbed the turbines the 'three dancing ladies'). The other main concern raised by the islanders was on intermittent production. Warren and McFadyen conclude by offering support to the assertion that public opposition to onshore wind farms could be diminished through more overt community ownership programmes in the planning process.

What exactly 'community renewable energy' means is not necessarily as clear as might first appear (Walker and Devine-Wright 2008). In examining the nature of community ownership, Walker and Devine-Wright differentiate between projects by asking who the intended beneficiaries are, and who the project is designed and constructed by. These parameters of outcome and ownership can be used to increase the value of projects. This ability to both design and use community renewable projects was offered through the (now defunct) Community Renewables Initiative until 2007, and Walker and Devine-Wright's study demonstrated the cascade effect as public funding for small-scale energy was influential in changing 'hearts and minds' with uptake

rates of the 'Clear Skies' domestic microgeneration programme twice that of other areas.

Devine-Wright and Devine-Wright (2004) promote the use of deliberation in energy systems but highlight that this could and should take place on the demand side and not just supply side. Demand side participation has begun to find application in four contexts: large scale renewable electricity supplies, small-scale community energy projects, new user-technology interfaces (e.g. smart meters) and new financial models (e.g. spot pricing). This research area is also highlighted by Owens and Driffill (2008).

2.3. From Engagement to Citizenship

In the preceding account of the evolution of public engagement with science, I touched on citizenship as a concept, both to critically explore public engagement that carries a currency of democratic innovation, and to explore the ways in which it is used in that literature, for example in Barry's (2000) account of the active scientific citizen. In this section, I turn to the conceptual field of citizenship more explicitly. First, in section 2.3.1, I will briefly examine citizenship as a political and sociological concept, exploring some of its genealogies and dimensions. This is followed in section 2.3.2 by a necessarily brief account of scientific citizenship drawing on STS literatures. Finally, in 2.3.3 to conclude this section I will introduce a framework that offers practical relevance for the empirical work through dimensions of membership, rights and responsibilities, and participation.

2.3.1. Citizenship as a Political and Sociological Concept

Before I begin, I would like to make clear that I am not attempting to present an exhaustive account of the history of citizenship, but to examine a couple of the totems that have led towards a definition that I will use in this thesis. Unfixed and evolving, it is the very fluidity of the concept that is of most relevance to this thesis, above and beyond an in-depth account.

Looking back across historical genealogies, Aristotle contended that humans were innately political animals, only reaching our full potential through political expression and by being part of the political state; this would include participation in the making of laws, holding civic office, performing military service and becoming involved in local affairs. However, not everyone was entitled to be a citizen in Aristotle's demos, and the early exclusions laid down in Ancient Greece – such as gender, race and class in the exclusion of women, immigrants and slaves - have proved difficult to fully escape. In this environment, citizenship was the province of the privileged, only capable of being fulfilled by those who could be served by those excluded from enjoying those very privileges.

Whilst the exercise of voting as a mode of decision-making can be traced back to Ancient Greece, this was considered inferior to the idea of consensus. Aristotle posited that such agreement could only come from 'civic friendship', a state arising from people living closely together in a community to "….articulate a basis for social unity and political agreement" (Leontsini 2013). The reality of living together, sharing issues and values was – it was hoped – enough for a commonly agreed decision to be feasibly reached. In return, citizens were expected to act in the common interest, reigning in extreme views and actively seeking fairness. The question of inclusion (and class) provides an important insight in differentiating the Greek from the Roman tradition. The Roman tradition – whilst sharing many features of the Greek *demokratia* had roots in the struggle of commoners (plebians) for a political voice under the dominance of the patricians. The Romans did not have the same rule by the people as the Greeks did, with the Roman Senate holding a majority of power.

These two examples of early forms of citizenship and democracy have gone on to shape our current understandings. From the Greek model comes the idea of the rule of the people, a search for consensus and a distrust of rulers who do not come from 'normal backgrounds', and much of this thinking is present in proposals for public deliberation around science as a form of governance.

From the Roman model comes the idea of citizenship as an assemblage of explicitly ratified rights, as different interest groups struggle to have their voices heard on parity with others.

The intertwining of these traditions has come about not least because of the emergence of the nation state as a unit of analysis over the last 1500 years – large enough to have some stability or autonomy but small enough to enable meaningful political participation. In expectations associated with modern forms of democracy are the continued threads of both of these nuances, where citizens are expected to simultaneously express their private preferences as legally recognised citizens (commonly called the liberal tradition) whilst representing the common good and acting on behalf of the people (the republican tradition). These strands continue today, contemplating republican and liberal traditions, a framing used by Darrin Durant when he contrasted the approaches of STS scholars Sheila Jasanoff and Harry Collins in the context of science and democracy (Durant 2011).

A significant step forward in conceptualising citizenship occurred when sociologist TH Marshall established an account of 'Citizenship and Social Class' in 1950, characterising citizenship as a 300 year long progressive assertion of civil, political and social rights. In particular, Marshall equated social rights with welfare rights, expanding the contemporaneous agenda of 'social liberalism' (e.g., Hobhouse 1911). Despite its resonance, Marshall's work has been critiqued for its failure to engage with the structural impediments facing certain classes of citizens, notably women and working men (Bulmer and Rees 1996).

Despite this long tradition, there remains absent an adequate social theory of citizenship (Janoski 1998). Janoski observes that Marshall is rooted in welfare rights of labour, Mann in the rights of elites (1987) and Turner in social movements and conflict (1990). Bellamy comments that whilst these can be normative accounts (e.g., what rights people should have) or descriptive accounts (e.g., how citizens have come to have the rights they do), all are

searching for an elusive explanatory social theory for citizenship (Bellamy 2008). Why is there an absence of an 'ideal' model in practice? Firth suggests this stems from an ongoing struggle to live differently within existent power structures. In the context of 'utopian citizenship', she discusses members building a new citizenship from the bottom up – underneath and apart from existent modes of governmental and economic organisation (Firth 2013).

Recent work has pointed to the porosity of nation-based accounts of citizenship in the face of globalisation, not least because forces more dominant than national politics increasingly impact citizens' lives leading to the promotion of ideas of 'cosmopolitanism' (Carter 2001). In place of the nation state, some have argued that cultural forces are the more significant shaper of citizenship. For example, Karlberg (2008) traces a progression of citizenship that gradually evolves from private values to the values held within status groups, culture being the force by which value-based action becomes validated and amplified (Stevenson 2003). From this can be discerned a form of cultural citizenship, incorporating – but lying in tension with – civic responsibility and an individual agency (Karlberg 2008).

The question of citizenship is not necessarily resolved by recourse to culture; this still opens up questions as to what citizens might be citizens *of*, if not the nation state; social and political mobility has opened up the possibility of forging identities, relationships and even communities that cross geo-political boundaries (Smith, 2003). Even in acknowledging the identity politics bound up in this approach, it has been argued that the nation state remains compelling precisely because it offers an answer to the question of what our society is at scale (Calhoun 2007:8). The question of scale is relevant not just in the rhetoric of citizenship but in getting a sense of legitimacy into the democratic process amongst the differences that are introduced as we start to recognise plurality. This potentially is the space into which deliberative democracy steps (Eriksen 2000:56), an important innovation in the UK/EU science-society landscape.

Into the space left by the nation state have sprung a wide variety of what Firth calls 'citizenship regimes', based on a "…transgression of territory, a process rather than a fixity…." (Firth 2013:79). This includes ideas such as global citizenship (e.g., Carter 2001, Falk 1993), biological citizenship (Rose and Novas 2004), ecological citizenship (Dobson 2006, Wolf, Brown and Conway 2009), post-state citizenship (after Faulks 2000, Hoffman 2004), dissident citizenship (after Sparks 1997) and sexual citizenship (Evans 1993, Lister 2007, Plummer 2003). To this, if justified, might be added scientific citizenship.

One element of citizenship discourse that perhaps has more resonance with scientific citizenship than some other social spheres lies in the idea of competence. In his later work, Bryan Turner has touched on the idea of competence as a precursor to rights (Turner 1990). This is a contentious view within a discourse that is largely driven by ideas of quality and fairness, and the idea of competence as a prerequisite to even passive rights has been critiqued as too exclusionary (Janoski 1998). However, in examinations of science and society, some of the discourses are so heavily dominated by ideas of knowledge that they have shaped what is accepted as scientific citizenship. Originally explicit in ideas of 'scientific literacy', the knowledge survey was the totem by which members of the public could be discriminated against and their opinions judged and shaped.

2.3.2. Scientific Citizenship

Whilst the idea of the scientific citizen is prevalent in academic and state discourse, it has proven difficult to illuminate this problematic individual. Continually evolving ideas as to what 'scientific citizens' might look like, where they might be found and how they emerge or are made are somewhat patchy and problematic. Why does citizenship –already a highly contested concept – need this further nuance? The literature offers a series of related justifications for the need to consider the status of the scientific citizen, spanning the societal change brought about by the commercial impact of neoliberal democracies, the increasingly prevalent role of technological

innovation in national economies and the dynamic impact technoscience is having on relationships between all sectors of society.

A useful starting point to consider the scientific citizen lies in examining the changing nature of the state (Elam and Bertilsson 2003). No longer defined exclusively by territory or militaristic identity, nations might now be more contemporarily and adequately described by their innovation capacity. This is particularly true for 'Western' nations – if the economic strength of a country becomes identified with its ability to generate, extract value from and export high value-added knowledge-based activities, then it becomes pertinent to explore the nature of citizen participation in a democracy with this focus. So is technoscience inescapable for the citizen? Economic markets in knowledge-intensive economies are constantly producing 'overflows' into the social world, and our individual and collective reactions to these overflows is a citizen-making exercise (Callon, 2007). In this sense, the market acts as the ultimate mediator between science and publics. At the visible level, technologies become intrusive when they spill over from innovations and rapidly reshape social practices, with a tendency of making our current practices outmoded or obsolete. In the UK, the analogue television now has a finite life of months, and anyone who has not made 'the switchover' (something of a euphemism for purchasing a new digital box) will soon not receive any TV channels. Likewise, a surfeit of technological strategies for producing energy from renewable sources is producing a breadth of social spillovers including home-based wind and solar microgeneration opportunities as well as presenting challenges associated with a changing landscape, most notably in relation to on- and off-shore wind power. Callon (2007) is not alone in considering such overflows to now be the natural order of things rather than the exception. Observing that a number of high-profile overflows since the 1990s (alongside social movements which challenge the ubiquitous top-down model of decision making), Jasanoff suggests that they serve as evidence of a more fundamental shift in societal relationships - a 'constitutional moment', where the rudimentary connections between state, market and civil sections of society are renegotiated (Jasanoff,

2011). Questions raised by the increasingly intrusive relationship between technoscience and the social world, and the role of the citizen therein, are numerous and profound. What are the rights and freedoms of the citizen in this landscape? What responsibilities and duties are they expected to fulfil? What is the political entity against which citizenship is to be analysed – is it local, national, global? Who is excluded as a citizen? What are the rules for inclusion? How and when should the citizen participate in this technically-driven democracy?

The notion of scientific citizenship as a disposition allocated and pursued by the state and its agents as opposed to an identity readily seized by individuals is something which is explored more fully throughout this chapter, through a lens focused on modes of engagement between science and publics. This locus offers an opportunity to consider how such encounters come about, the meanings that have been uncovered for participants in the roles they adopt, the drawing out of implicit assumptions and the impact they have on the process and the active mediation occurring throughout such coming-togethers. Through a focus on modes of public engagement we start to discern and evaluate three dimensions of citizenship: rights and freedoms, responsibilities and duties, opportunities and barriers to participation; as well as the normative expectations of the state. Evaluating these parameters is at the heart of understanding the nature and role of the scientific citizen in modern society, and the aim is to draw out some of these unspoken assumptions about citizenship. In the next section I will lay out how they might be explored practically.

2.3.3. An Empirical Framework for Exploring Citizenship

Given the multiple interpretations inherent in a concept as fluid as citizenship, there is a challenge in mobilising the idea through empirical means. The summary work of Richard Bellamy is very helpful in navigating the territory in this respect, in that he puts forward three mutually dependant dimensions necessary to a contemporary, rounded definition of citizenship: membership, rights and participation (Bellamy, 2008). Although Bellamy

identified these dimensions whilst developing a definition, I will be drawing on them for their practical use.

The first dimension relates to ideas of membership and belonging and asks, 'who is a citizen?', going on to outline the different ways people have been excluded from citizenship. Bellamy outlines internal exclusions, for example on grounds of gender, property ownership or imprisonment – some of these have been equalised as democracies have evolved but many are still vey live issues in many countries. External exclusions most obviously include nationality, and immigrants are a prime example of how external exclusions are negotiated. In an era of increasing globalisation, this is particularly pertinent. Ideas of membership are important to the construct of citizenship because they provide a basis for citizens to identify with one another; it is the root of the 'civic friendship' Aristotle referred to and thereby negotiates the rules for effective participation and starts to develop ideas of the 'common good'. Membership is also important in facilitating ideas of rights and responsibilities; only when citizens feel they belong to a common civic body are they able to respect its rules and requirements. Developing this sense of belonging and friendship is closely related to ideas of identity, a concept being challenged significantly with increased global movement, multiculturalism and urbanisation.

The second dimension relates to rights and responsibilities, and Bellamy outlines two approaches that have been used in the articulation of rights. The first lies in the tradition of legal status, the idea that citizens can be rendered equal through the granting of a status (I discussed in section 2.3.1 the work of Bryan Turner in this sense). The second more pragmatic approach is focussed on the rights citizens need in order to equally participate in decision-making. Clearly different people's interpretation of what is required in such rights can vary widely, and is related to quite fundamental outlooks on life. What citizens in advanced democracies believe their responsibilities to be, and how they come to shoulder and share those responsibilities is an area that remains emergent within the literature. Jasnoski (1998) contrasts the two differing

approaches to responsibilities that characterise the field. Rather than responsibility being viewed in a punitive way, where homogenous responsibilities are exchanged for homogenous rights in a transactional sense, Janoski promotes the framing of responsibilities as being subject to 'mediated social control' where obligations are '…functional, flexible and targeted', existing to 'internally protect the integrity of a democratic system'. (pp.54-56). This more fluid interpretation of responsibility has gained significant traction outside the legal genealogy of citizenship.

In Western liberal democracies it is predominantly the institution of rights that defines the legal content of the status of citizenship (Firth 2013:114), and here returns the idea that rights are inherently bound up (at least in the liberal tradition) with the (indistinct) border between the public and private sphere. Even Bellamy acknowledges that the 'rights to have rights' has become the defining paradox of citizenship in modern democracies (Bellamy 2008:17). However, Jansoki (1998) identifies three problems with rights forming the central ground of debates of citizenship. Firstly, that rights and responsibilities aren't adequately grounded or codified (Jasanoff (2004) also makes a distinction between claimed and sanctified rights), the balancing of rights and responsibilities and their negotiation in light of individual identities, and finally the development of rights and responsibilities theory at macro- and micro- level, including attention to internal and external membership (and exclusion).

The subject of rights is both complex and paradoxical, and rights are only codified with the will of the people who in turn are largely restricted to expressing their will in ways that are already codified. Rights can only ever be realised when the collective agrees not just in principle but to releasing the resources and freedoms that are required to support those rights. It is in this sense that rights and responsibilities are bound up – not in a transactional sense but in a facilitative sense. For example, if we agree that humans have a right to equal access to the benefits of scientific endeavour then we accept the responsibility to fund that research through taxes. Here, we see the

relationship between rights and membership and participation - there (arguably) should be some level of granularity at which a group of citizens can participate to shape the rights that are enabled by the responsibilities they bear. This dimension of participation is the third and final element of Bellamy's triad.

Even in moderately developed democracies the opportunities for participation far outweigh those that are codified as 'rights', not least because of the spontaneous actions by individuals, civil society, the state and even commerce that expand opportunities to participate. Indeed, this is one of the central arguments in this thesis. The preceding account of public engagement literature shows how scholars in this field have become adept at exploring accounts of engagement from participatory points of view, and an important part of this scholarship – although not discussed in these terms - has been the question of who is supposed to benefit from public participation and how, and when it is promised, offered or seized. Wrapped up in this are questions of membership, rights and participation.

So, whilst there are nuances and complexities to each of the three dimensions, Bellamy's framework does at least offer a structure that can be used in an analytical sense. Although not straightforward, and certainly calling for an interpretivist approach, the framework facilitates a dialogue around the triad of membership, rights and participation that has become the structuring force for this thesis. The account of the research process in Chapter 2 explains how that came to be the case, but before that comes a typology that bridges the theoretical and the empirical strategy.

2.4. Emergent Typology

This survey of literature has covered broad ground, spanning evolving models of publics and science, relationships between renewable energy and the public and an overview of sociological and political conceptions of citizenship. Amongst the work have been glimpses of what might be recognisable as

notions of the scientific citizen, and I have aimed to draw these out in brief form in Table 1. In this we can map the various literatures. The rows are broadly drawn from ideas in section 2.3 above and utilise Bellamy's three dimensions of citizenship: membership (interpreted here as publics), rights and responsibilities, and modes of participation. These three dimensions are mapped against five categories of citizens derived from the review of public engagement literature in section 2.1: the recipient citizen, the consumer citizen, the dialogic citizen, the epistemic citizen and the activist citizen.

The purpose of this typology is twofold. On the one hand it starts to crystallise how the empirical phase of the work can be conducted, suggesting new sites and themes of study that expand on a narrow definition of public engagement. Secondly, it provides a theoretically-grounded basis against which to later conduct a pattern-matching analysis of the findings of the fieldwork. The importance of grounding the empirical work in a theoretical base was something that played a large role in the design of the research; it is to this I now turn.

Table 1 Typology of the Scientific Citizen

	Recipient Citizen	Consumer Citizen	Dialogic Citizen	Epistemic Citizen	Activist Citizen
Literature base	PUS	Science centres Interaction	PES	Patient involvement Citizen science	Activism Counter-publics
Membership: sources and attributes of publics	'everyone', homogenous Passive, receptive Ready to be educated, enthused	Self-selecting 'everyone' To be excited about/supportive of science and technologies	Formally recruited Demographically 'representative' created	'Stakeholders' – identity tied into issue Emergent Collaborator	Socially recruited Emergent Polarised 'unwelcome' antagonistic
Rights of citizens	Clear, timely information that can be trusted	To know what scientists do Be given information is an entertaining and interesting way	To assert some level of influence on future issues that will ultimately affect them	To be intimately involved in issues that affect them directly To be able to contribute to the endeavour To have their own expertise recognised	To make up their own minds To find and pursue solutions that work for them Personal conscience is greater than allegiance to establish-ment
Responsibilities of citizens	To act in accordance with information To trust expert knowledge above other forms	To direct own resources to consuming science	To speak for the public they represent	To offer something of themselves which will later be of more general benefit	To defend a wider public, sometimes global To make a personal commitment to the topic/cause
Participation: Modes and Styles	Lectures Science centres Informal science events eg busking, café scientifique	science festivals Bright Club	Formal dialogue eg Sciencewise Informal dialogue eg events at science centres and festivals	Citizen science Patient involvement	Activism protest

CHAPTER 3 Research Design: A Qualitative Study of Practice, Decision-Makers and Practitioners

To investigate the research questions that arise from the literature gaps, a programme of empirical work was conducted between 2010 and 2013. The aims of this chapter are to describe and justify the programme of work that forms the basis of chapters 4, 5 and 6 and the arguments that follow in chapters 7 and 8, and to provide an assurance of its robustness. In outlining the underlying context for the research, the chapter covers three main strands. The first (in section 3.1) outlines the methodological approach, explaining how the theory and data are related to one another and clearly stating the methodological tenets that are adopted. In section 3.2 this account evolves to incorporate the origins of the empirical data - identifying data sources, describing the methods and analytical process used and describing how careful consideration of sampling, access, ethics, dependability and analysis have produced a robust plan of research. Finally, in section 3.3 I include a brief reflexive account of this qualitative research process that can be considered alongside the more descriptive account that precedes it.

To begin, I will address the question of research methodology and outline the general framework within which the research was conducted.

3.1. Methodological Approach

In laying out the philosophical approach that guides this thesis, I will take as my point of departure an understanding that scientific citizenship as a concept is socially constructed – it is understood, interpreted and negotiated by humans rather than claimed as existing in any objective independent capacity. Specifically, the thesis is rooted in an acknowledgement that interactions amongst people - and between people and technologies - are fluid, subjective and interactive. Consequently the work seeks to develop a narrative of meaning (rather than explanation or causation) to explore the relationship

between various groups of humans and their material, social and political environment. In this sense this research is interpretivist in its epistemology.

3.1.1. Relation of the theory to the data

Chapter 2 outlines three theoretical domains that can be understood as the conceptual landscape on which the empirical work for this research takes place: forms of public engagement with science and technology, relationships between the public and renewable energy technologies, and evolving manifestations of citizenship. In noting that this research is not firmly located within a sociological 'grand theory' (such as symbolic interactionism, structural functionalism or Foucauldian sociology) it is relevant to question which strategies have been employed to assure this research goes beyond a work of empiricism incapable of any wider use beyond the specific case.

As an emerging field of study, the relationship between the conceptual and the empirical in science and technology studies (STS) is negotiated on an ongoing basis and continues to evolve (Jensen 2013). Jensen comments on how the earliest STS was proud of its empirical footings (such as the sociology of science built on the laboratory ethnographies of, for example, Harry Collins and Bruno Latour), and yet the case study methodology has become so prevalent in the field that readers can often be left feeling that its dominance comes at the expense of more theory-building work. This is particularly problematic for research that seeks to inform policy. Beaulieu, Schamhorst and Wouters (2007) observe that the utility offered by case studies within STS has largely been generated through cases that have highlighted differences, "….they all use cases to emphasize the diversity of science and technology, to de-essentialize them" (p675). In acknowledging that STS can make positive policy contributions through a focus of pertinent and important questions (Geels, 2007), the challenge arises as to how then case-study driven approaches can inform policy in a meaningful sense. At its essence, this is a question of generalisability and is common across research that uses qualitative methodologies.

The question of the generalisability of case studies is not solely the concern of STS but rather an underpinning dialogue across research (e.g. Schofield 2002). Larsson (2009) points to three strategies that can be used to enhance the generalisability of qualitative studies. The first is in the use of purposive or theoretical sampling to achieve heterogeneity of context, where generalisability is facilitated through the inclusion of the widest range of characteristics. In this approach, the breadth of data drawn offers some policy utility through the study of a phenomenon in the broadest range of settings, inherently testing the findings against a range of contexts in an iterative fashion. Larsson's second approach is anchored on ideas of 'transferability' where careful diagnosis of similar contexts (or cases) will indicate to what extent the findings can be transferred. Larsson's third strategy – of pattern recognition - is an attempt to sustain the research on a level that will allow it to make a contribution beyond the case study. This essentially builds a field of '*middle-range theory'*, inhabiting a space of description and explanation that bridges grand theory and empirical observations (Larsson 2009).

The prevalence of case study methodologies in STS and the relative scarcity of mid-range theory has been the subject of ongoing comment (Wyatt and Balmer 2007). The popularity of case studies in the field is undoubtedly influenced at least in part by the genuine value they bring to the study of science and technology in society, where phenomena are studied when they are not clearly distinguishable from their contexts (Yin 2002:5). Whilst a case study cannot develop and defend a theory on its own due to it being bound to its context, it builds on earlier cases and – in turn – builds theory that can be tested in future cases. This has been described by Eckstein as the 'heuristic case study' (related in Moses and Knutsen 2007:136-137). This research draws on purposive sampling and employs the analytical strategy of pattern recognition with the explicit aim of building a robust conceptualisation useful outside the specific context, and the presentation of findings is made in such a way to facilitate testing in other contexts.

3.1.2. Methodological tenets

This tension between the use of an interpretivist approach, the pursuit of generalisability and theoretical development reaches its point of concretisation in the strategy used to design, analyse and present the fieldwork. In this research, this tension was resolved through the use of pattern-matching (drawing on Campbell, 1975) – it develops a typology from the literature (Table 1), suspends this for the empirical phase but then returns to it in analysis stages, asking whether the patterns expected matched those found. In its purest form pattern-matching is a deductive process where a theoretical framework is proposed and tested against specific empirical sites. Potentially reductive, the approach can reduces rich descriptive accounts to a series of propositions to be tested; however, the breadth of this research does not lend itself to such a fine level of granularity and the 'pattern' was maintained at the level of the typology in Table 1. Whilst the use of essentially deductive strategies might be considered unusual in interpretivist research, the two are not essentially incompatible (Yin, 2002) and – arguably – deductive strategies are more common in interpretivist work than is frequently recognised and often co-exist with inductive reasoning (Hyde, 2000).

The second element of methodology revolves around the general method of enquiry, which is qualitative. Suited to *who*, *what* and *why* styled questions, qualitative research strategies aim to uncover emergent meanings, as opposed to quantitative strategies which lend themselves to deductive hypotheses and exploration of questions around scale, causal relationships and effect size. Qualitative strategies allow the researcher to be more receptive to the 'object of study' speaking for itself in its own terms, rather than seemingly objectively providing a response selected from a measurement or scale predetermined by the researcher. However, there is a careful process of interpretation involved, where the researcher is interpreting the response. This process of interpretation makes the idea of an 'object of study' somewhat difficult to defend, as the research data is in some senses co-created by the researcher and

respondent. The benefits of this approach lie in a depth of knowledge that can be developed that would not be possible if knowledge were being gleaned against tightly-defined predetermined criteria (Maxwell 1996:59). Instead, "what, how and why" cover the usual bases of an explanatory qualitative approach even as we are forced to acknowledge the "the paradox of designing a naturalistic inquiry" (Lincoln and Guba 1985:225).

In this section I have located the research as being interpretivist and qualitative. I have stated an aim of contributing to middle-range theory and have outlined how I will enhance generalisability through purposive sampling and pattern-matching analysis techniques. The next section of this chapter moves on to give a more thorough account of the design and conduct of the empirical work.

3.2. How The Empirical Data Came About

This section of the chapter describes and justifies the empirical work carried out in the research. It provides details of the sources of data (section 3.2.1.), an overview of mapping, observation, interview and document analysis methods (3.2.2), the design decisions that make the data robust including considerations of sampling, access, ethics and dependability (section 3.2.3), and an account of how the data was recorded, analysed and presented (section 3.2.4). To begin, I outline of origins of the data.

3.2.1. Where The Data Came From

In the early stages of the study, one of the first choices to be made was whether scientific citizenship would be explored in a bottom-up sense - involving detailed fieldwork with members of the public – or in a top-down sense, from a more organisational point of view. On the one hand, a bottom-up microsociological approach would not be an unusual approach in studies of citizenship and would be the only way of making robust assertions about the role of scientific citizenship in peoples' lives. On the other hand, this would not have been a marginal piece of work, and would come at the expense of

other areas of scope. A second deterrent factor was the lack of any obvious existent theoretical framework about scientific citizenship within which to conduct that level of research.

Consequently, the empirical focus was maintained at a broad level in order to maximise the work's contribution to both theory and policy. In theoretical terms, I wanted the work to reach beyond an incremental account of public engagement in a particular context, so was keen to involve existing concepts and frameworks for citizenship. This is reflected in the structuring of the thesis and the findings. In policy terms, the fieldwork was carried out within the remit of the research sponsor - the Scottish Government, and I looked beyond traditional framings of 'public engagement with science' in terms of the modes of participation studied. This is reflected in the specific empirical sites and the policy implications in chapter 8.

The sites of study involved in this research evolved as the project progressed. The obvious starting point for the empirical work included all those modes of participation supported by the Scottish Government, including science centres, science festivals, Cafes Scientifiques and the public engagement small grant scheme. In Chapter 2 I highlighted that although these forms of engagement are popular and growing they are relatively under-conceptualised in academic literature. Alongside an expanding public engagement agenda within Universities, this kind of activity forms the backbone of state-sponsored 'public engagement with science' in Scotland and is the substantive part of the landscape in terms of visitor volume. I entered the study aware that more policy-led public engagement, for example through formal public dialogues on emerging technologies may well impinge on the Scottish population, and kept an eye out for these. As the empirical work commenced it became apparent that these Scottish Government supported activities filled an important part of the field but did not stand alone. In particular the institutions involved in Scottish civil society regularly exercised a voice on science in society issues, for example through the Royal Society of Edinburgh or the Church of Scotland, so these were included as foci of study.

By this point, the idea of 'public engagement' had been significantly expanded. The empirical field was now extremely broad and I wanted to maintain that sense of looking widely at a snapshot in time. However, for practical purposes (both in terms of fieldwork expenses, time available and to balance breadth of study with a depth suitable for a doctoral thesis) I elected to choose a particular context against which to consider these forms of engagement. Rather than a specific technological case study or empirical site I chose to focus on a policy initiative with significant technological content but obvious social implications, in this case that was Scotland's transition to a low-carbon economy or low-carbon society.

The next stage in the empirical strategy drew on the context specifically. Building on the organisational view came a balancing question as to how members of Scottish public exercised a voice on their low-carbon transition. This raised cases of opposition and protest, and took me towards the planning system and the critical role of land use in managing the tensions in this transition. As the partners or antagonists in this process, the corporate sector came into view and I incorporated companies active in engaging publics in low-carbon ideas in general as well as developers associated with particular projects. I then looked towards communities and came upon the Climate Challenge Fund, a programme of community based projects led by a variety of actors, all aimed at reducing the carbon footprint of self-define communities.

A further decision that had to be made pertained to the geographical location of the empirical sites, and in Scotland there is a delineation between the 'central belt' (consisting of Dundee, Edinburgh and Glasgow) and the 'Highlands and Islands (the more rural communities). This was a significant decision and one linked to the nature of knowledges being drawn upon. Two strategies presented themselves. The first was to access Highlands and Islands communities about a wide range of renewable technologies. This suggested the advantages of eliciting meanings within communities and would allow me to look in more detail at specific technologies such as tidal, offshore wind, wave power. However, the trade-off (through time and cost) would have been

breadth, and I would have only been able to visit a few communities. The alternative strategy – and the one adopted – was to take a more policy-oriented cross-national view that acted as some sort of 'snapshot' as Scotland progressed through this transition. Whilst I could then sample a range of empirical sites to get a feel as to what was going on I would not be able to make any claim as to the meanings of technology beyond any specific cases that arose. Another note relevant to site selection revolved around the practicality of conducting extensive fieldwork in Scotland on a limited fieldwork budget: observations, interviews, visits and reporting to the Scottish Government had to be balanced with programmed and opportunistic public engagement events and the availability of interviewee participants.

Finally, the research focuses on adults rather than children. The teaching of science in schools is a heavily populated and active research area. The compulsory nature of much of the content of children's education, the particular pedagogical facets of their learning and the limits placed on their freedom as social actors makes the interaction of children and science a sufficiently distinct topic for it to be placed outside the scope of this research. That is not to say that children do not enrol their parents into revitalising their own interest in science, and the nature of their school experience will shape their relationship with science into adulthood; this research will complement work that brings insight to these issues.

The evolution of the fieldwork strategy is shown diagrammatically in Appendix A. An overview of the different participant groups follows in Table 2. This is expanded on, to include specific sites and coding scheme, in Appendix B.

3.2.2. Methods Used

Having decided on the general focus on empirical work in terms of sites to be studied, the question arose as to which methods would be used. In the previous section I recounted the general directions taken in the mapping process, and this was in fact the first task. This was followed by participant

observation, semi-structured interviews and document analysis, each of which I will now describe. As an overview, Table 2 summarises the different participant fieldwork groups involved in the study, how they were sampled and what their ethical stance was.

Table 2 Overview of Fieldwork Groups

Interviews	Participant Observation	Documents
Elite interviewees: …policymakers, event designers, commercial actors (formally consented, recorded, unnamed and ungendered, purposive/referral sampling)	Members of the public: …in science centres, festivals or Cafes where audience size is estimated at being greater than 10. Fully public events, ticketed (verbally consented by organisation, manual fieldnotes, anonymised, random sampling)	Policy documents: …from government and learned societies, and selected responses from civil society (all publicly available)
Facilitators/presenters: …at events/institutions (formally consented, recorded, anonymised, purposive sampling)	Facilitators and presenters: …in science centres, festivals or Cafes where audience size is estimated at being greater than 10. Fully public events, ticketed (verbally consented by organiser, manual fieldnotes, unnamed and ungendered, purposive sampling)	Historical records: …of event programmes and grants awarded (all publicly available)
Individual members of the public: …regarding their engagement with science (verbally consented, non-recorded, anonymised, random sampling)	Visits and Tours: …to engagement sites in policy, corporate and civil society sectors. Fully public sites (covert, manual fieldnotes, individuals not observed, snowball sampling)	Historical accounts: …of events and projects (all publicly available)

Mapping of Actors

Before the fieldwork could start in earnest, the actors and sites involved in science and technology engagement in Scotland were mapped. This was largely focussed on organisations and processes, and was necessary to inform the empirical work and help shape the literature base. It was carried out concurrently with the literature review, and was conducted digitally. The benefit of the mapping exercise lies not in the visual representation of the map, but in opening up the field of study in advance of the empirical work. By tracing back cases of public interaction with renewable energy technologies, I was able to identify sites of practice that lay outside the literature focus. This was a useful method of sampling validation, and in the sense of starting to visualise how individual projects started to form a larger whole, the method was similar to that of concept mapping (e.g., Trochim 1989).

I conducted internet-based research on different examples of public engagement projects with science projects in Scotland; Appendix A shows how the map at the beginning of the project (Map 1) was both expanded and solidified as the mapping developed. I then turned to the specific case of low-carbon technologies, searching for news reports, articles, blogs and websites around the themes of "Scotland + : renewable, energy, carbon, technology, citizenship, public, wind, community, or local". This led to the remapping presented in Appendix A, Map 2. which was further refined as the fieldwork started as referrals took place.

One of the most significant points to note is how much the field expanded when I turned to the low-carbon context (Map 2). Although part of this can be attributed to the increased level of detail that occurs when a specific context is taken and specific institutions and policy interventions emerge, the contrast also arises in part from the mundanity of the technology, bringing in commercial actors, land use processes and civil society organisations. Also coming into view here are more bottom-up activities as opposed to those orchestrated by policy actors.

Participant Observation

For research focussed on questions of how people relate to a particular environment, observation is a crucial part of the methodological repertoire. Spanning a range of techniques, the observation method can be more or less structured and the researcher can be more or less involved. Where the affective dimensions of a setting are important, or the researcher sees the benefit of being amongst and interacting with participants, participant observation is usually the method of choice.

In particular, participant observation allowed me to experience public engagement events in the way an attending member of the public would. Whilst participant observation is regarded as something of a gold standard in qualitative research (stemming from its anthropological roots), this has traditionally referred to the immersive, long-term exposure of the lone researcher within a community (Adler and Adler 1987:15). The participant observation referred to herein is not of this nature, and would be more accurately described as short (part-day) experiences in different public environments. How much this type of research can accurately be described as participant observation has been the subject of ongoing reflection within the field. What was performed here is perhaps best described a passive participant observation (after Spradley 1980:58-62), where there is a recognition that levels of rapport and immersion are very limited. This reflects the field's canonical typology of observation a similar spectrum of participant observer roles that spans complete immersion, participant as observer, observer as participant and complete observer (Gold 1958). In this sense, I would identify my role as that of 'observer as participant' – I was in the setting but not naturally or normally.

In some senses the public engagement and visitor centre settings I explored were ideal research settings for this technique: they were public, open access, note-taking was not incongruent and there were enough opportunities that

observations could be dovetailed in a single trip to coincide with interviews. Notes were taken in a fieldwork notebook at the time of the observation and included a diagram of the room layout and a note of my position in it. I noted a variety of practical, interactional and affective elements of the observation. These might include movements and speech from participants, questions they asked at public events and the general 'feel' of the event. Given that the affective domain was one of the reasons for employing this particular method, I felt this was an important part of the process and have endeavoured to reflect it in extracts used in this thesis.

A summary of observations is presented in Appendix B and the observation protocol is included at Appendix C.

Interviews

As a research tool, interviews cover a broad spectrum of interaction, from highly structured and carefully directed interactions aimed at producing data for quantitative analysis, to more naturalistic, undirected, in-depth discussion with a meaningful degree of relating (Jupp 2006:157).

A summary of interviews is included in Appendix B and the interview schedules is presented in Appendices D and E. The interviewing in this research fell broadly into two camps. The first was short discussions of a few minutes with members of the public in attendance at an event, who were asked how they came to be at the event and what they thought of it (schedule at Appendix E). Here, no recording devices were used but hand written notes were taken immediately on closing the encounter. As I will discuss in section 3.2.3, the purpose of these 'chats' was largely one of triangulation as opposed to in-depth study, in case completely new themes or issues arose that were not currently in view.

The second group I will call elite interviewees, professionals in largely unique roles where, although accounts may be subjective, can be considered unique –

offering an account that only that actor could give (Mannheim and Rich 1995). Here, I conducted semi-structured audio-recorded interviews of around an hour in length (Schedule at Appendix D). An important note about the interviews is that I deliberately did not want to reify the typology developed from the literature and mapping work, so as to avoid the 'self-fulfilling interview' (Potter and Hepburn 2005). Consequently I did not use the word citizenship, instead encouraging a discussion around rationales and imaginings of publics, rights and participation mechanisms. Even these were not phrased in such terms. Instead, I aimed to use the interviewees own language and field, mirroring those during the interview. This took a considerable degree of focus, but was necessary given that interviewees spanned various roles, backgrounds and fields. Berger (2013) notes the problems of interviewing participants when researching from a position of non-familiarity, namely that no common language can be employed and questions are framed in a way that makes them difficult to engage with. This was a further reason for avoiding conceptually grounded questions – it is particularly difficult to judge them correctly and instead I asked question such as "what kind of people would you like to be involved?" or "what is it you want people to do?"

I drew on the notion of elite interviews in approaching this element of the work. Although much of this literature is aimed at (for example) sportspeople and celebrities, it can be used in planning interviews with policymakers who are in some way 'irreplaceable', exerting unusual influence in the political aspects of a field of work (Richards 1996). The elite roles of scientists, engineers and policymakers have previously been noted in a methodological context (Undheim 2003). The purpose of these interviews was to discern the conceptual positions of the interviewee including how the 'audience' for their work is imagined and conceptualised, and what the broader role of public engagement work is. Clearly some of this can be discerned from documents, but interviews are not so much about uncovering a truth as opening up unseen areas of knowledge. Unlike documents, interviews can open up the

processes of framing and negotiation that led to the positions that are ultimately coded in policy and practice. Interviews also offer a snapshot of current issues and practice, many of which were being wrestled and experimented with as I did my research. And finally, conducting interviews allowed me to orient my mind towards the practical implications of this work.

Interviews are not without critique, and elite interviews in particular can raise problems regarding access, unreliable memory, inconsistency and power balance in the interview (Richards 1996). To this I would add an issue specific to civil servants: dogged adherence to official published positions, which occurred in one interview where I found it very difficult to counter repeated responses of "it's all on the website". I tried restating questions in different ways, but on reflection and after further reading, the strategy I would adopt in future is the idea of inviting interviewees to critique their own case, possibly using arguments made by a third party (as suggested in Berry 2002).

Document Analysis

In a constructivist methodology, discourse is a powerful analytical concept that recognises the active, persuasive and constructed nature of language (Bryman 2008:501). Analysis of documents and official accounts is one of the oldest traditions in social sciences, stemming from early compilations of health and crime occurrences. The growth of qualitative use of such sources is a more recent phenomenon, bringing with it a standpoint of looking to discern "….the perspectives, assumptions, concerns and activities of those who produce them…." (Taylor and Bogdan 1998:129). All of the documents used were public and freely available, offering a historical and detailed record that would be beyond the recall of an individual participant, reflecting a position at a moment in time. On a more practical level, the information contained in documents can often be enough to satisfy a research question without needing to access specific elites.

This work's fourth method involved document analysis on a small number of documents that resided in two clusters. The first involved historical analyses of engagement programmes to understand how (for example) the science festival and Café Scientifique movements had grown in Scotland and what kind of topics tended to be covered. This lent itself to a more structured analysis of events over time and checkboxes of thematic themes. The second cluster comprised policy-related documents to identify prevalent discourses on how the public is imagined and on the purposes of different types of participation. This was a more qualitative analysis using the thematic framework included in Appendix F, and helped diagnose some of the tacit positions that underpin written documents.

A summary of core documents is included in Appendix B, along with the thematic analysis framework used in exploring them as Appendix F.

3.2.3. Making the Data Robust

Purposive and Referral Sampling

An effective sampling strategy is important to ensure breadth, depth and the efficient use of resources and time for both fieldwork and analysis. Consistent with Jupp's definition, this research employed a strategy of purposive sampling, where the selection of observation events, interviewees and documents focuses on that which can provide the richest, most relevant data across a range of multiple perspectives (Jupp 2006:244-5). In contrast to random sampling, it can be argued that purposive sampling increases the possibility of bias, although pragmatically speaking the impact of resource and time efficiency had a greater effect on sampling than bias. The fieldwork was conducted at a distance of over 200 miles away, on a limited research budget and according to a timetable set by the schedule of public events. In combination, these constraints had more of an effect than biases arising from purposive sampling.

Focussing on the urban centres of Edinburgh, Glasgow, Aberdeen and Dundee allowed me to firstly examine the four science centres seen as the backbone of science-society engagement in Scotland, while also encapsulating major science festivals, commercial centres, University public engagement programmes and policymakers. In this sense it allowed me to access a range of what I might call supply-side participants performing a range of functions. There are of course healthy centres of activity that could not be covered – the University of the Highlands and Islands, and Inverness and Orkney Science Festivals for example. There has been no indication that significant centres of low-carbon technology engagement have been missed that would have suggested the need for a change in strategy.

In some instances, particularly after the first interview with a commercial actor, and an interview with a senior policymaker (INT-COM01 and INT-POL04), a number of referrals were given which opened up the visits and tours part of the fieldwork (specifically INT-OBS 15-17 at the Scottish Parliament in session, Whitelee Windfarm visitor Centre and the Electric Garage). Whilst there were many other referral opportunities that arose from the original interviewee pool, it was not feasible to follow them up. However, experiencing these sites was very useful to the study, and it was helpful that interviewees with local knowledge suggested them.

Access

The research for this thesis depended on access to six generic groups of participants, and three generic groups of documents, as described in Table 2 in section 3.2.2.

Given that they were public events, the three observation groups were unproblematic in terms of access, as were the interactions with members of the public and presenters at these events. The interviewing of elite role holders required more careful planning given that they a unique opportunity is lost in the event of refusal. As I will go on to outline in the next section, elite interviews offer unique accounts of the context of decisions and their

guiding thoughts on their field. They are also critical in facilitating access to other role holders within the organisation (Jupp 2006:85); a number of interviewees had unexpected participants that added different perspectives, enriching the interaction. Studies suggest two general models of access: external mandate or internal negotiations (Hall and Hall 2004:38). An external mandate occurs when a sponsor coerces an informant to participate in the research. This poses the possibility of specious conformity, and some have questioned whether consent can properly be considered to have been granted when coercion is present (Jupp 2006:97). So, instead of asking my policy sponsor at the Scottish Government to facilitate access, I asked him to provide a general introduction to a list of named contacts then contacted them independently, negotiating directly based on the project's aims and their possible contribution.

Elite interview literature suggests that access to elites is almost expected to be problematic (Richards 1996, Goldstein 2002). Unexpectedly the policymakers proved to be the most straightforward group, perhaps in part because my policy sponsor acted as a key informant and gatekeeper. Access to corporations proved more difficult, not least because of the concentrated structure of the market – there are just two (non-micro) renewable energy companies in Scotland and one declined an interview as did the industry trade body. However, the one interview that did take place lasted a whole day and opened up new lines of questioning that were followed through in policymaker interviews

Clearly it is possible that access might affect representativeness, although this is balanced by the dominance of two renewables company in Scotland. The many small companies, intermediaries and public involved in microgeneration are rather outside this study anyway. Undheim (2003) has highlighted the importance of reflection when elites decline interviews, and suggests it is important to consider why the interviewer is considered insufficiently important to be given time, or why respondents prefer to keep silent. In this case, the reluctance of corporations to engage in social research perhaps

reflects the general politicisation of renewable energy in Scotland and the problematic state of relations with communities; both these themes are core to the arguments in this thesis.

Ethics

When social science research reaches beyond purely documentary sources, it brings with it a responsibility to treat research participants ethically, in a morally sensitive and appropriate manner. As such, the field of research ethics acts to stimulate reflective thought and good ethical practice and researchers pursue the 'greater good' that forms the rationale for the project (Jupp 2006:96-97): the agency rights of informants, the pursuit of knowledge and a responsibility to the field and other researchers. The ethical stance adopted within this research draws on three main sources: the requirements of the University of Nottingham's School of Sociology and Social Policy, the ESRC's Research Ethics Framework (ESRC undated) and a wide literature base.

For studies conducted under the auspices of the University of Nottingham's School of Sociology and Social Policy there is an expectation that participants consent to their participation and that such consent is fully informed – that participants 'know what they're signing up to' and have adequate information to make this judgement. The School's processes of ethical approval correspond to four of the six parameters of the ESRC Framework on informed consent, preservation of anonymity and confidentiality, and avoidance of harm and absence of coercion (ESRC2010:2-3). There are two further principles included in the ESRC Framework – the requirement for integrity and impartiality (some thoughts on the expanding interpretation of research ethics, as exemplified by the ESRC, are contained in Bryman 2008:125-128). In the School, ethical compliance is achieved through consent forms and participant information sheets, examples of which are included in Appendix B.

To begin the process of ethical reflection and approval I identified the various groups of participants present in the project which were summarised in Table

2. Included are members of the public and engagers who were present in a variety of science engagement settings. The second grouping includes those who participated in interviews, including members of the public, engagers and elite actors.

Covert Participant Observation

In Table 2 are two issues for particular ethical attention – the use of covert observation and challenges to anonymity. The first issue relates to fieldwork where covert participant observation will take place in public settings including science festivals, visitor centres and science centres. There are a number of possible reasons for structuring a participant observation in covert terms (Taylor and Bogdan 1998:36-37), perhaps most obviously when one can anticipate participants behaving differently in the conscious presence of an observer. Here, the rationale lies in more pragmatic territory given the practical challenges of giving consent and information sheets to every visitor to an event, or getting informed consent for an interaction that would take less time than the consent-giving process. The events at which observation will take place are public, and participants are not expected to behave – or make statements – they would not have made were they aware a researcher was present. In this, we can start to see the liminality of these ethical dividing lines, which are not as clear cut as we might articulate. To protect participants as far as reasonably possible, no audio or video recordings were made, and private conversations were avoided. This enabled me to experience the event alongside other attendees in the moment, just as any other interested participant.

Anonymity in Elite Interviews

The second area for reflection lies in the difficulty of maintaining anonymity in the elite interviews. An interviewee who speaks authoritatively about, for example, the origins of the science centre Our Dynamic Earth is likely to be identifiable by funders, peers and employees should they care to look. Given the unique nature of some of the facilities and events to be studied, I came to the view that it was not sufficient to rely on assurances of anonymity. Instead,

I erred away from such assurances and amended the participant consent form accordingly (attached in Appendix A). During the consent process I drew particular attention to that clause, and explained that although no names or other descriptors would be used in the analysis and reporting, and although gender-neutral pronouns would be used, this could not guarantee anonymity given the specialist nature of their knowledge. Consent forms were signed on that basis with no refusals; two interviewees requested that I seek permission to use quotes of theirs and this has been honoured. This resulted in two quotes being written in a different way and additional steps taken to protect the interviewees anonymity.

Dependability

Discussing ideas such as validity and reliability necessitates a redefinition from their common usage in quantitative enquiry, as different parameters must be applied in order to explore their meaning in qualitative research. Golafshani (2003) suggests that validity in qualitative research is underpinned by trustworthiness, rigor and quality – attributes associated as much with the researcher as with the research itself. This of course is very much in the spirit of the blurred researcher-subject boundary in qualitative research, in contrast with the perceived divide in quantitative research where the data instrument is seen as the container of reliability, validity and reproducibility. However, Morse et.al. (2002) suggest that the rejection of the idea of validity and reliability for qualitative research over the last three decades had transferred responsibility for establishing quality from the research to the reader.

There is a tension here when it comes to assessing the dependability of context-anchored work common in science and technology studies. On the one hand, some (e.g. Patton 2002) argue that the value of qualitative empirical investigations lie in their ability to contribute to middle-range theory that can span other cases - in other words, generalisability. Others (e.g. Maxwell 1992) argue that generalisability is a concept only useful for quantitative research,

and that a constructivist epistemology by definition recognises that knowledge is co-constructed between the researcher and the participant and hence cannot genuinely be generalised. Instead, its value lies in explanation and description, although the question of robustness remains.

In navigating these strands of thought, I used three strategies to enhance the dependability of the discussion points and conclusions within this research. Firstly, I maintained a reflective research diary throughout the life of the project. This enabled me to trace my own journey of decision-making through the research and brought some less-visible areas to my attention. An example of this is when I had surveyed the usual intermediaries (e.g. science centres, science festivals, Cafés Scientifiques) and reflected that fairly specialist leisure-based events such as these carried no resonance in my own life and social circles – they were not activities I or any of my family undertook. In turn this led to a broadening of the field of study to explicitly include the planning system and actors through the market as sites of science-society interaction.

Secondly, using a combination of methods is a classic set for triangulation purposes. Drawing on observation, interview and document analysis allows for different approaches to data that have the potential to uncover a phenomenon through different lenses. Furthermore, the brief chats with members of the public at whichever events I could manage them was not aimed at uncovering their voice but was in essence a further test of scope. By looking away from the orchestration of events and my own experience of participation, the simple act of asking other attendees how they came to be there and what they thought of the event kept open the possibility that new a focus might emerge that would otherwise have been missed. An example here is that members of the public repeatedly said they came 'because it was fun but worthwhile', comments that were initially frustratingly opaque but that came to make much more sense as the theoretical line of cultural citizenship was opened up.

Finally, there was an explicit intention to gain a broad understanding of the current state of public engagement with science, and consider how this related

to the implementation of Scotland's low-carbon strategy. Consequently a good proportion of the empirical work took place around 'science-in-general' or topics outside the low-carbon remit. For purposes of clarity, the exemplars drawn out in Chapters 4-6 inclusive will be based on low carbon examples whilst the other fieldwork helps contextualise this in the broader field of public engagement and bring a critical insight into the limits to generalisation.

The aim here is not to develop a simple and widely generalisable model but, as so often is the case in social sciences, to develop a "….model…built on detailed observation often that the form of complex and contingent generalisations (or middle range theories) that describe a smaller subset of a phenomenon with a higher degree of precision or probability…." (George and Bennett 2005:144). Context-embedded research continually navigates a balance saying something specific that is also useful beyond the immediate observation (that is, between dependability and generalisability). Indeed, George and Bennett point to the power of 'typological theorizing, where comparisons are made across contexts and the process by which they come about is traced, being able to suggest theoretical patterns without making specious assertions about causal mechanisms. Instead, typological theorizing draws on a cumulative body of empirical work whilst remaining located in context (ibid, p149).

3.2.4. Handling the data and looking for patterns

Transcription

Firstly, the interview data was transcribed. Often considered something of an invisible step in the research process, decisions made during the act of transcription can be a profound indication of the researcher's approach to the subject (Oliver, Serovich and Mason 2005). Transcription strategies can perhaps be broadly conceived as *naturalistic* (where speech is recorded verbatim including pauses, stuttering and accents) or *denaturalised* (where grammar is corrected and non-verbal elements are omitted). These of course are positions that embody extremes of transcription practices, with a variety of

techniques in between. The relevance of the approach used lies in the underlying philosophy seen to be revealed in the two positions. In naturalistic transcription, language is seen to be real, whereas in denaturalised text, language becomes a subjective tool of meaning and perception.

In this study, the final transcription decision took place about a third of the way through the process. I had retained local accents and phrases, ungrammatical sentence structure, and indicated pauses and non-verbal elements as far as possible. At this point, I stepped back and asked what representational decisions I was making thus far, having become increasingly concerned by the purpose and role of the Scottish accent, vocabulary, non-verbals and phraseology I was encountering (and – to a lesser extent of concern – the swearing involved in some of the interviews). Whilst I had attempted to remain faithful to the recorded speech, I was becoming reoriented to the fact that my purpose in interviewing was primarily information extraction, and to consider how respondents considered audiences (publics) and participation. To this end, what looked like quite twee representations of speech were not adding anything to the analysis and were in danger of becoming what Preston calls 'linguacentric' representations, where any non-standard English speech becomes an exotic point of focus (Preston 1982:306). There was also the possibility that the choice to transcribe verbatim would be taken to be making a statement about the importance of dialect at the expense of the more relevant meanings that were being revealed. Thirdly, I considered whether it was more respectful to the participants with native Scottish accents and diction to transcribe them naturalistically or in a denaturalised way. On the one hand, it makes for awkward reading, and one does not know how participants hear their own speech. On the other hand, Anglicising the speech of Scots has been a longtime point of contention. As the Scottish National Party has commented "….the primacy of English as lingua franca has meant 'our national languages have been suppressed and oppressed over the centuries…." (Scottish National Party, quoted in Mycock 2012), although Mycock goes on to build a case to show that the SNP's

commentary about language in Scotland is largely opportunistic. Fourthly, I was aware that the policymakers had more formal modes of speech compared to some of the rest of the interviewees. Certainly not a hard-and-fast rule, there was a danger that this would come over as a distinction in the data if reported naturalistically, and I did not want to introduce any hierarchy in the different representations (Preston reflects on the hierarchies that can be inadvertently introduced as differing geo-ethnic accents are included). As it became clear that the intricacies of Scottish pronunciation and vocabulary were not the focal point of any of the research questions, from that point I decided to use the data in a denaturalised manner.

Analysis

Transcription complete, the process of data analysis follows logically, although this is not to imply that these are completely separate stages (Martin, 2009 puts forward a comprehensive account of how the data gathering, transcription and analysis processes typically overlap in qualitative research). This is particularly true in research designs that make use of purposive sampling strategies that are subject to refinement as emergent themes are identified. There are a number of strategies for analysing qualitative data. These may include manual processes, computerised processes (using packages such as NVIVO), or different theoretical approaches such as grounded theory or thematic analysis.

This essentially heterogeneous dataset was analysed on a pattern-matching basis. That is, the deviant case samples were interrogated to draw out themes across a range of participation modes and policy arenas that would bring life to ideas of scientific citizenship, concepts of membership, rights and responsibilities, and modes of participation. The findings were compared with the typology developed from the published theory, in Table 1.

Pattern matching has a solid history as a core procedure in case-based qualitative research, where empirical data is used to test a hypothesis drawn up from theory (Yin 2002). Some commentators have noted the inherently

positivist connotations of such an approach (Hyde 2000) and it is certainly the case here that a significant amount of inductive analysis took place, particularly around emergent themes of materiality – in the sense the analysis strategy was a combination of pattern matching and pattern recognition.

The pattern matching occurred on two levels. The first, at an operational level, was about citizenship attributes of individual cases. The second higher level, pattern was about the relationship between public engagement as a practice and policy implementation – if there was a hypothesis it would be that public engagement efforts would be in some way underpinning Scotland's transition to a low-carbon economy. This proved not to be substantiated, and the implications of this gap are discussed in Chapter 7. The bounds of the pattern-matching approach were flexed to include pattern-recognition, an allied process to recognise and build theory as opposed to testing a fully formed hypothesis. This is most visible in the theme of materiality, which was not present in Chapter 3's theoretical framework but forms the basis of a significant discussion in Chapter 7.

Representing the Findings

This section addresses an exceptionally important part of the qualitative research process – writing up and representing the findings in a manner that does justice to the research, making a clear and compelling argument that is justifiable within the scope of the work conducted. This involves process of interpretation, translation, synthesis and representation as "….writing is not simply a true representation of an objective reality…waiting to be seen. Instead, through literary and rhetorical devices, writing creates a particular view of reality…." (Richardson 1990:9). This is a process of transformation, and involves conscious decisions on the part of the researcher.

These types of decisions are commonly neglected in qualitative methodologies, a source of not inconsiderable confusion and concern for this researcher (and which I will reflect on in the concluding section to this chapter). The structures used in telling a qualitative 'story' can come from

multiple sources – theoretical concepts, the data itself or a personal structuring that comes from the argument being made. Despite efforts to the contrary (Lincoln and Guba 1985, Manning 1997, Taylor and Bogden 1998) there are no widely adopted rubrics for exploring methods of representation.

In many senses, all of this chapter is concerned with the decisions that led to the findings being represented in the way in which they are – the methodological approach (section 3.1), the methods and procedures used (3.2) and the handling and analysis of data (3.2.4). What is left then is how this story came to be told in the way it is – what led to the chapter structure from this point onwards.

For this thesis, this was by no means a straightforward decision and I was conscious of the power invested in what I had thought was a decision that would 'make itself'. In the end, the structure used here is the third iteration. Perhaps unsurprisingly, a very early draft assumed the empirical work would conveniently follow the theoretical work, and was reminiscent of the typology of citizens that was proposed at the end of Chapter 2 (Table 1). As the fieldwork greatly enhanced this early conceptualisation, and because part of this story is that the citizen it not a 'static' figure, it proved impossible to construct that narrative using the existent typology. A next attempt built on the differing roles of policy, the private sector and civil society that were emerging from the fieldwork, and this was used as the next chapter structure. In practice, this might have been very useful for a thesis on innovation systems, but completely obscured my arguments about citizenship, which were at the core of the work. Finally, after a somewhat painful process of having to return to the research questions to become more decisive about the most compelling arguments emerging from the theoretical and field work, the current structure was developed. Here, through the dimensions of membership, rights and participation, I hope to have built a convincing argument that says something novel about scientific citizenship but has clear roots in both theory and fieldwork.

3.3. Reflections on Crossing Disciplines in the Research Process

This agonising over how to represent the findings is just one of deep challenges involved in qualitative research that include the explicit acknowledgement that bias can exist, that meaning is co-constructed between researcher and interviewee, and that the assumptions and personality of the researcher are taken into the data collection and analysis process (e.g. Sword 1999). In this sense, reflexivity becomes an important element of the research strategy. In this research, this took place both in supervision and in research diaries, and half-way through the project I wrote a 1000 word auto-ethnographic account of how I was feeling about the research. I would argue that this reflection became of critical import at three particular stages of the research, and I would like to make some space in this thesis to discuss them in an evocative sense (Ellingson and Ellis 2008:445) to make them a visible part of the account.

The first was in the early orientation period. I came into this PhD as an engineer who had worked in social sciences in the context of business studies. Although I would not have used the word at the time of entry, my orientation was firmly positivistic. Firstly, there was the challenge of getting to grips with ideas of social construction, the fluidity and contingency of the social world and how that can be operationalised into a research plan. Looking back, an early research diary notes how I had recognised "how is the audience constructed?" would be an important part of the study in both observations and interviews, but that at the first observation I conducted I realised had no idea how to discern this in practice. Thus, an early orientation period of multiple short observations at public events was invaluable, as an exercise in practical skill development and personal management.

The second, and more challenging period of reflection was sustained throughout the data analysis. There was an overwhelming feeling of

messiness to the data and I searched for some time for the ultimate grand social theory, middle range theory (e.g. Merton 1967), map or typology that would represent what I could see was occurring. I was successful in developing many mind maps that portrayed the key features of what I was finding and how different elements related to one another and to different literature fields, but they proved impossible to write up "as they were". Instead, their role proved not to be to find the perfect framework against which to hang the empirical work I had conducted, but to constantly refine and process my own thinking, getting better at understanding how different fields of study related to one another and what their strengths, weaknesses and blind spots were. Sometimes, the places where the social world cannot be explained, the very messy places and the holes, are equally important places to be explored – the valuable gem amongst the bedrock – and this is where novel angles come from. This is what occurred as I spoke to many members of the public at visiting events who would consistently say they attended events because they were 'fun'. I could not make sense of the idea of 'fun' within the discourses of science and society, and this was a challenge until I connected it with the idea of affective engagement as a counterpoint to the cognitive, which later evolved into discussions of cultural citizenship.

The writing process was not a place where I expected to still be challenged by the nature of the data and my role in presenting it. I had recognised that developing a convincing narrative was important to writing a doctoral thesis but when presented with the data I was consistently questioning whether I had done justice to the empirical work. "…What do you mean, the "*right*" answer?…." was a common question from my supervisors. Again, this points to the need to practically master the handling of different data sources when crossing disciplines – cognitively being able to list the differences between qualitative and quantitative strategies is simply not enough. Instead, it was necessary in this case to work and rework the data to find the lens through which I could most carefully, usefully and authentically depict the general patterns on this landscape. Previous iterations of the data chapter had been

structured in different ways – different levels of intermediaries and different sectors of society - before an acknowledgement that presenting and discussing the work against the three tenets of citizenship would most clearly facilitate a useful contribution to knowledge. This processing and reprocessing is the flip side of the rich data generated in qualitative work – there is no way it can all be used and the process of selecting which context, which mini-case, which quote "speaks best" can be a disconcerting process for one trained and practiced in the art of "letting data speak for itself"[2].

Many of the thoughts that have arisen in the learning curve associated with this thesis have influenced my thoughts on a future career in academia. At the time of writing, I have been becoming a social scientist for nearly five years, but I still remember the feeling of shock when I realised that the safety blanket of engineering and business had been taken away. Their value, in public discourse at least, goes unquestioned. Even as I was convinced of the power of qualitative research (and the challenge in making it useful), I also struggled with its lack of clear answers. For me, a significant part of my development has been in learning to articulate the need for – and value of - social scientists amongst science and engineering.

Having described the methodological approach and data strategy, the next three chapters (4,5 and 6) recount the findings of the fieldwork and Chapter 7 presents a discussion around what might be concluded.

[2] It is not coincidental that this thesis is located in science and technology studies, a field that has systematically challenged the notion that quantitative data is objective (e.g. Latour & Woolgar 1979). I invoke the idea here as it reflects my own prior lack of systematic reflection as an engineer, an analyst and a businessperson.

CHAPTER 4 Locating Scientific Citizenship: 'Membership' and the Construction of Publics

This chapter addresses research question 2: *"How can we begin to understand the territories a scientific citizen inhabits?"* In invoking ideas of scientific citizenship, the question arises as to who these citizens might be and to what they belong. In traditional understandings of citizenship, membership has commonly been interpreted as an eligibility to formally participate in a political community, often clearly defined by constitutional arrangements that create internal and external exclusions, through birthplace, military service, property ownership or gender. A reading of scientific citizenship in these terms leads first of all to the question of how the political community is defined in this instance; in the absence of formal constitutional documents offering explicit definitions, we need to look at policy-initiated activities that serve a similar purpose. Second, and related to the issue of definition is the question of who is included and whether some groups of potential citizens are rendered invisible. This issue has been explored in the research rationale in section 1.2 and theoretically in section 2.3.3. In this chapter, I draw on my fieldwork to investigate how membership in a community can be conceptualised in policy activities, by corporations and within civil society to promote scientific citizenship in Scotland.

4.1. Concepts of membership in scientific citizenship

Here, I take a step back from an *a priori* definition of citizenship to explore the broader, more fluid, sociological nature of various publics that are created or emerge in the context of technoscience. This leap – from *the public* as a dominant concept in public discourse to publics, a largely analytical term is an important element in this chapter. At its heart is a recognition that the public, rather than being a static easily described mass, can be imagined or described by different actors for different purposes at different times, for example as laity, consumers, stakeholders or sometimes citizens (see Wickson et.al. 2010). My use of the term 'publics' serves as a reminder that the publics that I and

other analysts discuss are constructed, plural and overlapping - seen through a mirror rather than a lens. In Chapter 7 I discuss the degree to which these different publics might be considered citizens, rather than 'merely' as a public.

The chapter draws on a bricolage of fieldwork and document analysis to outline some imaginings, summonings and emergences of the public in relation to science and technology in Scotland. It spans calls from science policy actors, the commercial sector and from within civil society to examine what kind of publics are being constructed in relation to science and technology in Scotland, with particular reference to its low carbon transition. In doing so, three publics are proposed: the enthused public (illustrated through the Royal Society of Edinburgh, the Low Carbon Scotland Public Engagement Strategy and the role of Scotland's science centres), the public as consumers (illustrated through Edinburgh International Film Festival, Whitelee Windfarm visitor centre, Glasgow's Electric Garage and the Scottish Government's Low Carbon Behaviours Framework) and the counterpublic, illustrated in opposition to onshore wind developments and to woody biomass proposals.

In exploring how publics are constructed, I have drawn particularly on the protocol developed for the observational fieldwork (see Appendix B), which is useful in bridging the gap between the theoretical concepts and practical work involved in describing something so shadowy and translucent. To discern constructions of the public, the data has been interrogated in six core areas:

- What is the public supposed to do? How have they become involved?
- What is the role of scientists or other professionals?
- What expertise is in play and how is it being used?
- How are topics framed and by whom?
- What value bases are in operation?
- What parameters of inclusion and exclusion are discernible?

In searching for different constitutions of scientific publics in Scotland, the fieldwork covers a heterogenous range of engagement formats and topics

(recounted more fully in Chapter 6). What follows is not intended to be an exhaustive account of all possible publics – this would suggest a specious validity and certainty that cannot rightly be supported by such messy data. Instead, I propose three archetypes of publics that I observed in multiple sites. With this approach I draw out the differences between these archetypes to be better able to discuss their role (or lack of one) in building scientific citizenship.

The main substance of this chapter focuses on these three archetypes: a public to be convinced, the public as a collective of consumers, and notions of the counterpublic. As with any attempt to group data there are some boundary issues. In drawing on concepts of multiple publics, I acknowledge that publics overlap, merge, evolve over time, and coalesce differently around difference topics; indeed, this is one of the key points that arises in Chapter 7.

4.2. Enthused Publics

The first public that emerges – *the enthused public*– describes a public that is to be won over. This idea is particularly dominant with science policy actors, and has considerable conceptual overlap with the deficit model of science-society relations, as I explore further in concluding this section. The fact that it recurs in my own analysis indicates the continuing salience of this as a 'mental model' of the public. This archetype relies on the idea of a diffuse, general, apolitical public who will respond to external stimuli in a rational manner. Knowledge is seen as being only the domain of experts (in science or in policy) who seek to communicate their knowledge to an unknowledgeable, indistinct group of people. There are two primary purposes to this enterprise: to enthuse the public about the benefits and wonders of science, and to transfer enough information (either in bite-sized chunks incorporating 'fun facts' or about how science works in general) for an attitudinal and possibly a behavioural change to occur.

There are three key points to note in thinking about the enthused public as a form of membership that may have a role to play as a citizenry. The first is that although enthused publics are imagined *en masse*, the conception is of a single mass and there is no sense that this public acts as a collective in acquiring, negotiating or understanding knowledge – the public is never more than the sum of its parts. Secondly, it is a very passive construction – although this public attends events, pays attention and is enthused, no demands are made of it and the process is carefully designed and managed by the engagement designer. The third point is about the instrumental nature of the relationship between engager and public. This relationship is imagined largely in terms of information transfer, a rational process whereby individuals will respond to explanation or technical information and this will increase support for science. The aim is that non-scientists will come to see technoscience as a worthy and worthwhile public investment, which increases wellbeing or economic return through clever or impressive feats of knowledge.

In the remainder of this section I present three examples in which the enthused public is invoked: the Royal Society of Edinburgh's views of biotechnology in society, the Scottish Government's public engagement strategy for a low-carbon Scotland, and the Scottish Government's science centres and *Talking Science* public engagement grant scheme.

4.2.1. Royal Society of Edinburgh

In Chapter 2 I talked of the sustained criticism that the deficit model has received for over 20 years. In spite of this, it remains popular amongst policy actors. Consider the Royal Society of Edinburgh's December 2009 Advice Paper to the House of Commons Science and Technology Committee. In this paper the Royal Society of Edinburgh (RSE) concluded that the main weakness in the UK's biotechnology capability was its inability to scale-up technological innovations from the laboratory to the field in which one of the primary barriers was public opposition. The Government was accused of being unduly passive in the face of public opposition to a breadth of opportunity, therefore undermining biotechnology research in Scotland. The RSE called for

leadership in 'informing public opinion', which they felt was the solution to the perceived opposition. The paper concludes:

> *"The RSE recommends a sustained campaign of public relations, promoting the public benefits that can be delivered by genetic modification, Synthetic Biology and stem cell research and undertaken with principled rules for engagement. This will have to be very different from the flawed public engagement of the 1990s, and will be vital to breaking down debilitating public opposition."*
>
> (RSE 2009)

These are strong words (including two telling ones: 'public relations'), and the RSE openly frames the public as an obstacle to be overcome, a sceptical population that might be won over (or enthused) by an upbeat PR bombardment and an unspecified process of engagement. Also implied is the instrumental nature of the process of public engagement (Stirling 2008) as one that can achieve a predetermined objective of winning support, and using 'better' processes will better achieve this ultimate ambition.

Within a few months of the publication of the Scottish Government's public engagement strategy, the Royal Society of Edinburgh published the results of their wide-ranging inquiry "Facing Up to climate change: breaking the barriers to a low-carbon Scotland" (Royal Society of Edinburgh 2011). This report effectively highlights a number of policy gaps in Scotland that act as barriers to adaptation, such as the previously mentioned need for grid upgrade and the vacuum between national targets and local planning. In amongst many recommendations, the Society promotes long-term deliberative dialogue with the public, hosted by and originated with current civil society groups:

> *"....Civil society has a critical role, because it provides social space where greater trust can be built through shared experiences and articulation of common goals. It is the basis*

> *for stronger deliberative democracy, which requires capacity for listening, argument from evidence rather than personal interest, and action to draw a wide range of groups into discussion. While simple agreement is likely to be the exception, local perspectives need to be heard, in order to achieve some shared understanding of the relevance of climate change, and the meaning of low-carbon transition for day to day life. Deliberative engagement is a means to move beyond the limits of individual actions, to enable everyone to understand their responsibility to act."*
>
> Royal Society of Edinburgh (2011):153

So, instead of adopting an instrumental approach of promoting dialogue as a means to reach consensus, this would appear to be promoting deliberative engagement as a means to make climate change 'real' and start to build some shared meaning, the lack of which had been repeatedly reported as a barrier during the consultation phase of the inquiry (ibid p148).

4.2.2. Low Carbon Scotland: Public Engagement Strategy

At the beginning of Scotland's decarbonisation agenda, public engagement around the low-carbon transition was similarly shallow and focussed on what might be called 'public relations'. Whilst I return to more recent strategies later in this chapter, I will take a moment to look back at the engagement strategy envisaged in the original legislation.

The legislation that affirms Scotland's commitment to reduced greenhouse gas emissions and a transition to a low-carbon economy is the Climate Change (Scotland) Act 2009. In Part 6 – embodied in the legislation – is a call for government to "….prepare and publish a strategy setting out the steps they intend to take to inform persons in Scotland about the targets specified by virtue of this act, [and] encourage them to contribute to the achievement of those targets…." (Climate Change (Scotland) Act 2009, Part 6, Section 91[1]).

In response, the Scottish Government published "Low Carbon Scotland: Public Engagement Strategy" (The Scottish Government 2010), a document intended to fulfil this requirement.

> *"We need to galvanise that enthusiasm and expertise, and share information more widely across Scotland. Developing fully as a modern, low carbon society can only come about if we all contribute"*
>
> Roseanna Cunningham, Minister for Environment and Climate Change (Foreword)

Unfortunately, the exhortation for public engagement was carried out in a fairly superficial manner, firmly rooted in the idea of a public to be educated, convinced and won over. Because of the narrow framing of public engagement in the original Act, the strategy was also limited in imagination. Aside from some small confirmation of existent activity in micro-generation schemes there was no mention of the energy generation sector. Consequently, no opportunity was presented to consider what the priorities of the Scottish people might be in terms of alternative generation technologies. Instead, the strategy repeatedly emphasised the need for a consistent message about energy consumption to be given to the Scottish population, as if a lack of clarity around this message were the only obstacle to publics behaving consistently with the policy aims.

The strategy was almost immediately criticised by civil society coalition 'Stop Climate Chaos Scotland' as having been rushed, noninclusive and uninnovative:

> *"What we need is a comprehensive strategy, but what we currently have is a list of activities – almost all of which are already happening……the fact that this strategy has been largely prepared behind closed doors, with no formal engagement with other stakeholders and the general public, does little to encourage us of the Government's approach. Their process for preparing this Public Engagement Strategy has, ironically, been neither very public nor very engaging."*
>
> Tom Ballantine, Stop Climate Chaos (Stop Climate Chaos 2010)

This unsuccessful exercise has since been superseded by the Low Carbon Behaviours Framework, which I discuss in the next section. Nonetheless it is appealing to conclude that the default position in imagining a low-carbon Scottish public has been one in which the public needs to be educated into better habits of consumption.

4.2.3. The Scottish Government - Science Centres

Finally, in contemplating publics to be enthused, I turn to the core science engagement work funded by the Scottish Government. The Scottish Government's Science and Society Unit is one of three Offices of the Chief Scientific Advisor for Scotland whose responsibilities cover all scientific areas with the exception of environment and health (areas that have their own advisors). In 2010 when this project started, the post was held by biologist, Professor Anne Glover (now Chief Scientific Advisor to the President of the European Union); at the time of writing the post is held by computational scientist, Professor Muffy Calder. Professor Calder is supported by two teams in her remit to champion science, promote excellence in science, promote the use of scientific evidence in policy and "….develop better engagement with science by society…." (TSG 2013c). One team focusses on science in government and the other on science in society; it is to this latter team that I turn now.

In addition to providing general ministerial support, the Science and Society Unit aims to make science accessible to the public through two main routes: support for key stakeholders[3] and through a responsive grant-giving scheme ("Talking Science"). Much of the work involving 'key stakeholders' has an emphasis on school-aged children with schools as mediators, and consequently falls outside the scope of this thesis. However, the science centres are a core component of the Scottish Government's science in society network. In Chapter 6 I describe more fully what kinds of participation are facilitated in science centres. Here I discuss the kind of publics they invite and create.

Perhaps the first thing to be said is that as a visitor attraction, science centres do appeal to visitors on an individual rather than collective level, and people tend to visit for a 'day out' rather than as a way to learn about any specific topic. In this sense, they are a broadly cultural activity, albeit with potentially significant scientific content. In observing and speaking to science centre visitors, two things stand out. The first is a sense of fun, enjoyment and interactivity, even if visitors feel the centres are geared more towards young children. At one science centre, I talked to a couple who had come along with both of their children. They said that they felt that their children were too old for the science centre, but had chosen this as their day out rather than the Riverside Museum on the opposite bank of the Clyde. "Which are your children?" I asked. They pointed to their 19 year old son who was engrossed in an optical illusions skittles game, and at that moment their 17 year old daughter tumbled out of the chute of an Alice in Wonderland exhibit at our feet.

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[3] 'Key stakeholders' in this context includes operational support for the core science communication infrastructure in Scotland reaching hundreds of thousands of people. This includes: core funding for science centres, facilitating support for science festivals, and funding for engagement activities administered by the British Science Association and by the Institute of Physics

The second theme becomes visible in asking visitors what other leisure activities they choose, and why they have chosen the science centre. Whilst it is primarily a day out, some value is attached to the worthiness of science; visiting a soft play area within a science centre is seen as quite different from soft play on its own. As the centre staff see it, "....in many ways that's what this place is about ..... we try to engage people in the science and to entertain them as well so they can have a fun day out but come out of it with that added value..."(SCI-CEN01). This view is also reflected by visitors: "...there is something important about science and science centres, if you can get half play and half learning that works..." (INT-PUB06), "....Children haven't stopped ... feels like they've done something worthwhile at the end of the day...." (INT-PUB14) and "....the children are learning all the time as well as having fun...." (INT-PUB13). This idea of worthiness is important to the Scottish identity, an argument further developed in section 7.4.1.

Exhibits in the science centres are generally aimed at children, although Glasgow Science Centre has exhibits aimed directly at adults, such as *Science in the Dock* or *Transformative Medicine*. In tackling the ethics of science (such as use of animals in space travel or organ transplantation) or cutting-edge medical research, the exhibitors aim to engage more critical reflective skills of adults. However, this type of exhibit is highly unusual, and there were no equivalents at any of the other centres. Rather than developing expensive exhibits with a long lead-in times, science centres rely on other mechanisms (such as Cafés Scientifiques or Evening Events) to engage adults in ways that run deeper than simply support seeking. However, the public that attends evening events is generally not the same one that visits a centre with a family, and in this sense parents can become bystanders in the experience.

Another significant point of exclusion is that science centres commonly have prohibitive entry costs; in June 2013 a family day ticket cost £17, £24 or £34 depending on the location. Such cost inevitably excludes certain parts of the population. One policy initiative offered a free minibus service to science centres for more rural populations that might not have their own transport.

Surprised at the lack of take-up of the scheme, it does not seem to have occurred to these policymakers that people who did not have transport may not have the disposable income to purchase an entry ticket. Not everyone can afford to be part of this particular enthused public.

Across section 4.2 the idea of the 'enthused public' has emerged, as a public drawn together into ill-defined bodies of people purely through the imaginations of engagement practitioners. There is something fundamentally problematic in considering enthused publics as members of a citizenry, primarily because they lack the opportunity and capacity to exercise their citizenship. When policy or engagement specialists imagine these publics there is little sense that they are anything more than an homogenous mass of lay individuals to be convinced (e.g. by the RSE), educated (e.g., by the Scottish Government), enthused and entertained (e.g. in science centres). The limited role of passive publics in a consideration of scientific citizenship is something that I return to in my conclusion, (section 8.1.5). Now, to continue with archetypes of publics that have emerged from the field work, I move on to a discussion of publics as consumers.

4.3. Public as Consumers

A second archetype to surface is a 'public' that is related to consumerism and patterns of consumption. This is not a new phenomenon, and a blurred line between citizen and consumer in relation to science has been previously noted (Michael 1998). The contemporary accounts that emerge in this context extend this work by asking key questions around the implications of conflating publics with consumers in the context of citizenship, and critiques have pointed to the one-dimensional nature of the citizen when treated in this way (critiques of this kind can be found in literature associated with New Public Management, e.g., Aberbach & Christensen 2005, Pierre 1995). Here, I will take what Schudson (2007) has described as a 'postmoralist' position, which challenges the association of political behaviour with public-spiritness in

contrast to consumption as being inherently self-interested. I draw on discussions of cultural citizenship (e.g. Stevenson 2003), in which the public can be considered in a collective sense through a lens of identity, reflecting on how important identity is in group behaviour and how the market can mediate a sense of 'self'. The examples are also described in light of my argument that all conceptions of membership encounter difficulties of exclusion, which I develop in the light of persisting and convincing critiques that consumerism is exclusionary on the grounds of economic and cultural capacity.

In this section I describe three areas where this type of approach can be seen. Firstly, in section 4.3.1. I discuss how the Edinburgh International Science Festival as a collective manifestation of public engagement relies heavily on a concept of the public as cultural consumers. Next, through the examples of Whitelee Windfarm Visitor Centre and the Electric Garage in Glasgow (section 4.3.2.), I look at instances where commercial manufacturers/developers have extended their scope of activity by moving into facilitating broader public engagement with science. In these facilities, Scotland's two market leaders in energy have public exhibition spaces providing the possibility of interacting with renewable energy technologies and experts. Finally, I consider how the Scottish Government's low-carbon public engagement strategy has been replaced by a 'low-carbon behaviours' framework operated through Greener Scotland (section 4.3.3.). In the move away from key messages and supportive publics seen in section 4.2.3, the Scottish Government has chosen to interact with the Scottish public through its modes of consumption (of water, white goods, transport and food etc.).

4.3.1. Edinburgh International Science Festival

The modern science festival originates in economic development not in science communication, and its roots can be traced back to the widespread deindustrialization that took place across the United Kingdom in the 1980s. Glasgow in particular suffered as heavy industries such as steel and

shipbuilding left the area, lowering employment levels and local income. This resulted in high levels of derelict land and stagnant buildings, which the city council had no funds to develop. To stimulate inward investment Glasgow embarked on a public relations campaign in 1983. Called 'Glasgow's Miles Better', the campaign explicitly sought to reposition the city as a tourist destination and site of commercial development. It is regarded as one of the earliest and most successful attempts to rebrand a city, and won a number of domestic and international awards. By the late 1980s the success of the project was becoming evident, exemplified by Glasgow hosting the 1988 Garden Festival, and becoming 'European Capital of Culture' for 1990.

Edinburgh – Scotland's capital with a great tradition in art, architecture and literature – had long regarded itself the centre for culture in Scotland. However, with Glasgow taking on the new moniker along with its economic regeneration, Edinburgh is said to have had something of an 'identity crisis' (OISF 2012). The Edinburgh city council searched for its own differentiator and decided to consider itself a City of Science. This was far from a random decision - the Scottish Enlightenment birthed a disproportionately large Scottish contribution to British science and engineering well into the 19th century, led by Edinburgh figures such as James Hutton, William Murdoch, James Watt, James Clerk Maxwell and Lord Kelvin. Indeed, Voltaire said, "….We look to Scotland for our ideas of civilization….", and from Churchill, "….Of all the small nations of the dearth perhaps only the ancient Greeks surpass the Scots in their contribution to mankind….".

So, rooted in the past but reflecting the local capacity of a wide base of research institutions and university departments, Edinburgh as a City of Science made sense, and communicating this image through a festival was seen as a natural step. In 1989, when the inaugural Edinburgh Science Festival took place, Edinburgh was already home to a lively festival scene: the Edinburgh International Festival and the Fringe (founded 1947), the Edinburgh International Film Festival (1947), the Edinburgh Military Tattoo (1950), the Edinburgh Jazz and Blues Festival (1978) and the Edinburgh

International Book Festival (1983). This celebration of science through a festival offered an opportunity to extend the Summer-focussed tourist season into Spring, and the Edinburgh International Science Festival (EISF) has taken place annually in April since 1989 (Gage 2001, OISF 2012). This first science festival was regarded as such a success that the concept has spread throughout Scotland with science festivals now taking place in 15 different locations, with recurring events in Orkney, Inverness, Aberdeen, Fife, Edinburgh and Glasgow.

Consequently, even the earliest forms of science festivals reflected a variety of audiences – those with an existent interest in science (e.g. the British Association) and those for whom science was an activity to be consumed, offering a point of engagement with the locality rather than just the subject matter (e.g. the EISF). At a practical level the science festival has always been more than simply an addition to a public relations repertoire (whether for science or a city). Science festivals pose quite specific challenges and one representative describes a shift in attitudes towards science in culture, "… the public wouldn't go to a science festival because they thought they were a bit weird - 'how dare you put the word science and festival together – what are you thinking of?'….. that's gone now because it's become part of the landscape…" (INT-FES01). This positioning of science in culture is an important theme in this thesis, and becomes a nexus for analysis in section 7.5.1. However, the change in attitude this respondent describes is not unanimously shared, particularly amongst local (section 7.2.1) and national (section 7.5.1) arts organisations.

One of the immediate areas of potential exclusion in thinking about science festivals is based on economic capital. The bigger, more established festivals in particular do tend to be more expensive than local events, with some ticket prices up to £35 and median ticket prices c.£8/£6. Detailed profiles of the socio-economic backgrounds of festival participants are generally unavailable, and such analysis does not form part of any current festival evaluation. However, it is reported that the visitor profile of the Edinburgh spring festivals

(which includes the Edinburgh International Science festival) is 80% ABC1 socio-economic group, that is – lower to upper middle classes (ETAG 2009). The barriers raised through pricing strategies are familiar to festival organisers:

> *"…yeah I mean most people that pay for a ticket to go to a science festival are middle class, that's - you know - no surprise there. That's why we do things like put photographic exhibitions in public parks or put events in shopping centres so …you can choose the demographic by your location and by your ticket price."*
>
> INT-FES01

In acknowledgement of this economic exclusion, wider involvement is achieved through the 'Generation Scotland' touring schools programme, where the under-18s element of the programmes can be much more specific and pro-active in reaching different audiences, as interviewee INT-FES1 commented, the class misbalance is 'compensated' for through a schools tour, "….you can choose your demographic very precisely by choosing the postcode of your school and we do a lot of free shows in places where people wouldn't ordinarily consider coming to pay for what we do…" *(*INT-FES01). Here, there is recognition that using modes of consumption to generate a public leads to some being excluded on grounds of financial capacity. However, the mitigating strategy that seeks to redress this exclusion is at best partial, drawing on further public funding to take a road show in to schools (excluding adults) in areas that are chosen on geographical and socio-economic terms. In Scottish policy, geographical exclusion is very visible.

In recent years, the Scottish Government has run a responsive public engagement grant scheme, administered by the small Science and Society team as part of the Office of the Chief Scientific Advisor. Historically, this grant scheme funded more infrastructural and youth-focussed elements, such as additional funding for science centres and support for 'Generation

Scotland'. In 2012 the scheme underwent a significant change. Infrastructural activities were reassigned as 'key stakeholder' activities and the remainder of the scheme was re-focussed on delivering science engagement grants into areas not located near a science centre (typically rural areas) or areas that in some way were considered disadvantaged (as defined by geographically-based socio-economic indicators). This emphasis applies to both the audience in mind and the actual location of the event, and is part of a concerted effort to bring the opportunity for science engagement to as much of Scotland's population as possible. As a policymaker in this field explained:

> *"Those are probably the two big axes we're looking at for gaps and people we're struggling to reach – geography and socio-economic deprivation. That's why we use a mosaic of different approaches – centres, festivals, Talking Science, key stakeholders. There will be some gaps but the reach is better. Not like-for-like everywhere but you are at least getting something out there and reaching people…trying to get people connected to science in some shape or form."*
>
> INT-POL03

So, here is a public that is imagined largely in geographical terms – whilst there is certainly an awareness that different socio-economic or identity groups might be reached differently, this is not the overriding discriminator in managing financial support. This strategic approach to geographical spread is unusual in the United Kingdom and might be said to stem directly from the national focus available to the Scottish Government. Unfortunately, this conceptualisation of a national public does not in itself overcome the many challenges of getting the 'right' people involved in the 'right' things at the 'right' time; this is of course the focus of this thesis and lends support to the proposition that facilitating a citizenry is a more complex affair than reaching a public.

Whilst there was some encouragement from the Scottish Government for projects that contributed to contemporaneous themes of Women in STEM or the Year of Natural Scotland, *Talking Science* is essentially responsive. It aims to provide some opportunity for science engagement throughout a geographically dispersed population. 'Bottom-up' initiatives - where 'audiences' have or will help define the focus of the work – are encouraged but in essence any theme is considered. The Science and Society Unit is not involved in promoting any particular agenda beyond the Scottish Government's strategic objectives for making the country wealthier, fairer, healthier, safer, stronger, smarter and greener. So, its ability to underpin any particular policy area, including Scotland's transition to a low-carbon economy, is manifest in the content choices made by science centres, festivals, key stakeholders and grantees.

4.3.2. Whitelee Windfarm and the Electric Garage

Beyond the public engagement specialists enabled through Government support, there is another field of actors who influence consumers: corporations. Whitelee Wind Farm, opened in 2009 and located 30km south of Glasgow City Centre, is the UK's largest onshore wind farm with 215 turbines totalling 539MW capacity. It is owned by ScottishPower Renewables and the site, open to the public, comprises a small visitor centre managed by Glasgow Science Centre. The visitor centre is home to an interactive visitor space with exhibits geared towards climate change, wind power, the low-carbon credentials of onshore wind and considerations that are taken into account when choosing sites and designs for an onshore wind energy development. Visitors also enjoy the 25 sq.km managed habitat, which has 130km of trails for foot, bike or horse, and an electric bus that offers guided tours. The affective experience is quite striking as captured in this extract from my fieldnotes:

It is an impressive site – a calm, wide vista of undeveloped countryside that is open enough for one not to feel crowded by the many turbines. Even though you are actually quite close to the turbines the countryside is so wide that they lose some of their scale, and in quantity they stretch as far as one can see. I don't think I would ever be able to get so close to a turbine anywhere else, but here you can actually stand under them. I went on the tour on the bus (diesel, as the electric one was disappointingly out of action) and the guide shouted a lot of positive information about the site, the technology, the habitat. What I actually wanted to know was whether the methane released by digging up the peat beds was factored into the carbon credentials but I didn't want to seem like a spoilsport, everyone was having such a nice time!

Fieldwork Notes, OBS16b

This inability of publics to fully express themselves in this kind of setting is a theme I return to in discussing science festivals. However, the visitor centre does not just attract supporters. Opponents of the wind farm have also sought to use its exhibition space as a source of information, but to discredit its credentials. When I was at the visitor centre the manager recalled one particularly sceptical man who visited often enough to become a regular:

… I was told about a man who would storm into the visitor centre every morning, and he did this for about a year. He would come in, refuse to engage with any of the staff but write down the live output display in a notebook he kept for those purposes…

Fieldwork Notes, OBS16a

The purposes of the visitor space are multiple; such a leisure experience enhanced by informational and affective experiences addresses many of the

issues of dissent described in section 2.2 when I examined some core reasons for public opposition to onshore wind. One can do a quiz asking what the 'carbon payback' period of a turbine is, one can see the live output level on a display, or choose where to place turbines within a scale model development (quickly learning that the spots for maximum wind speed are often expensive and difficult to access for construction purposes). The openness of the farm also sends an important message countering views that the countryside is being 'industrialised' or made into *wind factories* rather than (the perceived euphemism) *wind farms*. An example of these alternate framings can be heard from a frustrated reader writing to the Herald Scotland:

> *"...As a matter of interest, why are they called windfarms? They are certainly not farms – they don't produce crops or animals. A more accurate name for them is wind factories. Each turbine is a small industrial area, with roads leading up to it and concrete and metal structures in place, grinding out an industrial product (on the rare occasions that it can). No other industry would be given permission to build factories in a rural area that depends on tourism for its main income..."*
>
> Herald Scotland (2011)

Clearly, the physical presence of the turbines can evoke strong reactions. Back at Whitelee, the majority of visitors are aged 60 or over, an unusual demographic in public engagement, and it is interesting that it is through their leisure choices (countryside) that they have learned about technologies that they might never have otherwise encountered.

The Electric Garage (opened 2011) on Waterloo Street in central Glasgow occupies the ground floor of SSE's 'Scottish Hydro Centre for Renewable Excellence'– the company's technical hub. Like Whitelee Windfarm, it is an operational site with a visitor space attached to draw in a generally curious public. At the Electric Garage, people will be able to charge their vehicles for free in a series of bays on the street, test drive an electric car or bicycle or hire

one for a couple of hours or the day. It has a very different feel to any of the other mechanisms whereby one might engage in low-carbon technologies. As I noted in fieldwork notes:

> *The thing that struck me about the Electric Garage is that it's very grown-up and very funky. It is right in the middle of Glasgow and has a large glass wall so you can see the vehicles … it's a little like a showroom. The cars were great – really cute little Peugeots and very enthusiastic and open staff who could chat effusively about how the cars worked, where the energy came from and what the future plans for the site were. It was really refreshing, to be talked to as an adult and have something practical that one could do … even if it wasn't necessarily affordable long-term!*

Fieldwork Notes, OBS17

In the visitor centre, people can wander in freely and interact with exhibits about balancing the energy mix and numerous kinds of renewable technologies (focussing on wind and hydro – consistent with SSE's activities - but covering other technologies too). As SSE's website puts it:

> *"Our exhibition centre aims to educate both young and old about the benefits of renewable energy. We'll explore together the many different means of energy capture along with the process from source to distribution. This is a unique opportunity for schools and the public to* ***get a direct insight into the renewable revolution."*** *[emphasis mine]*

Scottish Hydro Centre, 2013

These two examples return in Section 6.4.3 in an analysis of modes of engagement, when I will highlight that at the time of fieldwork these (corporate) facilities offered interactive engagement spaces on the topic of renewable energy that were not available in any of Scotland's science centres

at the time. Before leaving the examples though, there are two pertinent points to raise about the kind of publics being reached.

The first is that this public is active and engaged, in the sense that the public comes to the company rather than the company approaching members of the public to discuss renewable energy. What they might be engaged with differs – at Whitelee this can be how the technology fits with the natural environment and what it looks like up close, at the Electric Garage this might have more of a product focus, early adopters wanting to explore new technologies coming into the market. What they have in common (in this conceptualisation) is a pre-existing capacity to engage in some of the context about energy production, an interest in doing so and an understanding of some of the complexities and challenges in implementing low-carbon technologies.

In this sense, the public that is imagined is relatively empowered and in possession of some critical skill. In return, this public is expected to embrace the technologies at hand, and perhaps become an adoptee or even an advocate for the technology and, of course, the brand. Here, there are commonalities with the idea of the enthused public, and the idea of publics as consumers is unavoidably open to critiques of instrumentalism (Stirling 2008). On the other hand, and as a progression beyond the passive enthused public, consumerism can be argued to facilitate identity development through increased facility for stylisation (Michael 1998). That consumers can act as advocates for particular choices lies at the heart of the area that follows – Greener Scotland's low carbon behaviour framework.

4.3.3. Low Carbon Scotland: Behaviours Framework

When discussing less empowered publics whose primary purpose is to be enthused, frequently subject to PR campaigns promoting technologies, I referred to the 2010 Low Carbon Scotland: Public Engagement Strategy, which did not gain a great deal of traction. Indeed it is difficult now to find any policymaker prepared to take ownership of it. Quietly forgotten, it has been

replaced by the Low Carbon Scotland: Behaviours Framework (TSG 2013a). This wide-ranging framework has at its core a set of ten key behaviours it wishes to promote to the Scottish population: keep the heat in, turn the temperature down, use energy efficient appliances, install a more energy efficient heating system or micro-generate, use your car less, drive more efficiently, avoid flying, avoid food waste, eat a healthy diet with seasonal fruit and vegetables, reduce and reuse. Around half of the ten key behaviours rely on buying new goods, as seen in this extract from the promotional material on the following page.

A policy lead in the area described the ten key behaviours as being consumption-based, acknowledging that some will, "…impact on production emissions but they're about what households consume. Obviously production emissions are a target because that's what we've signed up to internationally but if we want to impact on climate change we need to look at consumption too…" (INT-POL02). There is some recognition here of the 'doublethink' involved in promoting new consumption in order to reduce overall consumption, but none on the ways different populations will experience these behaviours differently.

Figure 1. Low Carbon Scotland Behaviours Framework (TSG 2013b)

Again, this revised strategy speaks to a public only on the grounds of the choices they make rather than opening up any strategic questions about where electricity comes from. I should add that these individual- or household-based behavioural targets focussed on consumption behaviour are one element of a broader framework that extends into civil society. Communities can be supported directly through the £10M Climate Challenge Fund programme (see section 6.4), and there are direct links to civil society through the Low Carbon Networks, a business engagement network and a scheme of demonstration pilot projects. Greener Scotland is also advocating use of the "ISM Tool" within government and with NGOs and civil society. The ISM tool (from behavioural change consultant Andrew Darnton) supports a model of behaviour change that operates on three fronts: individual, social and 'material' (where material in this instance refers to infrastructural capacity for, for example, recycling). It recognises that individuals need to be aware of the opportunity and need for change, that social norms and communal practices shape behaviour and that new behaviours cannot be sustained without a facilitating material infrastructure.

Nevertheless, the mode that the Scottish Government have chosen to relate to the Scottish public is consumer-based and does not offer any other options such as more participatory techniques. They could, for example, have run dialogue events to realise and empower a public that could help develop decarbonisation strategies, or perhaps have taken an approach of cascading carbon mitigation targets to specific communities for a more bottom up approach. So, whilst this latest framework from the Scottish Government is certainly not rooted in a 'public understanding of science' approach to publics, it is still relatively unidirectional, and limits the agency of the public to the choices they can make as consumers. With climate policy targets firmly in place, one supposes this public can only ever be *enactors* of policy, rather than *co-creators*.

One of the principal arguments I have made in this section relates to the idea of the public being consumers, a framing now prevalent even outside the

market. Unsurprisingly, the consequences for a public treated as consumers by policymakers have many parallels with the same treatment by corporations. Both invite criticisms of limited agency and exclusions based on financial capacity. However, a closer reading reveals that these same critiques can be made about the enthused public.

For an enthused public, agency is limited by type and nature of event on offer and a carefully controlled interaction between 'audience' and 'expert'. The audience has very limited capacity to shape programming and the emphasis on enthusing naturally casts the expert as a mediator of wonder and knowledge. Equally, there are exclusions in operation here as I outlined in section 4.2., operating on financial and cultural terms. However, I have also highlighted some ways in which membership is built and maintained through consumption – through the dual process of identity building and stylisation. The choices that members of this public make, in common with other members, build a shared identity that forms the basis of a membership. When combined with the economic power that is exercised (for example in building a market for hybrid cars and charging infrastructure), one can envisage how a citizenry might emerge.

In this section I have highlighted some low-carbon transition projects in which the public are considered to a significant extent in terms of their capacity as consumers, largely of products but also of energy. The examples have come from both the private sector (through expanded marketing strategies and new products), but directly from policymakers, embedded in the science communication landscape. Both the public as consumers and the enthused public invite a reading of instrumental use in 'top-down' approaches, where a powerful actor seeks to enrol a public for some particular gain (although I will offer an alternative reading of this in Chapter 7). Next, I consider what happens when publics resist enrolment – where they seek to reframe proposals and relocate the fundamental nature of problems and together emerge as the membership for which I have used the label 'counterpublic'.

4.4. Counterpublics

Before embarking on an account of what I am calling the 'counterpublic' following Robert Asen, Nancy Fraser, David Hess and Michael Warner (see section 2.1.5.) I will extend their work beyond the vision of counterpublics as the unique perspectives of marginalised groups (e.g. Fraser 1992), particularly those that draw on 'subordinate social positions' to counter official science policy (e.g. Hess 2011). I will locate my analysis more along the lines of work that proposes counterpublics as emergent groups who position themselves against wider publics (e.g. Asen 1990), or more specifically those that are "….formed by their conflict with the norms and contexts of their cultural environment…." (Warner 2002:63).

In section 2.1.5. I highlighted how the idea of counterpublics had been extended beyond its original terms, and I hope to preface my use of the term to signal that publics cannot be superficially labelled as inherently 'pro' or 'con'. Instead, this can perhaps be better understood as a question of competing visions of what is effective as a *socially-sustainable* low-carbon technology. Through this section I draw on two publics that are both positioned as being 'counter'. However, a key point to note is that the oppositions that characterise these counterpublics are frequently accompanied by arguments that are not objecting to low-carbon technologies *per se* (for example when opponents of onshore wind object primarily to the subsidy regime), or are promoting what are considered more sustainable alternatives (for example when No Leith Biomass promote local, community energy in place of an international woody biomass plant). This is a tension I return to in section 5.4.3. on the nuances of 'opposition'.

I aim in this chapter to extend and apply existent work by bringing into view the political summoning of wider publics who are drawn as a rhetorical device to frame a group of actors as a counterpublic. I bring commercial organisations in here as a point of tension in addition to wider publics and official policy. So, I put forward the idea of counterpublics in the spirit of Asen's and Warner's approach, firstly by using the example of onshore wind

development to critically explore the 'wider public consensus' that counterpublics are said to work against, and secondly by looking at proposals for woody biomass plants to show that counterpublics emerge around commercial socio-technical assemblages, as opposed to countering only 'official' or 'consensus' positions. Through this reading I aim to maintain an openness towards the often nuanced position of counterpublics and to avoid reifying the idea of them as exclusively oppositional (and therefore amenable to being sidelined, as I discussed in the context of NIMBY framings in section 2.2.3).

The counterpublic differs from the other publics I have proposed in its emergent rather than created nature. Whereas enthusiastic supporters and consumers can only engage with an opportunity that is made available, a counterpublic seizes its own opportunity on its own terms and evokes a 'public good' that is counter to the prevailing view or official position. Counterpublics form around particular topics or arrangements, so specificity is important. This means counterpublics often possess significant amounts of knowledge, and this can be brokered by intermediaries looking to facilitate and scale-up opposition. It is difficult for anyone – including expert advisors – to remain 'neutral' when a counterpublic has emerged, because of the very fact that the issue is considered to warrant enough attention for a public to have emerged around it.

Although the attention I draw to implemented technologies often brings commercial actors into view, this is a qualitatively different concept from a public being imagined from without as consumers. Here, there is a rising from within - a group of people claiming a greater public good. It is the enrolment of a wider group of concerned people and their wider arguments that makes this a 'public' as opposed to a closed group - it "….comes into being through an address to indefinite strangers…." (Warner 2002:86). The individualistic, rational consumer discussed in section 4.3 can indeed be instrumentalised whilst they can be accessed through patterns of consumption. Here, counterpublics pursue a normative role (Stirling 2008) to – for example -

control the shape of the market by bringing policy and public attention to the detrimental effects of a particular proposal.

In turn, the counterpublic can illuminate further new publics that have previously been invisible, either because they lie outside the 'policy boundary' (e.g. global publics out of sight) or because they have not yet come into being, either literally or metaphorically. It is this 'latent' public – future generations - that is commonly brought to the forefront of climate debates, sometimes juxtaposed with current economic interests that are said to serve a current – more visible - public. Counterpublics can also expose and challenge the fundamental values rarely discussed in public debate. A wide range of interviews, observations and documents show that a real challenge to the *scale* of consumption only comes from within civil society.

The two cases of counter publics that I offer in this chapter are specific to the Scottish context and offer different – but related – insights. The first is the thorny issue of local opposition to onshore wind, a counterpublic frequently criticised as self-serving and trivial in the face of significant distributed climate challenges. In that case, I show that resistance is rooted in something more than aesthetic distaste and introduce the idea of materiality and its effect on public response. The second case – on the proposed Leith Biomass plant – highlights how a range of small social groups coalesced to share knowledge and raise their visibility as a public. It shows how going beyond a superficial reading which has their 'countering' grounded solely on aesthetic distaste, brings into view the impact on a distant public, otherwise left invisible.

4.4.1 The Counterpublic Opposing Onshore Wind

Precursors to studies of public attitudes to onshore wind often start from the basis that despite reported public support for wind energy at 80% (DTI 2006), only a quarter of contracted wind power is actually commissioned (Bell, Gray and Haggett 2005). It is interesting to note that a good deal of the research relating to public attitudes to renewable energy (for example in section 2.2.)

seeks to explain this gap by exploring oppositional publics, yet there have been significant incentives in the policy environment to encourage contracted capacity even in the absence of commissioned plant.

To start, there is something of a paradox around renewable energy in the UK – surveys indicate widespread support for renewable energy but planning proposals often meet with public opposition when they start to move through the planning system. Section 2.2.3 showed how this is often explained in terms of 'NIMBYs' – a pernicious framing of a particular counterpublic that is not convincingly substantiated in practice. Aitken (2010b) in particular has highlighted that at the foundation of the dismissal of opposition as self-centred NIMBYism, is the view that widespread public approval pre-exists. Without this, opposition is not deviant and therefore does not need explaining. Here, I would like to bring in the "generally supportive public", constituted through surveys, that has to be invoked to be able to talk about counterpublics in this context at all.

Views of Scotland is a web-based campaigning organisation that tackles this question head on, has looked at oft-quoted surveys to evaluate whether they are conducted properly and whether the conclusions and headlines are robust enough for the purposes to which they are put. For example, when critiquing the government's flagship attitudinal report (Scottish Executive 2000) they found that no consideration was made for whether respondents currently lived within sight of a turbine, whether they were employed in the sector and what local environmental issues were currently in play, and one survey target was the location of Europe's largest opencast coal mine (Views of Scotland 2003). My point here is that the confidence with which we can discuss counterpublics must include a challenge as to how robust the prevailing consensus position actually is.

Section 2.2 of the theoretical grounding considered a range of reasons that cause publics to oppose onshore wind capacity, and how a NIMBY framing of opposition based on aesthetic reasons is something of a caricature. In Scotland

there are similar complaints. Alongside concerns that the new jobs promised by onshore wind development are frequently short-term and unsustained, opponents note that the number of turbine applications in the consent system vastly exceeds Scotland's total electricity demand, pointing to the role of onshore wind in providing flexibility to the grid in times when generation exceeds demand. This, they feel, is a mismatch with government incentives that reward capacity (not generation), leading to a 'windrush' of turbines often in areas of visual sensitivity (Views of Scotland, undated). Scale (of both individual and collective developments) and rate of development are important influences in the way publics have engaged with this particular technology. As an energy activist commented, "…none of these large scale technologies will deliver social justice. We need smaller scale, much more local developments, people living more local rather than more global where they don't see the consequence of their consumption…." (INT-CIV05). These important questions are far removed from processes of land planning for renewable energy technology development; in fact, the only other place these kinds of questions on consumption arose were in the work of the Church of Scotland, discussed in section 6.4.1.

Onshore wind development proposals present a host of other provocations for interested publics that are connected with its physical form, and a survey of local opposition websites indicates concerns as to size, number, colour, proximity to housing, flicker, concerns as to health effects from low frequency vibration, effect on local bird populations and feasibility of access for components during construction phases (for examples, see the library of resources hosted by campaign group Scotland Against Spin, 2014a). At the root of these concerns is not a question of public belief or scepticism around anthropogenic climate change, or a question of support or opposition for renewable energy, it is the wide range of physical characteristics of developments that becomes subject to response, debate, dispute and negotiation.

Many of these issues are contested and open to debate, they point clearly to a range of concerns that can only be negotiated when a sufficiently material proposal has been made. This materiality – the physical and spatial arrangement of a (proposed) technology *in situ* – is precisely what causes the public to emerge. Without specific parameters to engage with, publics would remain diffuse being constructed perhaps by policymakers or others. To further explore this idea of how materiality causes counterpublics to emerge I turn to a second example – that of woody biomass.

4.4.2. The Counterpublic Opposing Forth Energy Woody Biomass

However, activists do sometimes act outside the formal debate and negotiation processes on projects that they feel are particularly unwarranted, destructive or symbolic. In 2010, Forth Energy proposed a series of proposals for electricity-only woody biomass plants that would be situated in Scottish ports at Dundee, Grangemouth, Leith and Rosyth. Since their inception, the proposals received objections on multiple grounds covering local, national and global concerns: in particular the Leith proposal became the focal point for organised protest. Reasons for opposition were manifold: the plant was said to be too big and too close to residential areas (Edinburgh News 2010), there were arguments that the proposal would not deliver a net reduction in carbon dioxide emissions, that heat would be wasted, and that 24,000 tonnes ash would be produced each year and would have to be removed by road transport. In addition, critics noted that the majority of 1.3 million tonnes of fuel needed would be imported, leaving areas of deforestation and forced eviction (Scotsman 2010).

Local campaigners and community groups (such as Grangemouth Community Council and No Leith Biomass) have been backed by national organisations such as BiofuelWatch. In May 2011 a group of protesters (who called themselves Action Against Agrofuels) successfully stopped access to the

Grangemouth plant, with around 30 people forming a human chain and one protester chaining himself to a scaffolding tripod. The protesters' claims focussed on the unsustainable nature of woody biomass and called for the Scottish Government to declassify it as a renewable energy resource. Seven people were arrested for obstruction (BBC 16 May 2011). In 2012, Forth Energy withdrew plans for the plant at Leith (on stated grounds of the port's redevelopment (Forth Energy 2012)), a decision heralded by the local community and the 1800 residents and bodies who had objected (Friends of the Earth Scotland 2012). At the time of writing, proposals for the other three plants remain live and are subject to vociferous debate and general opposition.

One interesting aspect of the counterpublic is the way they often invoke other publics in making their case. In particular, civil society can be more adept and less constrained than policy and commercial actors are in speaking for or about other publics located elsewhere. Just as boundaries and residency have posed a challenge to classical understandings of citizenship, the question of which publics are made visible and invisible challenges ideas of scientific citizenship. This becomes more pronounced as socio-technical innovations make the transition from abstract idea to concrete application, where existent and latent publics are affected but who fall outside any governance process or political realm. We can see an example of this in the example of proposed woody biomass plants in Scotland. Opposition is not confined to local issues of material arrangement, but also brings light to the impact of deforestation on the source country. Without a civil society voice (and in the absence of any substantive corporate social responsibility), this impact would remain outside the remit of any governance processes. Instead, campaign group No Leith Biomass build a robust argument against a number of material parameters of the proposals, and the real effects felt across the supply chain:

> *"Large scale biomass for energy production is not sustainable: the demand for wood supplies to feed the rapidly increasing number of biomass plants in the west cannot be met by suitable supply. Forth Energy's stated aim of using only certified renewable wood cannot be assured, as organised crime and illegal logging are rife, and 'p*olicing' of certified sources is weak. *Globally, the rush to biomass is emerging as a major cause of land-grabbing and deforestation leading to flooding risks, evictions of indigenous people, human rights abuses, and threats to wildlife habitats and fragile ecosystems" [emphasis mine]*
>
> No Leith Biomass (2013)

This is not a case of objecting to renewable technologies, or an argument based on aesthetic grounds; rather, it deconstructs the project's renewable credentials by following consequences along the socio-technical network. In the context of this thesis on scientific citizenship, there are several interesting aspects to the Forth Energy case. The first is that citizens are clearly capable of forming around issues in an uninvited manner. The case that this thesis broadly makes – that active scientific citizenship has to at least *recognise* the actions of publics involving *themselves* in technoscientific issues – builds on observations that talking about 'public engagement' is a framing error that leads to restricted views of science in society (Wynne 2007).

The second is that the extended socio-technical network is crucial in understanding civil opposition, in a way that abstract discussions of publics and their attitudes to renewable energy cannot illuminate. What the No Leith Biomass campaigns shows is that this is not an attitudinal matter of supporting or opposing renewable energy. Instead, objections revolve around attributes that are specific to this proposal and reach beyond the symbolic towards the material – the kind of energy mix that is evolving, the nature of

the port's redevelopment and the practical consequences of this development for distant fellow citizens.

The third interesting aspect here is the role that direct protest is considered to take in the governance process, and what 'public' the protestors seek to represent and are seen to represent. Even as protesters and more active local communities bring considered and extensive objections to the decision-making process, their ability to act epistemically remains hampered. The influence they have is not confined to the nature of the objections they raise (which are given various weight and credibility depending on their nature and the confines of the planning process). Equally – or instead – they have a political role. As an interviewee from the Scottish Government's Planning Division commented, 'vocal groups' can impact the planning process by bringing attention to concerns, "….that can sway politicians and planning committees and it might be the difference on the decision or might make a difference on the developer themselves, more inclined to maybe look at mitigation if there's a very strong vocal group…." (INT-POL04). The impact is not always on the decision-makers. Sometimes, the pressure applied to the developer is enough to change the course of the project, "….Sometimes developers with a .. good case can pull out of a perfectly acceptable development because …… an element of the community's opposed to it - I wouldn't underestimate the power of a lobby group…." (INT-POL04). Clearly, activism can influence decisions and is an interesting reflection on the informal process of struggle activists engage in.

I have referred to different incumbents counterpublics are said to be 'countering'; here is a case where a counterpublic directly influences the commercial actor (rather than policy officials) to bring about change. In acknowledging the withdrawal of the Leith proposal, the interviewee points to the activist's role in applying pressure directly to the (commercial) project developer rather than on the decision-making process itself. There is no suggestion that planners see direct action as "unfair" or "cheating" as previous studies such as Hillier (2002:119) have suggested. This casts the policymakers

(manifest through the planning system) as mediators between private and public interests (in this case between a developer and a community) in a fairly passive way, in terms typical of the classical liberal democracy.

Activists themselves understand their symbolic role within the decision-making process. It is not a case that the process can be improved through their input, it is that fundamental injustice needs to be highlighted, and local communities are often unable to do this unaided. As one interviewee – an energy activist involved in direct protest - said, "....I don't think everyone could do this. The stage of my life.... I don't have a mortgage or children so I can do this. I understand other people can't so this is now my role in the bigger system...." (INT-CIV05). This points to the need for mobilising intermediaries which I have explored in an analysis of the differing roles activists play.

So here publics themselves can form and be instrumental in identifying and supporting other publics who may not previously have been visible in a public debate, and this idea that citizens can or should act on behalf of other publics is one I shall return to in Chapter 5. The idea that publics overlap, are fluid, and emerge around specific configurations is important in developing a conceptualisation of scientific citizenship (for example in the work of Marres 2005, Michael 2009, Wickson et.al.2010). Equally important are the multiple sites that can constitute a public emerging around an issue. This can cover scales that are local, national or global – publics that, in the context of climate justice, have conflicting demands and priorities. These kinds of conflicts are explored and analysed in an examination of 'rights' in Chapter 5.

This last area of analysis – on counterpublics – follows on from two previous conceptualisations that considered membership in terms of enthused publics and publics as consumers. In this analysis I have shown a progression from enthusiasm to consumption and then opposition. In this, I drew out a sense of increasing autonomy where publics rise up and coalesce around an issue, and a greater recognition of the material features of technoscience. Central to this

thesis is the argument that these two dimensions – emergence and materiality - are closely interdependent.

4.5. Conclusion

I began this chapter with the question, "*, how can we begin to conceptualise the territory upon which a scientific citizen can be said to be a member*?" as an introduction to the question of membership – that is, what might scientific citizens be members of? To answer this question, I have taken as my point of departure the idea that scientific citizenship transgresses national boundaries and can be conceived much more broadly than formal democratic participation in national policy. To understand this breadth though, the citizen needs to be considered as something more than an actor operating solely within the established bounds of a national democracy. In place of that, I approached membership through the idea that different actors implicitly represent and construct different ways of thinking about who counts as the public in public engagement with science. Each of these ways of thinking constitutes a particular vision of a public that might be invoked as 'scientific citizens' which on inspection have a stronger or weaker potential as a political community.

I propose three archetypes of publics that can be observed. From the RSE's *Facing Up to Climate Change*, the Scottish Government's *Low Carbon Scotland Public Engagement Strategy* and the Scottish Government's science centres emerged the idea of the enthused public, who need to learn or be educated into a sympathetic position in relation to scientific authority. The Edinburgh international Science Festival, Whitelee Windfarm, the Electric Garage and Greener Scotland's *Low Carbon Behaviours Framework* outlined a public characterised as consumers. And finally, examples covering public opposition to onshore wind and Leith biomass gave instances of the emergence of counterpublics, countering common and policy views of sustainable development.

These emergent publics open up the conceptual area of 'scientific citizenship' through two core dimensions which I will draw out for reflection, although I return to them more substantially in Chapter 7. The first lies in what membership can tell us about exclusion. Traditionally, reasons for exclusion might be external (such as rights of birth) and internal (such as qualification through gender, property, being law-abiding). I argued in the case of counterpublics that geographical borders do not sit well with ideas of scientific citizenship, given the normally global nature of the socio-technical network that surrounds new technology. Instead, it is the assemblage itself that becomes the terrain, where any and all participants might claim some citizenship sometimes through a quite distant impact (for example, in the No Leith Biomass example in section 4.4.2.). Internal exclusions are a much more flexible concept. I have discussed some of the socio-economic hurdles in place that can readily exclude certain people from some of the conceptualisations of publics discussed (particularly in light of consumerism in section 4.3), and I return to the theme of unintended exclusion in Chapter 6, as I explore modes of engagement.

The second aspect returns to the validity of using constructed publics to understand the membership dimension of emerging ideas of scientific citizenship. If citizenship is anchored in a political community, what are the political aspects of our publics? Although counterpublics visibly rise up to engage in debates within the public sphere, the political features of publics extend beyond their capacity for political action. The politics of publics (such as the enthused public) are also significant in the way they are 'made use of' by policymakers or opponents to navigate political stages – the rhetorical value of publics is therefore significant. And finally, the consuming public adopted as a preferred conceptual framing by the Scottish Government low carbon behaviours team reifies a number of stances that some might say should remain open for debate, such as the legitimacy of consumption and the neutrality of the market.

In this chapter I have shown that a consideration of membership is fundamental to any deep understanding of citizenship, and that this remains true for scientific citizenship. I have also proposed that *membership* in this terrain can most usefully be considered in terms of fluid publics, rather than in political membership or geographical location. I do not pretend that shadowy ideas of unstable publics makes them easy to identify, or to reach out to and establish relations with, but this difficulty is perhaps key to the idea of citizenship here. It is not the role of citizens to be reached; it is their role to shape the society they want to live in, including its carbon characteristics and technological shape. It is this foundation of citizenship – ideas of responsibilities and rights that follow.

CHAPTER 5 Normalising Scientific Citizenship – Rights and Responsibilities

Developing a means by which to discuss who is, and is not, a citizen is a critical step in moving debates of scientific citizenship beyond sweeping ideas that rely heavily on static concepts of political, national membership. Drawing on empirical data I have gone beyond ideas of nationhood as the only framing of citizenship, and put forward the idea of multiple, fluid publics that are constructed, imagined and emergent. I have drawn on the work of Bellamy (2008) to introduce an overall framework for citizenship that comprised three dimensions: membership, rights and participation. Having explored the idea of membership through the notion of publics, I now turn to the second of Bellamy's concepts. In this chapter I look more closely at what rights are established and given and at the processes by which these rights are claimed, challenged and shaped as the public itself evolves.

5.1. Concepts of Rights and Responsibilities in Scientific Citizenship

There are two aspects of rights and responsibilities that need revisiting. The first relates to the different approaches scholars have taken to the question of rights in citizenship, of which there are at least two distinct ones. The first approach (and the one to which the arguments in this thesis favour) involves identifying the rights and responsibilities that citizens adopt in order to be able to freely participate in the democratic process on equal terms. The second involves the rights that must be acknowledged if citizens are to award one another a fair and equitable status (whilst a law-making body ratifies these, rights are a result of the civic will, so in essence citizens award such rights to one another). This is the general direction that sociologist Bryan Turner takes (e.g., Turner 1993:162-190) and some nations are more amenable to rights as the central issue of citizenship than others.

The second point relates to the symbiotic relationship between the concepts of rights and responsibilities, and Bellamy (2008:13-15) outlines rights as collective goods in two senses. The first is that all members of society need the same opportunity to steer their own lives (indeed this is why rights has sometimes emerged as the defining characteristic of citizenship). The second is that a collective will is necessary in facilitating these rights. An example of this emerges from the public funding of scientific research, where citizens support research by paying taxes that funds the research in return for perceived benefits of enhanced quality of life, economic growth and stewardship of the environment. It is this approach to rights and responsibilities – as interdependent sets of expectations and actions – that I draw on throughout this chapter.

None of these approaches comes without difficulty, and the difficulties are near the surface. Such rights may be agreed in principle, yet in practical interpretation the values and preferences of individuals may come into conflict with one another, even under circumstances of apparently broad normative agreement. I find multiple examples of this here, especially when it comes to land use and considerations about who might be a stakeholder in those decisions. Add to which, in practice we see a proliferation of rights that are not necessarily complemented by clear obligations which leads to concerns that claims are increasingly devalued (e.g. Janoski 1998). Again, we see multiple examples of this throughout this chapter. The emergent discourse around 'accountability' is a good example.

Here I return to the interviews, observations and documents to identify and explore empirical manifestation of the theoretical idea of rights and responsibilities in the context of public engagement with science and technology. In particular, interview data have been especially useful as professionals engaged in public engagement practice frequently articulated their own reasons for becoming involved as an expression of the rights of the public to enjoy some level of access to scientific thinking and research. However, ethnographic techniques proved equally useful in identifying some

of the rights participants do *not* enjoy – as an observing participant one is able to experience what is missing, as well as what is present. And so, in exploring the data the following questions are asked:

- What rights are attributed to society, citizens or the public?
- What responsibilities are expected, or necessary in order to facilitate these rights?
- How do individual rights overlap or come into contact with collective rights?
- What 'common good' (if any) is being invoked?

What is being drawn here is not a rubric of science-society rights, and the notion of 'the right to have rights' is something I explore in Chapter 7. Instead, I seek out clues as to how participants in public engagement practice construct the rights of various publics in the low-carbon transition, as well as any absence of rights that would impact ideas of democratic engagement. To exemplify the nodes at which we can see these tensions manifest, I present four areas of rights: the right to science, the right to openness, the right to debate and opposition and the right to help shape the future. On the whole, these rights prove patchy and uneven and I show some of the complexities in the universality and visibility of the rights I describe. I begin with a feature of the science and society relationship that is fundamental – that technoscience funded or supported by government leads to increased quality of life or wellbeing through economic growth. It is to this 'right to science' that I turn first.

5.2. A Human Right to Science

Before moving into the question of how rights are manifested in any specific instance (including the Scottish landscape of science/public engagement), it is helpful to revisit the idea of rights at perhaps its broadest base, manifest as the human right to science. The right to benefit from scientific progress has been codified in the United Nations Universal Declaration of Human Rights,

"….Everyone has the right freely to… .share in scientific advancement and its benefits…." (United Nations General Assembly 1948, Article 27).

Unfortunately a lack of clarity as to the meaning and application of such a right has hampered any progress in realising it even whilst its pertinence is recognised. Recent scholarship suggests that science policy directed by the principle of universal human rights differs substantially from that directed by commercial, professional or national principles (Chapman and Wyndham 2013). Such a right incorporates open access to scientific applications and knowledge, the right to contribute, the right to participate in scientific decision-making and the nurturing of an environment, which facilitates scientific development and diffusion (Shaheed, 2012). However, the question of access to scientific research is a contested policy field and the tensions between intellectual property rights (IPR) regimes and the idea of a universal access to scientific advancement are perhaps obvious (Suoranta and Vadén, 2009:42). Nevertheless there is a suggestion that the Declaration may offer a route into IPR reform (Shaver, 2010). Efforts are being made to enrol scientists and scientific institutions in this discussion through an ongoing investigation (OHCHR 2014). How can minority and poor communities benefit from scientific developments whilst scientists and companies retain the right to benefit from their creations? How can less-developed countries benefit from knowledge in more-developed countries whilst knowledge remains behind paywalls and governments restrict collaboration and internet access in the name of national security?

In some ways, this fundamental (if diffuse) right underpins many of the rights that follow, where the value of science is either taken as read or is a matter of contestation. In many of the arguments in the present work there are multiple examples of diverse public responses to different technologies; it is this complexity – in which different parts of the public voice different priorities – that is missing from the United Nations' laudable aim. Part of the difficulty is that the aim laid out in the Declaration is made on a global scale, and that 'the sharing of benefits' does not cascade down to national, regional, local and

sectoral levels with ease or equity. First, I will turn to what the Declaration recognises as a precursor to societal benefit from science – that it must be shared, 'diffused' and in some way made open.

5.3. The Right to Openness

5.3.1. Policy-driven Public Engagement

That science should be open, and scientists should engage with the public on some level has become something of a mantra of modern times. In the UK, a primary driver of the cultural and practical changes considered necessary to encourage a more outward focus in higher education institutes (HEIs) has been the National Coordinating Centre for Public Engagement (NCCPE), a project financially supported by HEFCE/HEFCW/SFC, RCUK and the Wellcome Trust who contributed £9.2M over the period 2008-2012. The programme was operationalized in six UK clusters that bring HEIs together with museums, galleries, science centres, visitor attractions, FE colleges and businesses. With one Beacon in Wales (Cardiff), one in Scotland (Edinburgh) and four in England (London, Manchester, East Anglia and the North-East), the Beacons looked for a more widespread meaningful engagement with the public, achieving permanent cultural change:

> *".....to create a culture within UK HE where public engagement is formalised and embedded as a valued and recognised activity for staff at all levels, and for students."*

National Co-ordinating Centre for Public Engagement, (NCCPE 2014)Edinburgh's Beacon – 'Beltane' – brought together five HEIs and eleven other partners[4], fostering a holistic approach to incorporate policymakers,

[4] The University of Edinburgh, Heriot-Watt University, Edinburgh Napier University, UHI Millennium Institute, Edinburgh College of Art, Queen Margaret University, Edinburgh

communities and researchers in a more dialogic relationship. Scotland's institutions (notably the Royal Society of Edinburgh) have played an intermediary role, hosting public lectures and backing public engagement prizes. The funding released through the Beltane Beacon, and the cultural change fostered by it, have brought about a cascade of novel and experimental mechanisms to bring public together with science and scientists. Whilst I will examine each of the modes more closely in the next chapter, they cover a wide range of formats that bring science and public together.

Outside HEIs, the skeleton around which public engagement with science is funded in Scotland comes from the Scottish Government's Science and Society Unit. The Unit provides structural funding for Scotland's four science centres, contributes additional support so science festivals can reach wider audiences and also funds a scheme of public engagement grants that bring scientists, engagers and the public together. The life sciences are particularly well represented on this landscape, partly resulting from active research bases and businesses in this field and partly because of active cross-disciplinary networks in the field. Current research on stem cells, for example, has been the focus of roadshows across Glasgow and Dundee through separate initiatives funded by the Scottish Stem Cell Network and the Scottish National Blood Transfusion Service that attracted 30,000 people.

The emphasis of both the Beltane's activity and the Science and Society Unit's support is very much on informal experience and social learning. A policymaker reflected on how their work was geared towards the informal and affective such that they focussed projects on "…enjoying science, appreciating its relevance to everyday life….. you wont get a qualification for any of the things we support but you're just going to hopefully have a better

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Consortium for Rural Research, Edinburgh International Science Festival, Global Science Network, National Museums Scotland, Optos plc, Our Dynamic Earth, Roslin Institute, Royal Botanic Garden Edinburgh, Royal Observatory Edinburgh Visitor Centre, The Herald, The Royal Society of Edinburgh, The Sutton Trust, Vitae

understanding of where science fits in and how it affects us all…" (INT-POL03). The presence of multiple easy entry points to science is an important aspect of this field, and plays a key role in the cultural citizenship I discuss in section 7.5.1.

5.3.2. Openness and Accountability

At a governmental level, there is recognition that informal science-public interactions are important, that there is value in simply opening up science in order that non-specialists can see its relevance in their lives. This openness is now regarded as important throughout the community, and is spoken of as an inferred right – not codified but becoming widely acknowledged and accepted. One scientist, a regular presenter in a range of public engagement arenas reflected on the connection between public funding for research and public access to outcomes. In contrast to the historical positioning of science as a private enterprise 'behind closed doors', this respondent felt universities "…. seemed to a lot of people just inaccessible and remote and I'd like to see that change, given that they are publicly funded and Id like the public to see what's happening and to understand what…these research developments mean…." (INT-CIV04). Here the relation of public engagement to public funding, and a neutral 'opening up' of science perhaps for diffuse civic benefit, is described in terms of accountability. What this intimates is the idea that taxpayers have the responsibility of funding science and in return have the right to know what is being supported. During the course of the research, this particular framing came only from scientists; it was not stated in such terms by policymakers, by any of the documents under review or by any members of the public in this study.

One respondent, a scientist involved in informal public engagement, emphasised how important it was that members of the public are given the opportunity to hear about topical research. When asked why they attached such importance to this, a connection between public funding for research and informing the public about research activities was made (INT-CIV03). Although an overt sense of accountability could be inferred here, it is within

the constraints that scientific research is worth its investment; accountability leans towards processes of reassurance.

Limits to accountability are set by the profession, and one of those limits seems to be that accountability is a post-hoc event. I explored the idea of accountability further with this respondent, to see whether it was acceptable for the public to be more integrated into the process, perhaps in the sense of debating conflicting priorities for research. The response was firmly negative, the respondent pointing to carriers of expertise in such an endeavour (INT-CIV03). Similar thoughts, albeit unsolicited, came from another scientist who was a practiced public engager, "…I'm quite comfortable that there be an element of 'scientist knows best' and to be the ones to determine the particular route of their topic…." (INT-CIV04). The barrier here (in this view) lies in the perception of the public as an inexpert audience prone to misunderstanding risking that public interest to be swept away due to irrational responses arising from ignorance. In summary, "….scientists need a certain control over their research – free rein almost – to research what they want. It's up to them to justify what it is but I wouldn't like to see public opinion necessarily stopping a particular aspect of science…." (INT-CIV04). A further respondent gave a more nuanced response, pointing to the different roles publics could play in different research activities, contrasting the specialist knowledge required to discuss particle physics with possible public participation in traffic modelling research. Whilst acknowledging these might be two extremes, the participant commented, "what I'm trying to get across is the idea that it's a simple statement to make – that the public could and should be able to influence research – but it has to be taken in the context of the research area" (INT-CV01). Whilst this response acknowledges the complexity of the proposition, it does point to the practical limits of any sense of universal 'rights' for the public in this sense.

This 'right to research' and to autonomy in scientific research, is a long-established and much-valued aspect of academia and is commonly regarded as one of the foundational aspects of the so-called 'social contract for science',

although not without some critique (Guston, 2007). In sharing his view of how the social contract has developed over recent decades, Guston highlights some of the institutional arrangements that have been put in place in order for policymakers to claw back some control, such as the US Office of Research Integrity. In the UK, the most controversial of these institutional intermediaries is probably acknowledged as the Research Excellence Framework (REF), a programme of expert review to assess the quality of research output over the period 2008-2013 and to drive future distribution of research funding. Against this contemporary backdrop it is perhaps unsurprising that scientists would be protective of their autonomy.

This is not to say however that all researchers subscribe to the same rationale or understanding in invoking their right to research. From just the two sources above there are hinted concerns about unqualified judgement, irresponsible media, or research avenues that are blocked off not negotiated. Brown and Guston (2009) have contrasted liberal and republican ideas of rights. In the former, the liberal interpretation would be associated with rights to autonomy, much as those intimated within the discussion above. As a counterpoint, they describe the republican interpretation as that which seeks to bring science more visibly into society, to integrate it into what we might call more mainstream civic institutions.

As the data demonstrates both the policymaker and engagers touch on the idea of bringing science out of the shadows in an accessible way and this is a firm priority for many more people active in informal science engagement. This is readily apparent amongst those engaged in the cultural stance of the science festival, for example in highlighting a shared professional responsibility to make science accessible and visible. As one festival organiser commented, "…..the public engagement community has to … bridge that gap between the right to know about it and the ability to engage properly and again I come back to this idea that we're here in a translational role…" *(*INT-FES03). This interviewee tackles the difficulty of making science public head

on, in that it is a highly specialised profession needing advanced cumulative levels of expertise to practice or even to engage and understand.

Enabling publics to actively assert their right to openness requires effort from scientists to overcome hurdles of inaccessibility; in this sense the right is inherently limited (the relationship between public 'competence' and participation has been explored quantitatively by Mejlgaard and Stares (2009). The important consequences of openness to engagement – here described by festival organisers, scientists, practitioners and policymakers – is captured here, "….Ultimately, the rights and freedoms of scientific citizenship can be seen as hinging upon the ability of citizens to choose for themselves their points of entry into new scientific community…." (Elam and Bertilsson 2003:247). When taxpayers take the responsibility of funding science, they are increasingly being given the opportunity to assert their right to know what is being done with those funds. However, that right creates responsibilities on the part of scientists – to co-operate with or adopt a 'translational role' so that this right can actually be active and meaningful. Here, we see the intricate co-creation of rights and responsibilities at their broadest.

5.3.3. Openness and the 'Deficit Model'

However, the deficit model is not completely extinct, and the PUS framing has been more persistent in policy circles, for example in an operational hypothesis that understanding the science behind climate change will lead to different behaviours , "…little things that everyone can do in the course of their life – switching off lights or driving a car less. If you understand the science behind that maybe you'll be more likely to actually do some of those things…." (INT-POL03). What is interesting here is that there is a tacit expectation that it is ignorance that holds back citizens from lower-carbon behaviours. As demonstrated in Chapter 2, this causal effect has not been substantiated in practice and we now have a body of evidence to show that the adoption of a low-carbon lifestyle is a far more complex affair than ignorance of climate science. Of course this persistent PUS approach is not confined to low-carbon technologies; I have already described the Royal Society of

Edinburgh's 'sustained public relations campaign' aimed at overcoming perceived public hostility to biotechnological innovation.

There are signs in some policy areas that the limits of a 'public education' approach to policy implementation has been recognised. More specific to the low-carbon agenda, information campaigns targeted at behavioural change have only recently given way to more nuanced ideas about what is required to facilitate such a behavioural transition. One policymaker in the low-carbon team in reflecting on the information campaign commented, "…it would be great if people did change their behaviour as a result of it but we know that you have to have the things underneath – the material, the social, the individual –much more underneath to really sustain changes in behaviour…" *(*INT-POL02).

Here, the Scottish Government acknowledges that more than education is required to facilitate behavioural change. Their old strategy, geared firmly toward the individual and their technical understanding of the challenge at hand, has been transformed into something anchored a recognition of the need to change cultural and social norms (labelled there as *social*) and the infrastructure that makes desirable behaviours easy, for example in recycling collection (labelled there as *material*). This 'Individual-Social-Material (ISM)' tool had been developed from work in the 'Sustainable Practices Research Group' led by the University of Manchester, and has been adopted and developed by the Scottish Government over the course of this research (TSG 2013a).

However, as critiques of the deficit model have shown (described in Chapter 2), openness does not always result in unambiguous support regardless of the nature of the science or of how developed it is. I next turn to the problem of what happens when publics become uncertain or are in disagreement about the world that will be created by a new technology.

5.4. The Right to Debate and Opposition

Moving beyond the right to science and to openness that assume publics are part of the wider scientific enterprise, reveals a very different intertwining of rights and responsibilities particularly at the point when technology gets close to implementation. Sometimes, the introduction of technologies is unproblematic, finding ready or accommodating neighbours, users and consumers. At other times, new technologies provoke members of the public to come together and resist prevailing accepted knowledges or cultural norms. In the last chapter, I showed how the materiality of a technology causes counterpublics to emerge – here, I will explore what rights and responsibilities they have or seize in reframing discussions, engaging in public debate and taking indirect and direct action to influence the course of scientific research or technological development.

My argument has three parts, beginning with the case that activists can legitimately be considered in terms of a 'public' rather than as 'other' individuals or self-interested small groups and so they do have a role in the discussion of a broader citizenship. Secondly, I argue that their right to debate and opposition is complex and uneven and that the measures taken to manage the competing rights of different communities (such as community benefits) can themselves be deeply unjust on a number of levels and introduce new problems of rights within communities. Finally, in bringing centre-stage the role of alternative futures I will highlight that debate is not always oppositional, and anyway oppositional is not inherently negative.

5.4.1. Activism in Land Use for Energy Resources

Central to my argument here is a focus on the right of citizens to challenge the bases upon which scientific information is presented to publics, by challenging the way information and activities are framed and produced and what they represent. Sometimes this right is explicitly granted (for example in the planning system) and sometimes it is seized (for example when activists protest). I consider counterpublics as a body and those who speak up as activists within them, as mediators and catalysts. Counterpublics assert rights

to debate and opposition as a consequence of a perceived responsibility to influence public discourse by highlighting alternative meanings or visions of the future, and by bringing into view parts of the socio-technical network that might be invisible. Concerns include perceived injustices amongst local communities, exposing vested interests or corruption, illuminating a new 'public' previously ignored or disempowered, or asserting their group identity on an issue that is local to them. Such rights are almost always asserted outside formal political systems, and sometimes outside existent legal systems.

Firstly comes the question as to how public activists are. Actively involved in promoting or achieving change, counterpublics are amongst the most engaged members of society and the idea of an emergent public actively participating on an issue for a greater common good could be taken as the hallmark of twenty-first century citizenship. Though these are laudable citizenly credentials, counterpublics systematically find themselves outside the 'legitimate' conceptualizations of public engagement, because legitimate publics are created publics of science communication and dialogue (Wynne 2007). Where literature does tackle the role of activists head-on, they are generally cast as radical, disruptive and oppositional playing varying roles including co-producing knowledge, expanding interpretative flexibility, performing symbolic acts and directly disrupting processes of innovation (Barry 1999, Elam and Bertilsson 2003, Irwin and Michaels 2003, Parthasarathy 2010, Szerszynski, 2005). In this framing, the role of the activist is to catalyse the emergence of a new assemblage of different actors who are working, shaping and wrestling with competing or emerging bodies of knowledge.

Whilst Irwin and Michael discuss activists as lynchpins in emergent 'ethno-epistemic assemblages', I consider the same issues through a different lens of publics, rights and citizenship. Activists are frequently discussed as individuals or small groups, but here I will reflect on their role as catalysts and mediators in enrolling and mobilising membership into a broader oppositional counterpublic.

I draw on the example of Coal Action Scotland, a group of people who work with communities subject to opencast coal mining. Whilst opencast coal is not part of the decarbonisation agenda in itself, it shares the processes that sceptical communities fear when an onshore wind development is approved, which include the incumbent re-approval rights or opaque relationships between councillors and developers. In March 2012, Coal Action Scotland (CAS) were a couple of years into their work in the Douglas Valley and I attended one of their public events. CAS describes itself as a grassroots collective that "…organises non-hierarchically against the advancement of coal as an energy source…." (CAS, 2014a). CAS – part of global collective Coal Action Network - undertakes activities such as bringing together people from the local community, raising awareness, 'paperjamming' the planning consent process, taking direct action to disrupt site operations, training new participants in direct techniques and maintaining an up-to-date working knowledge of the industry and its implications. Through the relationship with the wider CAS network links are forged between the disempowerment experienced in this isolated local community and similar communities on distant continents.

Mainshill Wood provides an example of the emergence of counterpublic, the arguments they make and the role of activists in that. Scottish Coal is to mine Mainshill Wood in South Lanarkshire for 1.7 million tonnes of coal, and is being considered alongside four other opencast coal mines in the vicinity. CAS assert this locality as being "….one of the most heavily mined areas in Europe…." (CAS, 2014b). The Mainshill proposals attracted protest from the local community in the form of 654 (largely proforma) letters of objection from a population of 1000, contrasted with 54 (largely proforma) letters of support (South Lanarkshire Council, 2009). The site has also been subject to occupation and direct action by activists, particularly over the period September 2009-July 2012 with, for example, the occupation and sabotage of drilling rigs and mining machines, damage and graffiti to a contractors van, locking the haulage gates against coal trucks, hydraulic and electric damage to

twelve vehicles (e.g., Indymedia UK, 2010) and a two-hour site occupation (BBC News, 2012). This came on top of a long-term site occupation that stopped work for seven months in 2009, resulting in eviction and 40 arrests (BBC News, 2012a).

The ability to take administrative or direct action for a cause not only cost the antagonist money, but established the credentials of the activists within the wider community. One protester who had lived with the community in Mainshill for a couple of years commented that his direct action had not only injured the company financially but had shown the community that they were prepared to give something of themselves, "....we were willing to do stuff that put our own personal security in jeopardy - we got charged with quite a high offence and it looked like we were going to trial by jury, people had started talking about custodial sentences...." (INT-CIV05).

The story that emerges around this planned mining is of alleged corruption and a breakdown of local justice operating on multiple levels which demonstrates the second part of my argument about the uneven and agonistic distribution of rights across and between communities. The most visible level injustice operates *between* communities and revolves around who is expected to accommodate sites of development. I will explore this further in the context of the spatial planning process for renewable energy technologies in Chapter 6 (section 6.4.2.). Decisions about land use are not by any means neutral, and as I will describe the anticipated capacity of communities to proactively engage, argue and mobilise can be a key determinant in site selection, long before the formal planning process is initiated. Here, considerations relating to distributive justice emerge.

The idea of justice emerges again at the review and approval stage – in essence, it concerns issues of a procedural nature. The resources and expertise activists have brought to the Mainshill context have uncovered concerns regarding the impartiality and practices of local politicians, who are said to have opaque and unjustifiable financial relationships with developers. Since

my fieldwork concluded, practices at the nearby East Ayrshire Council have been independently investigated in order to determine how £132M funds needed for the remediation of 22 opencast mine sites (Scottish Herald, 2013) were subject to a catastrophic shortfall. Wide scale failures in governance were noted alongside failures to adhere to Scottish Government guidance in granting permissions for development to individual firms. Clearly, the criticisms levelled by Coal Action Scotland at Mainshill Wood's South Lanarkshire Council are not unfeasible and this is a direct undermining of communities' right to a robust and impartial decision-making process. In that case, there would appear to be some gross failures in responsibility at the council level, which can either lock-in mining when restoration could be taking place, or leaves local communities with unpleasant and unusable surroundings. In the case of such systematic failures, it is perhaps to be expected that communities begin to assert other forms of rights – those of debate and opposition, sometimes assisted by activists who have particular skills at working outside formal systems. This kind of story circulates amongst those who are sceptical of other forms of energy land use, potentially making communities resistant to onshore renewable technologies; they believe that once a turbine (for example) is in place it is there to stay, is subject to constant upgrades and blocks site release.

5.4.2. Competing Rights and Responsibilities

There are concerns here around distributive justice (across communities) and procedural justice (around impartiality in the decision-making process). I will now turn to a site of heterogeneous rights that is less visible - how technological development can be implemented with sensitivity to justice *within* communities. Over recent years there has been an increasing recognition of the rights of local communities to share in the benefits of low carbon energy schemes that they host, with the preferred mechanism emerging as payment to the community and promises of employment opportunities and infrastructural improvement. In order to promote fair community benefits, The Scottish Government developed and published a set

of good practice principles in relation to community benefits for onshore renewable energy projects (Local Energy Scotland 2014). In this, they described and gave case studies of three kinds of benefit: those derived from community part-ownership (community investment), finite cash payments dissociated from mitigation payments (community benefit fund) and other, one-off benefits in cash or in-kind. In defining the 'community', developers are encouraged to look at those parts of the community that might be overlooked.

Making community benefits more visible and open to evaluation, critique and ideas of good practice is a very positive move, particularly in light of the experiences of our opencast coal community. Here, entrenched interests have propagated uneven access to resources and benefits. When discussing the effectiveness of community benefits as a means to offset an uneven burden of responsibility. Coal Action Scotland reflected on the case of a community centre and a community hall in the same village. The community centre is run by the council and has benefitted from a £100k refurbishment, "….and fits around a clique in the village who mostly live on the North sides of the roads and are a bit wealthier and get money from the Trust Fund that Scottish Coal contributes to….." contrasted to the community hall which the council refuse to support that "….is entirely run by the community and hasn't seen a single penny from opencast money despite having lived next to a massive [mine] for 12 years now…." (INT-CIV05).

Coal Action Scotland see this as leaving the community open to fragmentation, since "….people are in support of it because they get their problems on the table basically and that's one of the divisive things the coal mining company does…people cant speak in a united voice …speaking out against opencast is a taboo issue because you might be upsetting your neighbours…." (INT-COV05). The need to recognise 'social differentiation' within a community and to understand how it is manifest in environmental terms has previously been highlighted as a key issue in the field (Walker 2012:215). There is a clear sense that community benefits can operate

destructively within a community rather than as a neutral tool of amelioration. This point is directly transferable to renewable energy, and was highlighted by campaign group Scotland Against Spin in their response to the Scottish Government's 2013-4 consultation on Good Practice Principles For Community Benefits from Onshore Renewable Energy Developments, commenting:

> *"Conversely, developers are wary of objectors using community benefit to generate negative PR ("a bribe for a development that would otherwise be unacceptable" etc).This means that they tend not to be open, transparent and inclusive in their contact with communities on the subject, preferring to deal with individuals and community groups, whom they think will be sympathetic. While this may make sense from the developers' point of view, communities, groups and individuals left out of the process are liable to feel they have been played off against those who have been included."*
>
> Scotland Against Spin 2014b:2

CAS point to the way that uneven access to rights disrupts what might otherwise be a more coherent (and possibly more influential) public emerging around an issue. Activists can work here *within* heterogenous counterpublics to promote the rights of its most disempowered, and to challenge those who have legitimate power over decision-making processes to hear all voices, not merely the most mobilised, articulate or loudest.

My intent here is not to take a normative position on the actions of activists, or to suggest all are equally valid, but rather to highlight that even the most disruptive of protestors, such as the ones attempting to spoil GM trials in the UK (BBC, 2012b), have motivations underpinned by assertions of citizenship. That is, they act on behalf of society as a whole rather than for personal interest (Szerszynski, 2005). Sometimes, there is a need to work *outside* the establishment to fully challenge narratives that may be flawed; an emergent counterpublic is critical in facilitating this. Activists play an important role in

challenging structural inequalities from the outside by inspiring action through the use of irony, disruption, emotion and slogans rather than through considered discourse, and as such they are considered unlikely to be able to make a useful contribution to 'micro-deliberation' (Young 2001).

The structural conditions that reproduce inequalities is one that has been made in the context of environmental justice (Walker 2012:10) and the low-carbon transition (JRF 2012); by remaining outside formal systems of governance activists play an important role in challenging these. These structural factors easily go unnoticed, or are accepted as a static part of the civil landscape until disengagement becomes the default, "…you can read about it, dust and noise impact and traffic impacting the infrastructure of the village but when you're actually in the area and you see quite how…disempowered and disenfranchised and disposed of the people have been for such a long time….." (INT-CIV05). Ideas of justice open up useful analytical spaces in the study of memberships, publics and rights.

5.4.3. Nuances of 'Opposition'

The final area of complexity around the right to debate and opposition lies in the tendency amongst policymakers and scientists to consider counterpublics only as *resisting* technologies or persistent institutional framings. They do not trouble to consider the alternative vision of the future that is imagined by activists or protestors. The observation is familiar enough. It is at the root of why some policymakers and scientists see counterpublics as deliberately misinformed, unscientific, emotional and irrational in their scepticism about technologies. This kind of pro/anti polarisation is made explicit by some scholars in examining public reaction to GM crops in Europe, "….throughout the history of scientific endeavour there have always been tensions between those who work to promote a scientific understanding of the world and those who would constrain or prevent it…." (Tait, 2009).

This limited view is essentially a 'strawman', which suggests that technologies must be accepted on the terms set down by knowledgeable researchers and

policymakers, or not at all. It fails to consider that there are forms of activism in civil society that focus on *promoting* particular technological paths or issues. This aspect of counterpublics – as supporters and disseminators of behaviour and knowledge that might be associated with 'good science' – has been reviewed in the context of environmentalism, water literacy and genomics (Lee and Roth 2003, Evans and Plows 2007). Such projects are empirically observed more often than the literature might indicate. Greener Leith (part of a counterpublic resistant to woody biomass) is a community-based and community-led project located near Edinburgh which actively promotes and supports a vision of energy that is community-owned, decentralised, diversified and low-carbon energy system.

As well as engaging in planning processes, promoting alternative transport, green spaces and microgeneration, and engaging with the community on climate change and energy use, Greener Leith is opposed to a proposed biomass plant on Leith waterfront due to its visual impact, proposed efficiency and concerns over the sustainability of fuel sources which are to be sourced and transported from overseas. Theirs is not a simple binary position of supporting or resisting all 'green' technologies, but a more nuanced position of challenging information and promoting alternative strategies or understandings in pursuit of the same aim – an environmentally sustainable economy. At its essence, this highlights different imaginings of the way in which the low-carbon transition should be implemented, contrasting 'private supplier' and 'community' modes (Walker and Cass 2007). It is not a lack of vision that characterises the counterpublic, but the opportunity to debate that vision on its own terms. Crucially, the reframing of debates often involves invoking the rights of minority or invisible groups, whether this be communities exposed to proximate open cast coal mining or indigenous groups who inhabit lands that will be disrupted by local fuel sources used by more-developed countries. In this case, activists are crucial in mobilising the exercise of rights across the fuller socio-technical network.

Whether they are supportive or in opposition to proposed technologies counterpublics, by definition push against wider cultural or policy emphases. This frequently leads to public controversy of the kinds described in Chapter 3. I have related there how attempts to ameliorate this kind of disagreement prompted a range of responses that spanned ideas of education, trust and participation. In the next section, I will consider what rights publics have to participate in decision-making before options are 'locked-in'. Without the 'upstream' and 'engagement' terminologies that now dominate such discourse, at its most fundamental this is about the opportunity for citizens to consider and articulate their preferred visions of future society, and to debate those amongst themselves. This comprises the first part of the following section. Secondly, I will turn to a field that has comparatively well-codified associations of rights but is somewhat neglected in the landscape of public engagement – the citizen's right to participate in decision-making about local development and land use.

5.5. The Right to Help Shape The Future

5.5.1. Deliberation and Dialogue

A reading of STS literature shows that participation in formal dialogue is becoming an established right for publics in shaping of science-society relations, particularly in Europe. Numerous mechanisms for dialogue have been identified, promoted, rationalised and critiqued (Rowe and Frewer 2005, Rowe et. al. 2008). Yet, despite the extent of dialogic activity in the public engagement landscape (see section 2.1.3), opportunities for timely dialogue involving the Scottish public on topics of energy and climate has been sparse. In this section I draw on the possible role of Sciencewise or projects such as Department of Energy and Climate Change's (DECC) *My2050* to consider what we might conclude from such an absence. I reflect on the constrained role of deliberation in a representative democracy and on differing philosophies of implementation and contrast this with the rights publics have to shape the

future when technologies become material through planning processes for local development and regional spatial plans.

Inherent to many distinctions between scientific communication and scientific citizenship is the democratic right to participate in substantive decisions about science and technology when such decisions are expected to fundamentally reorder societal relations. Whilst not routine or default, pockets of deliberation around science and technology have emerged in public consultations and public dialogues, frequently facilitated by Sciencewise, the UK Government's public dialogue arm. Public dialogues around science and technology have taken place in a wide range of fields including nanotechnology for healthcare, GM Food, the biosciences and the leap second. The nature and role of some of these dialogues is explored in depth in Chapter 2. Although the specifics of purpose and process in public dialogue projects are subject to ongoing experimentation, they tend to attempt an engagement with the public through questions about the nature of future society as manifest through the technology at hand.

When considered in the light of Scotland's low-carbon transition, it is reasonable to anticipate that such dialogue would include, for example: How much of the emissions reduction target should come from reducing demand as opposed to supply? What infrastructures are needed to support less energy-intensive lifestyles? Which technologies might support that in an acceptable way? Some of these questions are embodied in the sorts of options and trade-offs asked of participants in *My2050*, an online simulator of emissions reduction run by the UK's Department for Energy and Climate Change (DECC) as part of its wider Energy2050 Pathways dialogue (2010-11). Whilst not dialogic in itself, *My2050* was unusual in that its online form enabled UK decision-makers to target the views of both younger publics and a larger proportion of the population than can generally be captured by traditional dialogue methods (although responses are constrained by the fixed parameters of each of the choices) (Mohr, Raman and Gibbs 2013). However, the wider dialogue project was meant to inform climate change mitigation policies for

the whole of the UK thus its relevance for Scottish climate legislation is limited (the supply and demand assumptions embodied in the tool are not spatially explicit), and a comparable project has not been undertaken in Scotland.

The sparse presence of structured formal dialogue for technoscience in Scotland is interesting given the attention paid to the approach in academic literature, an observation that raises a question about the relationship between public policy and public engagement and what that is or should be. Nevertheless, the experience accumulated through Sciencewise over a decade of projects with the public could provide a rich resource in helping the Scottish Government foster a constructive conversation with the Scottish public about how its ambitious decarbonisation project can be implemented. This is by no means a new technique, and Sciencewise-ERC have an established track record of facilitating many such dialogues in the United Kingdom. To date these have been projects designed to meet the needs of policymakers based in England and whilst specific events have certainly included Scotland, I am not able to trace any public dialogue with science that asks specifically Scottish questions of a Scottish public for the purposes of Scotland. This is perhaps unsurprising given the relative newness of the devolved Scottish Parliament, and, indeed there is a policy-lead link between the Scottish Government and Sciencewise. Public-science dialogue in Scotland can be framed as an opportunity waiting to be filled rather than being hidden as it is. A policymaker in this area said their goal would be to "…connect an area of Scottish Government policy that hasn't come across Sciencewise and get a discussion going about whether that … area has policy in development that's at the right time to benefit from the injection of some of the outputs from dialogue…" (INT-POL03).

This can be juxtaposed with accounts from policymakers involved in the public face of the low-carbon transition, in describing their aspirations for a 'low carbon dialogue' with Ministers. Happening perhaps twice a year, the aim would be to bring around 20 members of the public into a meeting, using civil

society organisations as mediators between public and government, to stimulate dialogue in a fairly unstructured way. As the policymaker commented, "….what we're trying to do is think of people in conversations and engaging and engaging wider. Our biggest concern about trying to do that to the level we'd like is really just resource and timing…." (INT-POL02).

There is clearly a place for some fruitful collaboration between these two policy-areas (which I did highlight during the course of both interviews) that could start to mobilise the right of publics to help shape the future of energy in Scotland. It is possible that science policy institutions may find that their nascent thoughts on dialogue are overtaken by some of the wider deliberative innovations taking place in Scotland. An example might be the Public Policy Network who have run innovative deliberative events on wide-ranging issues, and helped advise public engagement practitioners on integrating more deliberative content into their practice (Escobar 2011). However there is a wider point at stake – that is, whether public engagement processes should be utilised to help deliver flagship public policies. Public engagement is commonly regarded as having a responsibility to maintain an impartial role in facilitating a dialogue between different kinds of public, policy and expert stakeholders in order to develop, share and debate different visions of the future and how they might be achieved. In this sense it cannot be seen to act instrumentally to achieve Government's priorities. At the same time, if a policy is to be implemented anyway (legitimated through the policy choices of an elected government), then the public can be said to have the right to a voice in what shape that implementation will take. Without 'upstream' dialogue, the only engagement space that opens up is acceptance or opposition, or indifference.

The Royal Society of Edinburgh touches on the role of deliberation in their wide-ranging enquiry "Facing Up to climate change: breaking the barriers to a low-carbon Scotland" (Royal Society of Edinburgh 2011). In amongst many recommendations, the Society promotes long-term deliberative dialogue with the public, hosted by and originated with current civil society groups:

> *"....Civil society has a critical role, because it provides social space where greater trust can be built through shared experiences and articulation of common goals. It is the basis for stronger deliberative democracy, which requires capacity for listening, argument from evidence rather than personal interest, and action to draw a wide range of groups into discussion. While simple agreement is likely to be the exception, local perspectives need to be heard, in order to achieve some shared understanding of the relevance of climate change, and the meaning of low-carbon transition for day to day life. Deliberative engagement is a means to move beyond the limits of individual actions, to enable everyone to understand their responsibility to act."*
>
> Royal Society of Edinburgh (2011):153

Instead of adopting an instrumental approach of promoting dialogue as a means to reach consensus, this would appear to be promoting deliberative engagement as a means to make climate change 'real' and start to build some shared meaning, the lack of which had been repeatedly reported as a barrier during the consultation phase of the Enquiry (ibid p148). What underpins the idea of dialogue in the RSE's report is that it will open up a space for 'open and mature debate' leading to 'a means of moving beyond individual actions and helping everyone understand their responsibility to act' (p169). When considered alongside some of the more entrenched inequalities discussed in section 5.4.2 this does seem an optimistic view of the power of dialogue amongst a civil society that is inherently plural at multiple levels.

So, there are fundamental challenges to engagement in the way we perceive democracy enacted in Scotland, and an ongoing struggle to locate pockets of deliberation in an otherwise representative system. What is clear in terms of rights and responsibilities is that there are numerous constraints on the ability of a public to engage at a stage where the future is still malleable enough to be

'shaped' (for example that key regulatory or strategy decisions are as yet unmade). Part of this relates to rights-centric approaches to citizenship, and the 'right to have rights', for example to request dialogue on a particular topic given that public participation is generally limited to topics already pre-defined by policymakers or experts. If the Scottish public had been asked what topic of science and/or technology they would like to debate, it is difficult to envisage that the thorny subject of energy would not have arisen.

Further clues as to the reason for an absence of dialogue around Scotland's energy transition can be found in Walker and Cass' work referenced earlier in this chapter (Walker and Cass 2007). The authors identify the differing philosophies that can be identified in implementing energy transitions, and I drew out the difference between the formal policy position of a market-driven transition in contrast to Greener Leith's idea of community-driven transition. A policy strategy that leans heavily on the market to facilitate Scotland's decarbonisation is arguably the most significant reason for the absence of dialogue, both for ideological and pragmatic reasons. Scotland's decarbonisation targets are ambitious, and the Government looks to have put its faith in the energy generation market to deliver them most expediently. Here, one might say that the responsibility to act has trumped the right to participation.

5.5.2. The Planning System

In discussing the right to (or absence of) public dialogue in the low carbon transition, I highlighted a lack of opportunity despite post hoc interest in the topic. By contrast, Scotland's planning system does provide a right for the Scottish public to contribute to decision-making about local and regional land use, even if planners and developers argue that the responsibility is not widely taken up. Both planners and developers go on to make the link between a lack of early engagement and the prevalence of subsequent protest. Given ongoing and far-reaching reforms in the Scottish Planning System particularly with respect to renewable energy capacity, it is not possible to verify, explore or disprove this hypothesis in this thesis. However, this is a well-developed

context. In the UK, spatial planning and land use enjoys something of a special role within the democratic structure, with established and sophisticated mechanisms in place to try to ensure that communities have a right to agree what their local space should be used for. Furthermore, Scotland has a charity (Planning Aid Scotland) that will help citizens participate in the local planning process and access expert advice.

The other part of the puzzle with respect to planning in Scotland is that in the eyes of the planning system, the public do not always exercise their rights at the right time. The development of Spatial Frameworks is the proactive planning stage that lays out general infrastructure for an area and as such embodies a future vision for the needs of that area in terms of education, transport, energy, health and economy. For example, all non-city local authorities are required to identify where suitable areas for onshore windfarms of larger than 20MW could be situated. This allows the windfarm to be considered as an integral part of the spatial framework and lays some fertile ground for developers later down the line.

However, there have been a number of issues with renewable energy in the spatial frameworks. Firstly, not all councils have undertaken them in good time. A policymaker in this area commented on the multiple reasons these spatial frameworks are not yet complete, "….we've had a lot of problems in terms of the authorities getting it done and its partly down to political reasons, its partly down to resources, a number of authorities did landscape capacity studies….." *(*INT-POL04). Secondly it has proven problematic to get real engagement from the public at this level of planning, in terms of capacity and interest. The issue of capacity is the first to be addressed, "….so that people can have at least a basic understanding of what they're being engaged upon.. a lot of people see planning as a technical exercise, its not meaningful to them, they don't understand it so capacity-building is important…." (INT-POL06). When plans do not relate to people's immediate environment the challenge of engendering interest becomes magnified, " [we have to] …raise their interest in both documents because national level documents aren't

always as obviously of interest to the layperson…." *(*INT-POL05). In this conundrum, is the opportunity for energy to be considered on more strategic terms, so that communities can explore and debate how they can best negotiate their responsibility of providing renewable energy capacity to Scotland? However, as these comments show, that opportunity is not one that is widely taken up.

A particular problem associated with rights in the governance of technoscience emerges from these reflections on process. Because technology by its nature changes the natural world, and because it is approaching the point of implementation, rights to participation cannot be left open-ended as engineering decisions become concretised. Recognising that a limited window of opportunity exists leads to a recognition of the publics' responsibility to engage at the right time and the right level. When communities do not get involved with spatial plans and then later object to some of the consequences of development they become an ongoing source of frustration for planning officials and developers. Some of the 'engagement gap' comes from an eventual affective and cognitive response to the emerging materiality of the development, but some of it stems from a general reconfiguration around formal participation that can be seen across the democratic sphere (Dalton 2008:6-10).

When it comes to specific development projects, the quality of engagement varies widely. Proposals for wind farms greater than 20MW carry an obligatory period of consultation before being submitted formally, and in this process different parties can state their concerns and the developer can amend their proposals, "… so when it actually comes into the formal planning process its capable of being approved and it has a smoother run through the planning system…." *(*INT-POL04). Here, there is an expectation on the part of planners, not that publics will approve or reject plans, but that the process will facilitate a process of negotiation and compromise.

Even though it is seen to be in all developers' interests to carry out effective community engagement, the diffuse nature of the industry means that not all developers reach a threshold level of capability in this respect and polarised opinion can become embedded. Community engagement through the planning process does not necessarily defuse local concern, and different communities have different motivations for supporting or opposing development (see section 5.4) as well as having different capacities to engage effectively. This lack of engagement at the Spatial Framework stage has consequences that ripple through an evolving energy landscape. Whilst the planning process can mediate different interests – and potentially leverage community benefits – when communities fail in their responsibility to engage, planners cannot address the more fundamental structural inequalities in siting renewables developments. One developer discussed some of the factors considered when siting decisions were made in proposals. Developers ensure they know which authorities have strong anti-wind lobbies some of which are "….backed heavily by academics and wealthy people…." and experience shows that these are difficult opponents and make approvals in that planning authority very difficult. In such instances the developer, "….might decide its more viable to go to other areas which may be more deprived or a lot more brownfield sites or industry's moved out so the community are more receptive to development coming in and creating economic generation opportunities…." *(*INT-POL04).

Here is a glimpse of the sifting that developers do in deciding which sites to select for a project (and which I will discuss further from the developer's point of view in Chapter 6). Once all technical dimensions have been satisfied, if there are a number of options remaining the developer will choose the site they feel offers the greatest chance of success. The difficulty is not necessarily that a deprived area should not host windfarms, but that more mobilised communities should too. A more robust engagement strategy for Spatial Planning would start to mitigate some of these inequalities and could mobilise community voices into decision-making phases. Indeed extensive work is

being done within the Scottish Government to improve the capacity for engagement at these levels. At heart this example illustrates the role of formally attributed responsibility in this discussion of rights.

5.6. Conclusion

My purpose in this chapter has been to answer the question, "Conceptually, what rights and responsibilities are being ascribed to scientific citizens, how effectively are they enacted and under what circumstances do they become contested or expanded?" To address this question, I have illustrated the kind of rights and responsibilities that can be inferred, seized and attributed to various publics of science and technology. I have highlighted ideas of rights and responsibilities in the context of a human right to science, openness, debate and opposition in shaping the future. Previously I discussed the idea of membership, and what a community might be taken to mean in the context of a socio-technical network, drawing out ideas of internal and external exclusions as confounders of the idea of membership. In my discussion of rights and responsibilities I also found obstacles to the expression of those dimensions, for example in process capacity, the need for expertise, and the need for (often external) mobilisation onto the decision-making system.

I have shown how rights and responsibilities are intricately entwined, and co-produce one another, sometimes in expansive ways, suggesting that citizenship is a framework that could usefully be employed to expand our understanding of science and technology in society. Rights and responsibilities are both tacit and fluid and complicated by the need to consider what the Joseph Rowntree Foundation terms 'recognition', that is the need to recognise the structural conditions that nurture uneven landscapes and make access to decision-making uneven (JRF 2012). Here, we can usefully return to the question of the differences between social movements and counterpublics, a discussion started in Chapter 2. The boundary between the two concepts is not a stable one, and some question the usefulness of pursuing classifications

(e.g. Asen and Brouwer 2001:17). However, the counterpublic's sensitivity to marginalised voices, from a standpoint of oppression, lends itself to discussions of justice where structural inequalities are seen.

Whilst the idea of openness has gained particular momentum, different objectives operate simultaneously. For the Scottish Government's Science and Society Unit, it is a process of providing learning opportunities. To two of the practising communicators interviewed, it is a process of building capacity for deeper engagement or offering a breadth of entry points to invite different members of the public to discover more. To the organiser of the Café Scientifique, openness is bound up with public accountability and reporting what progress has been made with the public funding received. These are all evolutions of an older idea of openness which has its roots in PUS-style understandings of public attitudes and behaviours and revolves around the idea that publics can be educated into new attitudes and behaviours, and understanding science is the key to this transformation. However, none of the eleven practitioners interviewed reflected this type of framing or expectation, and workers from science centres, festivals and Café Scientifique were much more likely to describe themselves as offering 'tasters', an affective learning experience or contemporary accounts of modern science as it is unfolding.

A final point of reflection here is on the question of scale. Energy technologies are rife with issues of scale and there is a lack of correspondence between taking responsibility and asserting of rights. Common talk around climate in relation to rights largely revolves around the right for nations to emit (particularly with respect to developing economies), and the right for communities to be protected from potentially catastrophic effects of climate change. In turn, claimed responsibilities frequently raise the need for action at national level (through emissions reduction schemes for example) and the responsibility of communities to participate in decision-making schemes that relate to the rights they assert. I have highlighted how these broad statements are manifest in Scotland, and looked at some of the contextual issues that complicate them.

However, if rights are in some way universal, then a problem emerges in which the rights of our (geographically) close neighbours may be juxtaposed against the rights of people further away. This is never more apparent than when society encounters highly material technologies, where the site, dimensions and parameters of a project become most visible as or after they are concretised. Bellamy places this paradox in the realms of deliberation and negotiations – an issue that cannot be reduced to permanent individual rights amenable to codification in law. Instead, a crucial aspect of citizenship is highlighted as being the right to have rights, "….what does the work in any account of rights is not the appeal to rights as such but to the arguments for why people have those rights…." (Bellamy 2008:14). Hence, the idea of rights is inevitably bound up with ideas of membership, and the way rights function is highly dependent on the robustness of the participatory mechanisms in place – our three struts of citizenship – membership, rights and participation – have to be considered together. It is to this final aspect of participation that I turn to next.

CHAPTER 6 Practicing Scientific Citizenship: Participation and Practice

In preceding chapters I develop two dimensions of citizenship in the context of science and technology. In Chapter 4 I draw out the idea of multiple fluid publics using the concept of membership to reach beyond conventional and restrictive definitions of citizens as political agents associated with a political nation state. I describe three publics, the enthused public, the consumer public and a counterpublic engaging with, or being engaged by Scotland's low-carbon transition. In Chapter 5, I use notions of rights and responsibilities that are inferred, seized and attributed amongst different publics and policy actors, exploring normative tensions between ideas of the right to science, the right to transparency and the right to debate and opposition. Now, I will take Bellamy's third element of citizenship as my point of departure and use modes of participation to consider in broader terms how the landscape of contemporary public-science participation is practically manifest in Scotland.

6.1. Concepts of Participation in Scientific Citizenship

First I need to clarify what I mean by participation. I intend to extend the concept beyond the constraints of politically-oriented modes of participation as in more classical citizenship theory. I do not focus solely on 'points of decision', which are often employed regardless of whether they are the substantial (if infrequent) voting exercises in a representative democracy or issue-based participation within a direct democracy. Instead, I invite readers to take a step backwards to bring a wider field of activity into view and to consider the diverse, vibrant and experimental public engagement landscape and what it offers for an understanding of contemporary needs and demand in relation to publics and science. Here I redraw ideas of citizenship as 'practice', or practicing citizenship in place of normative ideas of participation or involvement (consistent with Wynne 2007 who cautioned against the limited framing of 'public participation with science'). I reach beyond participation mechanisms instigated by policy or research actors and critically examine

forms of engagement as they emerge from other sectors of society. In Chapter 7 I consider what these modes of participation, rights and responsibilities and membership might mean together in terms of citizenship.

Here I interrogate the fieldwork data, describe some of the public engagement mechanisms and ask what they tell us about Scotland's science-society landscape. I explore the backbone of Scottish Government science engagement – science centres, outreach projects and science festivals as well as those activities that originate in civil society such as Cafés Scientifiques. I also look at how public discourse is shaped through policy advocacy and activism. The low-carbon context incorporates numerous intermediaries who mediate between different publics and low-carbon ideas in, as in Climate Challenge Fund projects, the Church of Scotland's 'Science, Religion and Technology' programme along with policymakers in the planning system responsible for facilitating onshore renewable technologies.

I draw out the dominant themes of participation that emerge from the data according to what public participants are doing or hope to be doing. I wish to avoid an institutional framing of participation in order to capture the heterogeneity of these diverse activities more fully. As I have already stated, I do not seek to present an exhaustive account of all science engagement activity in Scotland, rather to draw on a breadth of activity to facilitate a coherent story about citizenship, and suggest ways of taking this discourse forward in practice and theory.

I present three kinds of practice. The first is about listening, learning and affect – the traditional activities of science engagement where audiences are informed, educated and enthused, in relation to which I discuss some public lectures at science festivals and at a Café Scientifique. There is considerable overlap here with ideas of the enthused public (Chapter 4) and the right to openness (in Chapter 5). The second kind of practice is more interactive, and I exemplify this kind of engagement through the example of science centres, the use of mediating technologies to reach new audiences and the role of the

market in producing products. Here, there is relevant correspondence with the public as consumers in Chapter 4. Finally, the third example of practice I present is when publics (frequently counterpublics) get involved in decision-making, either through influencing debate or through protest and activism for or against particular technological proposals or dominant framings. In this, there is some overlap with the counterpublics described in Chapter 4, and the right to debate and opposition and to help shape the future in Chapter 5.

Whilst these overlaps are now starting to emerge, I focus here on the practice and participatory elements of the examples that follow. A recurring theme of materiality runs through all the examples and influences the kinds of participation. I reflect on this dimension, how we might understand it in the broad context of public engagement with science.

6.2. Listening, Learning and Affect

Stimulating an enthused public relies heavily on mechanisms for generating interest and eagerness, often through education and entertainment, as I explored in Chapter 4. Such science communication activities are traditionally interpreted in terms of the deficit model of public understanding of science and are contrasted with a participatory model of public engagement (though as I will show even 'deficit type' communications have a participatory element in their own right). Relying primarily on talking, educating and reasoning, informal public engagement is not entirely unidirectional, particularly given a tendency toward informality since the 1990s and a proliferation of science festivals, science cafés, hands-on projects, science busking, and research themed stand-up comedy for example. Questions and answers and informal chats with participants are common, although topic, style and content are framed and controlled by experts. A drive to engage people in an affective way has accompanied the new informalities in style. Emotions such as wonder, humour and admiration are seen as desirable in contrast to the view that science engagement is a *cognitive* activity. To illustrate these points I draw on three examples: two public events at Edinburgh Science Festival and a Café Scientifique evening on the topic of renewable energy.

6.2.1. God, Science and Global Warming

In April 2010 I attended a public lecture at the Edinburgh International Science Festival as a participant observer. Organised by the Church of Scotland, the ex-Chair of the Intergovernmental Panel on Climate Change, Dr John Houghton, spoke on the topic of 'God, Science and Global Warming'. The event was held in a university building in the early evening and attended by a sizable audience (>100) who were seated 'theatre-style'. Dr Houghton was clearly sympathetic to – and drew heavily on – a biblical framing for climate change, pointing to the responsibility of humankind as "God's stewards of Planet Earth". The audience were apparently sympathetic to his framing. The lecture was formal and comprised an unusual combination of technical data, satellite imagery and biblical passages to reach the audience on the issue of climate change and their roles as mitigators. The audience was fairly unchallenging. One non-conformer was met with a majority pantomime boo when s/he questioned the so-called hockey-stick scenario. Yet even this protest was couched in supportive language. "….I'm in public office and I want to fulfil my spiritual duty but have reservations about the more severe future scenarios….how would you advise me to negotiate that whilst still fulfilling my duty?…." (OBS13).

Reverence for expert-speakers was not unique to this overtly faith-based event. At another lecture at the same Science Festival, TV presenter Robin Ince facilitated a public question and answer session with science communicator and physicist Professor Brian Cox, after a screening of an episode of Cox's BBC television series *The Wonders of the Solar System* in the Lothian Theatre. If the John Houghton lecture was a performance of faith and respect, this was a performance of celebrity and admiration. As one male audience member put it (to vigorous audience applause), "….I'm a 44 year old hairdresser, not a scientist like people here obviously are, but I love the stars. I do agree with the previous lady – you bring humanity and humility to science that enthuses people and it excites me that my kids can look to you…." (OBS05).

I draw these two examples together to make the point that public lectures are far more than a simple transfer of knowledge despite the fact that science communication might be considered to be one of the most cognitively intensive forms of engagement. They exhibit quite clear cultural aspects, Attendees appear to identify with certain subgroups, whether they are environmentally aware congregations or the 'fandoms' of a celebrity scientist. Therefore, to understand these levels of engagement we have to look to cultural representations and move beyond ideas that traditional science communication activities are always about knowledge. The affective domain is equally important. As Cox himself said at the *Wonders…* screening, whilst discussing Carl Sagan's 1979 documentary Cosmos, "….There can be a sterility to science if we aren't careful, and Sagan reminded me that it's an emotional response to the Universe…." (OBS05).

To explore informal science engagement further I look to a model that has explicit aims to simulate a conversation or dialogue around a scientific topic – the Cafés Scientifiques.

6.2.2. Café Scientifique Dundee – Renewable Energy

There are approximately 65 Cafés Scientifiques in the UK that generally meet on a monthly basis in informal spaces such as a coffee shops or bars. Cafes Scientifiques is an international grassroots movement. The Cafés have become an important cultural mediator of science and society, often consisting of a short preliminary talk followed by extensive discussion (in contrast to the Danish model of debate between experts, or the French format of panel discussion). They are locally organised and nominally self-sustaining since small financial contributions from the audience go towards reimbursing the speaker's expenses. The role of Café Scientifiques in informally re-positioning science closer to civil society and distancing it from professionalised institutions has been described as "bringing science back into culture" (Oliver Sacks, quoted in Grand, 2009), and breaks down the walls so science becomes a more visible, a less 'special' part of society. In the general context of public engagement, Cafés Scientifiques are unusual in their autonomy and limited

financial support which is normally only available as seed funding for the start-up of new Cafés. This independence gives the Cafés flexibility in providing for the needs of audiences, speakers and venues and in catering for differing expectations of the participants. Participants in Cafés in Scotland reveal that various motivations are simultaneously in operation in any one meeting, including:

> Couple, early 60s: come regularly to both Cafe Med and Cafe Sci, he is a microbiologist at University of Aberdeen, she is an HR consultant who wanted a science career but was discouraged from it at school, feel it's important to engage in science "*arts etc are hobbies but science is everywhere in our daily life, especially biological sciences*". Got involved as are on Festival mailing list where Cafes were promoted.
>
> Fieldwork Notes, INT-PUB23

These visitors are already interested in and advocates for science, and want to keep up to date in an informal setting. Here science is a leisure topic, a view that was also expressed by another visitor, although he did not attach any special value to science over other cultural domains:

> Gent, late 30s: came alone, eclectic background, quite cynical outlook, wants a Cafe Eng!. Enjoyed the event but felt it could be pitched at a higher level, feels science is important but is part of the general landscape "*art adds value, and life would be empty without music*". Comes regularly but not always, attends Cafe Sci too but won't attend the cremation topic on Wednesday ("*life is depressing enough*").
>
> Fieldwork Notes, INT-PUB27

A third participant appreciated the importance of understanding contemporary research so that citizens would be in a position to debate dilemmas of public interest:

> Gent, early 60s: regular at Cafe Sci and Cafe Controversial, comes alone. Likes this Café model, "*you can learn about science on your own but it's like being given the full Encyclopaedia Britannica*". Feels it's important people engage in science because "*otherwise we're doomed, as a nation, as a species … and we can't leave it to scientists because they'll build another CERN and forget about all the relevant stuff*".
>
> Fieldwork Notes, INT-PUB28

In some circumstances visitors may have a personal resonance with particular topics but no prior engagement with the Café Scientifique format:

> Female, ~60: first time – she'd been looking at Alzheimer's research on the University website - was thinking of volunteering as a research participant as her brother has been diagnosed - and came across this event (Café Sci on "Green Alternatives to Cremation") on a topic which particularly interested her as she'd recently made a will. She has a general interest in environmental issues (cf science per se) and recycles etc but doesn't usually come to any events like this.
>
> Fieldwork Notes, INT-PUB29

Scotland nominally hosts 12 Cafés Scientifique, although the Inverness and Orkney Islands Cafés do not run outside of the Highlands and Orkney Science Festivals. This leaves a core of ten Cafés operating in six cities: Aberdeen, Dundee, Edinburgh, Glasgow, St. Andrews and Strathfillan. Some cities have found the format so successful that they have expanded the model to reach new audiences. Dundee hosts two Cafes: the Sci Café and Sci Café Extra whilst Aberdeen hosts four: Café Sci City, Café Sci Shire, Café Med and Café Controversial (started in Autumn 2010 to engage in controversial issues such as cannabis use, nuclear power, creationism and sex selection of embryos). The content of Café events varies, whilst most cover a variety of scientific issues and processes, Aberdeen's Café Med focuses on the theme of health such as bowel disease, heart health, diabetes, asthma and arthritis. Cafés run

in a variety of venues although most use social spaces such as coffee houses, restaurants, bookshops and theatres. The Aberdeen Café Med takes place on the University campus. In addition to the evident expansion of the Café movement in Scotland, the established Cafés have developed some innovative ways of reaching new audiences such as Dundee's Café Sci Shire's Coffee Morning Special, which invites young children along with their parents to an event on 'Studying Mother and Baby Play'. This is a successful attempt to engage a set of participants who are be less likely than others to go to evening events.

As with many other forms of engagement, the bottom-up nature of the Café's organisation means it is responsive and non-strategic in terms of the topics it covers. Attendees are generally given opportunities to suggest topics in feedback forms. Looking back at over 100 events spanning the period 2008 to 2011, only one was related to the low carbon transition. This was the event I attended at Sensation Science Centre in Dundee (OBS07). On that occasion, the speaker, who critiqued some of the claims about different low-carbon electricity generation technologies, struggled without a powerpoint presentation and repeatedly referred to what the slides would have showed if they had been "allowed".

Clearly, Cafés Scientifiques remain a relevant training ground for researchers practicing communication skills particularly for non-specialist audiences. Audience questions were largely of a technical nature, with some audience members challenging some elements of the talk: "….I need to correct you carbon equivalency measures in that concrete is not the same as cement….", "….you didn't mention losses in transmission" and "you didn't make any reference to baseload….". One audience member noted "….there's an air of hypocrisy as we sit here in a building that's grossly overlit and you have a projector and two plasma screens operating but doing nothing…." (quotes from OBS07 fieldnotes). Even the most discursive of events turns attention to materiality.

To explore the role of materiality in mediating between publics and scientific topics in more practical and tangible situations, I will now turn to the exhibits and devices of engagement.

6.3. Engaging Through Interaction

Moving on from lecture and other talk-based passive engagements, there has been a rapid spread of interactive events as a more meaningful way for publics to engage with scientific topics. The most obvious of these are science centres which are modern developments of museums as places where visitors can engage kinaesthetically with exhibits designed to make abstract ideas more tangible and material. However, artefacts as mediators of engagement are not only in science centres, and I explore two examples in which technologies act as mediators to new audiences outside science centres. These are smart meters and thermography surveys. Finally, I will reflect on how corporations are able to offer modes of public engagement with science of a kind that policy or civil actors cannot, and that lifestyle, consumption and leisure choices can be considered a form of citizenship participation, particularly when considered in the context of the free market as the preferred mode of low-carbon transition. First, I will discuss Scotland's four science centres, which are the backbone of Scottish science engagement.

6.3.1. Getting Interactive in Science Centres

As I have already explained The Science and Society Unit of the Scottish Government facilitates a broad programme of science engagement activities for adults and children in Scotland. Scotland's four science centres in Aberdeen (Satrosphere), Dundee (Sensation), Edinburgh (Dynamic Earth) and Glasgow (Glasgow Science Centre) are flagships of the science and society drive. Aside from Satrosphere, which has a longer history, the others are 'Millennium Projects', funded in part by the UK National Lottery at the beginning of the last decade to celebrate the millennium. The four centres have received core operational funding since 2004, to ensure their sustainability to facilitate collaborative educational activities and integration with the wider (loose) informal public engagement network "….to raise

awareness of scientific issues and encourage a science-literate public, [and] to educate and inspire our children…." (Scottish Executive, 2005).

All of the science centres are iconic buildings in some sense. Satrosphere (opened 1988) is housed in Aberdeen's old tramsheds and is still referred to as such by local people. The tramsheds are listed buildings, a factor that has contributed to the space's slow redevelopment. Many of the exhibits are also quite old, some having been in operation for decades, as the Director acknowledged, one had been there in his childhood. Satrosphere caters largely for pre-school children, and visitors particularly appreciate the soft play area, although the content of the exhibits adds a lot of value. One visitor who had brought her grandchildren commented, "….Well you could go to a soft play but here you feel like they're getting something worthwhile too, learning…." (INT-PUB14).

Moving down the Eastern coast to Dundee, the geometrical roof of Sensation (opened 2000) is easily visible from the rail route. Sensation originally had a focus on the human senses but has since sought to broaden its scientific scope to life sciences more generally, since this is a particular feature of the local economy. In addition to developing its scientific focus, the management team at Sensation have spent considerable effort reorienting the centre's role to develop it as a community resource available for use as a hub for lifelong learning. Consequently its activities have expanded beyond exhibitions to offer development activities for teachers such as Continuing Professional Development training (CPD) and facilitation of meetings between publics and research. Through science communication training for scientists, collaborations in two local science festivals and hosting a monthly Café Scientifique for example (see section 6.2.2.). On a quarterly basis Sensation runs "Reclaim", which are informal gatherings that combine a bar with exhibits and adults are treated to a fun evening with a sprinkle of science such as a speed dating event with DNA extraction activity on a Valentine's evening. The goal of these types of activities is largely to expand the audience by using

the science centre's core capabilities and reaching towards a different demographic.

Edinburgh's science centre *Dynamic Earth* (opened 1999) sits at the foot of Arthur's Seat, the extinct volcano that dominates Edinburgh's skyline. Dynamic Earth focuses on earth sciences, its topic chosen to reflect its position. The Chief Executive reflects on the surroundings, "….an old volcano [from] 350 million years ago, a craggantail feature moulded by the movement of ice and near 2 million years ago; there was a landscape that was telling us that we should tell the story of how the earth works…." (INT-CEN01).

Unlike other centres, the Dynamic Earth visitor experience is linear in that it is based upon the narrative of a story. Where other centres allow visitors to move backwards and forwards between themes, exhibits and floors, at Dynamic Earth everyone follows the same route from start to finish. The main disadvantage of this linearly designed exhibition is its inflexibility; the only practical place in which the experience can be easily changed and made topical is at the end. The experience as a whole is not amenable to frequent updating or refreshing. Like the Sensation science centre in Dundee, Dynamic Earth is well-connected into local science education and science engagement networks, contributing expertise, a venue and a context for this professional network. It works with local higher education providers on science communication education and often acts as a venue for engagement activity in Scotland's capital.

The last part of this network is Glasgow Science Centre (opened 2000) and IMAX cinema, a remarkable building on the banks of the Clyde to the west of Glasgow. More than any of the other science centres, Glasgow has set out to engage adults with appropriately-themed interactive exhibits. In particular, *Science In The Dock* sets out some of the ethical challenges associated with such developments as human organ transplantation or lunar space travel. Here, in a quirky puppet-based format, adults are challenged to consider some of the implications of more controversial areas of research.

Aside from specific exhibits, the role these different centres play in the wider science engagement network is considerable. The argument that science centres mainly attract children and families, and thus rely on unidirectional modes of outreach is well-worn. Practically speaking, science centres are sustained by the income they receive for this kind of activity which allows them to fulfil several important roles in the process. High profile buildings in prominent city locations bring science into view for a more general audience. Science becomes more than just the specialist activity carried out in universities; interesting buildings with open doors in accessible city centre locations make science something more accessible and cultural. Science centres also operate as key nodes in the science engagement network and they are instrumental in providing venues and expert knowledge for diverse projects such as adult evenings, Cafés Scientifiques and specialist CPD for schoolteachers.

Here I have explored projects funded by the Scottish Government to bring fairly abstract ideas of science to the public, using interactive exhibits in science centres to science tangible and experimental for the visitor. However, science centres cannot fulfil all aspects of participation and publics on their own. As I discussed in chapter 4, some communities are excluded on grounds of cost, and there is also a distinct lack of exhibits on renewable energy. How then can the Scottish Government reach beyond science centre audiences to engage broader publics on decarbonisation? One way they have done so is by employing technological devices to foster engagement, as I will now show with reference to Scotland's Climate Challenge Fund.

6.3.2. Devices for Interaction

The question of reaching new demographics (or, as I argued in Chapter 4, those who have been previously been excluded) has ongoing salience in science engagement, and I turn now to an example that demonstrates how technological devices have been instrumental in building relationships with tenants in social housing. While Marres and Lezaun (2011) described the role of material devices in self-styled green experiments, here, I consider their

significance for more top-down efforts driven by those seeking to promote public engagement on the issue of carbon reduction.

Reaching new publics through devices

The Climate Challenge Fund (CCF, initiated 2008) is a Scottish Government sponsored programme administered through the charity, *Keep Scotland Beautiful*. The programme funds responsive grants for communities who have proposals to lower their carbon emissions, from advice to intervention aimed at increasing the efficient use of energy. More than 100 projects have been funded, from community gardens to community food initiatives and energy advice.

I spoke to a representative of a medium-sized CCF project in one of Scotland's largest cities. Despite being relatively wealthy, the city has pockets of disadvantage, and this project is run by a Housing Association (a private sector supplier of social housing) to target the energy usage behaviours of their tenants. Here, access is a major barrier since tenants are generally unresponsive to 'outsiders' and anyway energy usage was not the most pressing concern for them.

Initially project directors tried their approach by knocking on doors to start conversations with people about changing their lifestyles, "….it didn't work…. I was knocking on doors in the middle of Summer …they wouldn't be interested in saving energy because the sun was splitting the sky, the heating hadn't been on… it was very difficult…." (INT-CIV08). When conversations were initiated, tenants were not necessarily receptive. Instead, a typical collection of responses would revolve around immediate issues, "….we don't really give a shit 'cos we've got houses that aren't particularly good, we've got junkies next door, or the place is full of Polish and I'm the only Scottish'….." (same respondent). A strategy that better reflected tenant's frame of mind was necessary.

The approach was quickly reoriented to frame energy in a way that is relevant to the individuals at hand. This generally means framing energy related

behaviours around cost in reducing fuel bills, around comfort since heat to maintain health and mobility, or around conscience for the minority who have concerns about energy and climate change. In 2011, the project allocated some funding to conduct 120 thermography surveys and this proved a breakthrough in facilitating an invite into the home. The surveys were quick, did not require any furniture to be moved and were requested by the Housing Association and these encouraged tenants to take up the offer of a survey. Building on the discussion prompted by the hotspots and coldspots shown on the thermal images, a broader discussion could be instigated whilst the surveyor was at work. By repositioning the encounter as something tangible and relevant to tenants in their immediate surroundings and moving away from abstract discussions of carbon the leader transformed the project. Abstract conversations about issues of climate change typically failed to interest or engage tenants, "…. they go, 'that's not for us, that's for the green welly brigade and the do-gooders'. They see it as something for the people who are more affluent or who have got more money…." (INT-CIV08). Something more material was needed.

The CCF project built relationships with 120 households by using the thermographic survey that would not otherwise have been possible, and the households have benefitted in practical material terms. Some have brand new, more efficient white goods through the white good grant scheme, which the project leader helped them to access, and some have reduced their fuel bills in a context of substantial fuel poverty. One tenant was able to charge his mobility scooter as a result of lower fuel bills and was able to get out out of his home and into the community more often.

The difficulties of meaningful communication around carbon-reduction also bothered a second CCF project leader, who used energy monitors as a means of reaching the community as well. He too struggled with engaging members in abstract terms, "….even when you get visualisation of …a tonne of carbon, its really difficult for me to imagine so how on earth anybody else can imagine it….[even though] the consequences of it are very important…." (INT-CIV02).

The community of interest was generally low income, so the message quickly transformed into one that was, "….more about the money they're saving and saving carbon becomes incidental…." (same respondent). Working with a tenants' co-operative in social housing in the same city, this project also turned to something physical to materialise an abstract message for a non-specialist:

> *"We started with the premise that the website would be the main tool…but it's overwhelming. So then we bought energy monitors and that's driven the bulk of the project. Initially people contacted us to have them for a fortnight and Id go and set them up and talk them through how they might save energy. More recently we've been targeting people on Housing Benefit(s) as a way to try to target people who might benefit the most from reducing their fuel bills"*
>
> INT-CIV02

Again, it is a device that encourages conversation and engagement that otherwise would not have taken place. The device acts as a mediator in the relationship. The relationship is the means by which low-carbon transition can be achieved in an area, simultaneously the most significant and most difficult for policymakers to move forward. Citizens have benefitted financially with reduced bills, but also have a better quality-of-life that is warmer and sometimes more mobile. And finally, since it all takes place within a co-operative, the message that tenants are have contributed positively to a global problem is reinforced. As the project leader said in conclusion:

> *"It makes them feel good about themselves…that's a part of society that feel least able…to do anything, 'Oh it's a global thing, its for governments to do, we don't really even vote…'. There's a whole lot of things they feel disengaged from. But I explain how their small actions taken together become something bigger"* *INT-CIV02*

My discussion on interactive participation looked at exhibits in science centres and examples of the use of devices as mediators of engagement. I will now return to the examples of Whitelee Windfarm visitor centre and the Electric Garage to consider what the corporate sector can offer that is unique compared to what governments or not for profit organisations offer in terms of interaction.

6.3.3. When corporations engage the public with low-carbon technologies

I have already described the Electric Garage in chapter, an SSE outlet in central Glasgow that enables consumers to test drive and charge electric vehicles. There, I considered the types of public that might engage through this sort of offering, and why they might do so. The aesthetic appeal of the Electric Garage and the opportunity it offers to physically interact with cutting-edge technology for fun, edges us towards a vision of technology in public as market product instead of a body of knowledge. In this example, publics engage with electric or hybrid automotive products as an expression of lifestyle and identity and not through a cognitive learning.

In participative terms, what is interesting about this case is that SSE is not a manufacturer of electric vehicles; it is a generator and retailer of electricity. Yet, on the ground floor of their technology centre in Glasgow they have opened up an exhibition space. Here, visitors can interactively engage with exhibits on renewable energy that have been co-designed with the assistance of Glasgow Science Centre. Entry is free. The Electric Garage offers a science engagement experience that is not provided by any other actors given that the Science Centre did not have any energy exhibits at the time of fieldwork and there is an entry charge anyway. The Electric Garage provides quality information and exhibits specifically on renewable energy in the centre of Glasgow at no cost.

As well as the exhibition space, Electric Garage offers free charging points for electric vehicles on the street, and short-term hires on a variety of electric

vehicles for sightseers or those who want to experience these new technologies. Clearly, there are branding drives at play here to 'green' the SSE image, but this particular example shows that this does not outweigh the engagement activities that corporations can achieve, which civil society and policy actors cannot or would not. As with the Whitelee Visitor Centre, companies moving into an engagement space that extends beyond their specific product or service potentially allows new kinds of publics to 'get up close and personal' with real-life technologies not primarily to *learn* but to *experience*.

6.4. Influencing Debate and Making Decisions

I have highlighted two kinds of engagement practice. I drew out examples that rely on listening, learning and effect, and the role of emotion and identification with a subject, event or personality (in section 6.2). I moved to consider a more material interaction, where a device or the physical attributes of an interactive exhibit serves to prompt participation or carry a particular message (in section 6.3). The final field of participation builds and extends the idea of materiality to develop a notion of 'materiality of substance' that refers to instances in which publics shape policy decisions. There is a range of degrees of distance between publics here and the points of decision making. I explore two examples. The first is the Church of Scotland's Science, Religion and Technology project and its role in bringing ethical perspectives into public debate, and more specifically its work with congregations in encouraging behaviours that will lower carbon emissions. The second draws on the direct and legitimating voice that the planning system has in policy decisions, and makes the case that participation in the land planning system should be considered a form of public engagement with science and technology.

6.4.1. Publics Framing Debates – the Church of Scotland's Science, Religion and Technology Project

The Church of Scotland is Scotland's largest religious organisation, and an important civil society organisation. Almost a third of respondents in the 2011 Scottish census identified the Church of Scotland as their religion and official membership stands at just under 10% of the Scottish population (Church of Scotland 2013). The Church of Scotland Guild is Scotland's largest voluntary organisation. Its membership and congregations can be considered as a public for a number of reasons: its significant size, its unusual reach, the public forum within which its states and debates its position, and the fact that it is disestablished (unlike the Church of Scotland). The Science, Religion and Technology Project (SRTP) was initiated by the Church of Scotland in 1970 to look closely at the ethical implications of science and technology in society, and to consider what religion has to say at that nexus. Environmental issues have been at SRTP's core since its inception at a time of rapid growth of the Scottish 'carbon economy' following the discovery of North Sea oil.

The project considers itself as bringing a 'balance' to the issues surrounding complex technologies, and expresses concern that there is sometimes an ethical lag in the process. SRTP hosts debates at the annual Edinburgh International Science Festival and the British Association's Science Festival, and works directly with agencies such as the think tank Demos, supplies speakers for individual congregations, showcases issues through youtube.com and produces short publications to record and disseminate its views. Some of its (quite technical) publications cover biomedical technologies such as cloning, stem cells, gene patenting, embryo research, GM food and crops and the social obligations of the developing industry. SRTP policy documents are developed on the basis of thought leadership as a result of debate amongst church leadership.

As such, SRTP helps the Church lead its congregation on complex issues based on theological reflection (rather than consulting with them and passing their views to policymakers). For example, SRTP establishes the Church's position

as upholding special status of the embryo in stem cell research, but supports some research in limited circumstances. The Church explicates the potential benefits to be had from stem cells alongside the ethical concerns and suggests that induced pluripotent (IP) cells as a possible alternative.

As SRTP turned to issues of climate change, the complexity and scale of the issue became so apparent that a new project *Responding to Climate Change* was initiated in 2007. The issue is considered so significant and so relevant to the Church's mission that it was delineated as a separate project that sits alongside the other SRTP work. In essence, *Responding to Climate Change* is the vehicle by which the public within the Church of Scotland congregation, has a voice and help to take action on issues of climate change. As the policy officer put it, "…the largest response I get is, 'Yes there's an issue, yes we understand it's an issue, no we don't know what to do, tell us what to do, this is too big to understand…if it's as big as you say– what shall we do?…." (INT-CIV07). In this, the Church acts as a guardian and guide, rather than as a consultant or facilitator.

By proposing that engagement in this public debate is a form of participation with technoscience, and that the congregation is a public questions of representation are raised. One reading would be that as Church policy leads, rather than reflects, the congregations position, the process is inherently undemocratic. To accept this critique though would be to misunderstand the way the Church works. It is very much in the Presbyterian tradition in the sense that issues are raised by the congregation followed by lively debate. However, the final position of the organisation is developed by Church leaders through in-depth analysis, which is then subject to the approval of the Church Council. Whilst explicitly accepting that the final stance is theologically- rather than consensus- driven, the Church feels that in some senses it is *more* democratic than some organisations such as NGOs in these questions of scientific ethics and governance, because they are more effective at challenging their own membership than NGOs traditionally have been:

"Other …. environmental groups who may have driven the arguments … are very reticent about challenging their membership. They're very good at challenging government. If the government say something they'll pop up on television to say "Oh no it isn't" and get their point of view across, and they're very good at lobbying, they all have their Parliamentary lobbyists in the Holyrood village - environmental lobbysits obsessed with legislative details - but they're very reticent about challenging their large numbers of members."

INT-CIV07

As well as challenging their own members and continuing the tradition of congregational responsibility, SRTP seeks to influence policy debates by participating in policy development; this can be particularly effective in reframing some areas of debate which are often 'off limits'. The climate change project has gone beyond technological innovation and behavioural change, to question the ownership structure of the energy industry and the consequences of growing consumption levels in the UK. The project officer reflected on the speed and ownership of onshore wind development in Scotland, noting that the sector was dominated by large companies and that local communities had little say whilst landowners could make large profits, "…. We want to see a far greater spread of ownership of that renewable power in Scotland to communities…." (INT-CIV06). Widening the frame of debate is something the church is particularly good at.

The Church of Scotland is confident that it plays a special role in Scottish public debate and is able and willing to tackle thorny questions that politicians are unwilling to. As the climate change project officer commented, "….of course there is one element missing from this whole debate that nobody wants to talk about, and that's consumption and how we need to consume less not more…"*(*INT-CIV07). The reframing role is not confined to climate; the

SRTP project has widened its remit to include assisted-dying technologies, "….beyond simply the act of dying to how people come to the end of their lives comfortably, so issues around palliative care are important to us as well as the act of somebody dying – their death should be a good death and they should have all the facilities they need…." (INT-CIV06).

In another mode of engagement, the Church goes beyond the purely discursive and fosters some material engagement. In Glasgow 2009, members of the Church of Scotland, along with David Chillingworth, Primus of the Scottish Episcopal Church, and Cardinal Keith O'Brien led a protest march as the *Stop Climate Chaos* coalition in 'The Wave', which was Scotland's largest action. A group of some 8,000 people marched to bring attention to Scotland's own carbon reduction plans ahead of the UN Climate Summit in Copenhagen (COP15) and call for other nations to adopt similarly challenging targets.

This kind of public protest plays a number of roles: it raises awareness through media coverage and word-of-mouth, it demonstrates political support for the prevailing energy strategy and provides a meeting point for like-minded individuals who may well be an emergent public or counterpublic. (a process I discussed in Chapter 4). Although they are most obviously oppositional in nature – protesting, refuting, halting – Michael Warner describes counterpublics as "….formed by their conflict with the norms and contexts of their cultural environment…." (Warner 2002:63). In this sense, advocates of environmentally conscious behaviour in a cultural context of overconsumption and waste can also be seen as counterpublics and part of a social movement (for example Greener Leith, discussed at length in section 5.4).

However, reframing arguments and telling different narratives is only part of the story of the counterpublic's participation. There is a question of decision-making. I have already looked at how counterpublics encroach on decision spaces; and now I move on to look at modes of engagement that draw in

invited publics, through the land planning system and through public dialogue for science.

6.4.2. Publics Making Decisions - Participation through the Planning System

The political and financial support available for renewable energy projects in Scotland has triggered a significant degree of land development in recent years. Energy production from renewable sources has risen by 28% since the start of this research, much of that from onshore wind. I observed a Scottish Parliament Debate on the future of the planning system, in which ministers discussed injecting an additional £14M into the planning system in 2013 in order to meet the demands being placed on it through rising volumes of renewable energy developments (INT-OBS15). The scale of proposed development amplifies the inherent tensions between ensuring adequate engagement and consultation with stakeholders and maximising throughput of planning applications, given the limited staff and resources available.

As a core site of decision-making about the future and about land use, it is surprising that public engagement with science and technology has not more fully addressed the competing demands on a planning system whose purpose is to, "….help build a growing economy, but at the same time protect our environment for future generations and make sure that communities can enjoy a better quality of life…." (The Scottish Government, 2009). This is generally executed through a systematic process that comprises three elements: local development plans, strategic development plans and supplementary guidance (that would cover, for example, guidance on location for large wind farms). All of which is developed by civil servants, approved by elected officials in councils and 'examined' by an expert appointed by Scottish Ministers.

The local development plan is the document in which the council's plans for the community are laid out, and it is the framework within which all future

development projects are assessed. Whilst there are opportunities for publics and communities to comment at the 'main issues' stage, and at the moment a draft plan is proposed, engagement at these stages is weak and uneven. Instead, as I illustrated in Chapter 4, opinion (particularly antagonistic views) can quickly coalesce around fully formed proposals for specific developments. This is often the case when the proposals are consistent with the local development plan, which opponents have failed to engage with previously. Consequently there is some conflict inherent in the system. Opponents fail to engage with abstract or outline plans when their views could have been much more easily accommodated. Instead they are much more likely to do so when proposals are more specific on details of size, scale, colour, and siting. This is highly evocative of the so-called Collingridge dilemma around the social control of technology. The features of a technology are uncertain until implementation occurs, but by the time implementation has taken place change becomes increasingly difficult (Collingridge 1980:19-21).

Policymakers and politicians have suggested that such mis-timed engagements might be ameliorated by the *charette* system of planning, where all parties – including the community, the developer, any stakeholders and the planner - come together for a finite period of time (often a weekend) to collaborate on design proposals. The emphasis is on achieving consensus. A series of evaluation pilots took place in Scotland in March 2010, and since then mini versions have been implemented where appropriate and written up as case studies to promote the practice. Whilst charettes offer the benefit of bringing all parties on to the same timeline in an explicitly collaborative basis, it is a very expensive system to administer on a large-scale basis. 'Mini-charettes' – shorter in length (3 days) and with a tighter focus – have been trialled (e.g., North Lanarkshire Council, 2013). A detailed exploration of the efficacy of the *charette* system is outside the scope of this work, but it is of interest as it shows another area of experimentation, alongside mediation and other process innovations in Scotland's low-carbon transition.

Large-scale renewable energy developments have different mandated mechanisms for engagement, compared to smaller renewable energy projects. Proposals greater than 20MW carry an obligatory period of consultation *before* being submitted formally, and in this process different parties can state their concerns at a time when developers can amend proposals. As one Scottish Government planning policy officer said, "… so when it actually comes into the formal planning process its capable of being approved and it has a smoother run through the planning system…." (INT-POL04). This process should enable communities to have a voice when operational parameters are still open to change which makes the process more cost-effective for developers.

This statutory consultation is not extended to smaller developments, where public comment is sought *after* submission of a concrete project plan. Cumulative impact of multiple applications is particularly problematic, especially where communities are sited close to the border of two or more planning authorities. Despite the fact that it is in developers' interests to carry out effective community engagement and there is extensive good practice guidance in the form of technology-specific Planning Advice Notes and a 10 Point National Standard for Community Engagement, this does not always happen. The diffuse nature of the small-scale renewables industry means that not all developers have the threshold level of capability to achieve the engagement and agonism can become embedded. Instead of learning to engage more constructively and potentially adding to the cost of proposals, developers tend to second-guess which communities they are more likely to be successful in. One engagement specialist from a renewables company said: "Oh yes, once you have a number of options that satisfy the technical requirements you'd always avoid communities with a high proportion of pale, male and stale…" (INT-COM01).

Here, the interviewee is commenting on the practice of avoiding communities with high populations of conservative white males, as this demographic is perceived to be both oppositional and mobilised, or well-connected enough to have influence. All other things being equal, developers prefer to locate a site

with a different demographic. This in-built fear of successful and expensive communities accurately reflects the 'imagined NIMBY' that I explored in Chapter 2 (Devine-Wright, 2011b, Walker et. al. 2010). Whilst Devine-Wright's research points to the consequent rise of polarisation that occurs from such imaginings, an alternative reading of this practice is that it comprises procedural injustice built-in before developments are even proposed. By selecting communities that are less mobilised, or more amenable to 'community benefits', the 'responsibility' of renewable energy siting is not equitable, a theme I explored in the previous chapter.

6.5. Conclusion

My purpose in this chapter has been to answer the question, "What modes of participation can scientific citizens be said to practice and how do the subject matter and participation mechanism shape one another?" I answered this question largely through the structuring role of materiality, finding that public participation spans modes that can be said to reflect different kinds of materiality. In 'listening, learning and affect' (section 6.2), I emphasised the emotional and non-cognitive aspects of what are largely discursive forms of engagement, using this distinction to highlight how even unidirectional models of engagement reach beyond critiques associated with the 'deficit model'. 'Engaging through interaction' (section 6.3) highlighted the mediating role of technological artefacts, in this case helping translate an abstract conversation about atmospheric carbon dioxide into a more tangible, material engagement via a thermographic survey, smart meter reading or an electric vehicle. Finally, in section 6.4 I looked at ways in which civil society and publics debate and oppose technologies, firstly in a discursive manner through organised civil society organisations (in this example, the Church of Scotland) and secondly in the challenges of publics participating in the planning system at the right time. In this last example, I invoked Collingridge's dilemma of the social control of technology - that features of a technology are uncertain until implementation occurs, but by the time implementation has taken place

change becomes increasingly difficult. Given that I have already argued that the materiality of a technology directly shapes public opposition and response (section 4.4), this emerges as a particular challenge to citizenship that I will develop in section 7.5.2.

Dialogue is surprising by its absence. There is a lack of formal dialogue in Scotland around the implementation of its low-carbon transition. Scottish people have not had the opportunity to engage on a national level about how this transition can or should take place. How much could it be reduced by lower domestic energy consumption and what support is needed for that? How much non-fossil fuel transport is needed and what role domestic does transport play in that, or what does the optimal energy mix look like?

After my fieldwork concluded, some activity did emerge so it is possible that there has simply been a lag in the process. As part of the Low Carbon Behaviours Framework, 'Low Carbon Dialogues' are being organised by the Scottish Government's Energy Team, in which a selection members of the public referred through civil society institutions meet with the Scottish Minister for Environment and Climate Change. When I interviewed the policy officer responsible for this in January 2012, the Scottish Government was wrestling with achieving the fundamentals of dialogue in terms of making facilitators, administrators and policy manpower available, assembling the 'best' group of public participants, and gauging the dialogic capacity of members of the public (INT-POL02). In general terms, the picture was of a less systematic process than the kind of public dialogue we have come to associate with the term. Since the fieldwork was concluded, the University of Edinburgh has become a participant in *R&Dialogue*, a European Commission project involving 10 countries that aims to encourage dialogue between research and civil society to facilitate transitions to low-carbon economies. At the time of writing, Scotland's activity has been limited to initiating a website although face-to-face dialogues can be expected shortly.

The second prominent strand to emerge from analysis of the examples through a lens of participation and practice is the role of materiality as a structuring principle. When I discussed concepts of membership and political community (chapter 4), I highlighted counterpublics and their overt political engagement around the consequences of the specific configuration of a technology. In Chapter 5, I drew out the special status of rights as technologies become spatially material, and here I describe different modes of practice and different ways of 'practising citizenship' that span discursive events, engagement mechanisms using material objects with new participants and participation that engages specifically on the material features of a technology.

This idea of materiality is more fully developed in the next chapter as a central node in citizenship. Here, I use the concept to point to a causal effect between materiality and public response and to highlight the necessary influence this has on both rights and modes of participation. If participation is considered in exclusion of the material, it is conceptualised by policymakers and commentators in an out-dated and overly narrow sense. As Nicole Boivin (2008: 6) comments in her book, *Material Cultures, Material Minds*:

> *"the material world impacts on the social world in a real way, not just because of its ability to act as a carrier of ideas and concepts, but also because its very materiality exerts a force that in human hands becomes a social force".*

Boivin highlights two different but related aspects of materiality – that which acts as a carrier of concepts (as in smart meters and thermography surveys) and that in which material forms exert their own force (as in local development). In distinguishing between these two aspects I do not place one in precedence over the other, but highlight that they do quite different work and can provoke different forms of participation. What I will call materiality of interaction (where a material device carries a concept) features in my analytical framework described in chapter 2 as "the active citizen". Barry (2000) went so far as to say that interactivity has a distinguishable effect on

citizenship. This work does support the role of material interaction in facilitating the communication of a wide range of scientific concepts and topics, and as in science centres, festivals and a range of public engagement projects designed to get 'hands-on' and experiential (see section 6.3.1.)

In contrast, aspects of what I will call the materiality of substance (where the material dimensions of a project become the 'issue' around which a public is formed arose out of the fieldwork as I sought to understand some of the observed responses to low carbon technologies whose shape and presence in the world was already formed and provided the object to which publics responded in an informed way. I use 'informed' here not to indicate a rational or cognitive response and I will discuss in depth the affective and axiological domains triggered by materialised technoscience. Instead, I use 'informed' to indicate that such responses are rooted in the specific configuration, siting and ownership of the technology and its supply chain and not in the general principles that are debated upstream.

Having discussed some modes of participation in relation to engagement with technoscience I will move on to position them alongside the work on membership and rights to draw out emergent themes and develop ideas as to how scientific citizenship might be conceptualised. In doing so, I will draw on themes that emerged across my analyses: political-cultural context, the role of the market and materiality.

CHAPTER 7 Discussion: Conceptualising Scientific Citizenship

In this chapter I address the first part of my final research question: "How are membership, rights and participation synthesised to produce an effective nexus in the performance of scientific citizenship?" In previous chapters, I examined social aspects of Scotland's transition to a low-carbon society through a lens of citizenship theory. I explored questions of membership,

using the notion of multiple publics to ask how we might conceptualise who scientific citizens are (see Chapter 4). I drew out examples of rights and responsibilities, contrasting how these are inferred, seized and attributed at local, national and global levels to consider what scientific citizens can expect, and what is expected of them (Chapter 5). Lastly I examined a range of sites in which engagement with technoscience (particularly low-carbon technologies) is practiced and I have suggested that differing modes of materiality are defining features in the engagement landscape (Chapter 6).

Here I will make some proposals for further defining the ways scientific citizenship operates by revisiting the typologies and drawing out the persistent strands of influence. I suggest three different ways in which might construct citizenship as a combination of membership, rights and participation.

7.1. Introduction

I begin by returning to the typology of scientific citizenship drawn from the literature that I presented earlier (Chapter 2), and ask how much of the typology is reflected in the empirical findings. I will describe how ideas of the *receptive citizen* remain prevalent amongst policymakers and civil society and return to established critiques of the deficit model to explore its surprising persistence. When I turn to the *consuming citizen*, I will point out how the 'interactive learner' represents an increasing focus on public engagement but the defining entry point of a 'consumer' shows the commercial influences on public engagement intermediaries and the expansion of commercial companies into the science engagement space. The *activist citizen* is also well established in the science engagement arena. I consider whether activism is a latent emergent form of ethno-epistemic assemblage, as suggested in some literature. The *dialogic citizen*, notable so far by largely its absence, is my focal point for considering the role of public deliberation in a context of far-reaching public policy that is apparently legitimised through representative democracy. Finally I turn to the rarely encountered *epistemic citizen* for a discussion of the disparate role of knowledge across the typology. I ask what

the prospects are for consolidation of different 'ways of knowing' in the low-carbon transition.

The central part of my discussion draws out three themes drawn from across the fieldwork that I have not considered explicitly so far. I turn first to the Scotland's national culture and politics as the context for the work and consider how the low carbon transition sits within that and how it has impacted public engagement strategies. I then consider the material nature of low-carbon technologies and argue that they differ substantively from more abstract ideas of 'science-in-general' (Michael 1992). I draw on the fieldwork to show how the material details of technological configurations fundamentally shape the publics that are relevant, the issues that are discussed and the strategies for engagement. I also consider the somewhat neglected role of the market in facilitating societal-level technological transitions, as a pathway to introduce new technologies to facilitate public engagement and, arguably, political expression.

The third and final section of my discussion reconceptualises the regime of scientific citizenship into three domains that better reflect the relational nature of citizenship. The first is *science, technology and cultural citizenship,* a densely-populated field of science-public interaction that extends intuitive understandings of citizenship from the political into the cultural. The second domain I propose is *science, technology and material citizenship*. Here, I build on the premise that the material configuration of a technology has a profound effect on the ways in which citizens engage with it, and will discuss the consequent limitations of consensus-seeking and ideas of 'upstream' engagement. The third and final domain I describe is *science, technology and anticipatory citizenship,* involving participation mechanisms that are based on situations where technological possibilities are not clearly formed, where research funding can shape future developments and where there remains space for citizens to be axiologically, epistemically and democratically dialogic. Here, the impulse to 'create' a 'representative' public distinguishes it from the other domains and is an ongoing challenge to ideas of scientific citizenship.

I hope to show that these domains invoke quite different ideas of publics and group membership, rights and responsibilities, rationales and modes of participation. I suggest that remapping scientific citizenship to reflect practice and theory allows us to come to terms with the fundamentally different nature of citizenship in differing socio-technical contexts and helps articulate alternatives to one-size-fits-all models of engagement. Remapping scientific citizenship also helps to challenge policymakers, academics, intermediaries and civil society to consider claims of citizenship in a more comprehensive and rounded way than has been done to date: as a triad of membership, rights and participation.

7.2. Revisiting the Typology

The typology I explored in relation to citizenship proposed five ways in which we might expect the scientific citizen to emerge: the recipient citizen, the consumer citizen, the activist citizen, the dialogic citizen and the epistemic citizen (section 2.4). I did not use these to structure my fieldwork so as to avoid reification of the conceptualisation (see section 3.2.2.). Instead, the fieldwork drew more broadly on the wide range of empirical sites that arose in the low-carbon context, which I subsequently analysed using the three foundations of citizenship: membership, rights and responsibilities. Having recounted that analysis in the preceding three chapters, this section will return to Chapter 2's typology asking how well scholarship in this field corresponds to empirical findings in this case. The section reflects on each type separately before considering the implications for low-carbon citizenship.

7.2.1. The Recipient Citizen

The receptive scientific citizen is a member of the public typically engaged as a recipient in unidirectional forms of communication or as a residual participant in participation structured around the deficit model of the public understanding of science. This notion of the public does persist despite academic critique and captures all three dimensions of citizenship - namely,

membership, rights and participation. Receptive publics, constricted by policymakers and science producers to 'learning opportunities', enjoy a right to scientific information and accommodate a tacit obligation to use the opportunity to learn more, to support the scientific enterprise and to encourage future generations in scientific careers. Publics are supported in these roles by a range of innovative participatory mechanisms: festival exhibitions, public lectures, celebrity appearances and demonstrations.

Despite the idea mooted by event designers that they offer publics an introduction to a larger 'world of science', members of the public showed little evidence of seeing themselves as setting out on a journey of discovery. The actual self-perception of these publics is outside the scope of this research, those who attend such events consistently describe their reasons for participating as being for 'fun'. In this somewhat perplexing response there is an echo of the "banal answers" that the anthropologist Nicole Boivin received when asking about *pili mitti* – a large red patch painted above the hearth in dwellings in the village of Balathal, Western India. Was it because the red soil used for the decoration was considered to contain Lakshmi, the Hindu goddess of prosperity? Or was it a symbol, representative of Lakshmi and all she might bring? Was its meaning carried from weddings, or death, or perhaps more generally life's transitions? Boivin pursued *pili mitti*'s symbolism throughout her PhD, afterwards returning to the actual answers given by householders at the time: "…….*because it looks nice*" they said. This stimulated Boivin's move away from her aim to retrieve of symbolic universal meanings to one that focussed instead on the substance's materiality and its sensory, not symbolic, qualities (Boivin 2008)

The idea that all social interactions have a symbolism and a deeper socially acknowledged meaning persists through many of the science engagement modes that have grown so rapidly during the course of this research. Interviewees – particularly those receiving core funding from the Scottish Government's Science and Society Unit - regularly attribute rationales of learning, cognitive challenge, career building or perhaps deepening of trust to

engagement activities that visitors simply describe as 'fun'. This is not to say that the interaction is one-dimensional or meaning*less* for these visitors, more that some of the meaning lies much closer to the surface than we have become used to looking. I explore this question of materiality more comprehensively in section 7.4.2.

Our ready ability to identify the recipient citizen lies in the persistence of the construct. After more than two decades of critical attention on unidirectional communication, and almost a decade of urging dialogue and upstream engagement by the National Coordinating Centre for Public Engagement (NCCPE), science popularisation is flourishing in demand (members of the public who wish to attend such activities) and in supply (the number of scientists who are willing to engage on this level). Scotland's Beltane has been particularly successful in stimulating and facilitating a culture of openness (see section 5.3). How should we understand the surprising disjoint between policy and activity? Is it merely an implementation lag, as communicators find ways to realise more dialogic and upstream ways of engaging the public with their work? There may be inertia in an academic system geared toward lecturing and science communication infrastructure that relies heavily on science centres (section 4.2.3) designed for children, and all that has pedagogically entailed. Or perhaps there is a value that has not yet been fully captured in the dominant discourse of knowledge and learning. It is a question that perplexed me throughout the project.

This is a fascinating question for further research, but there are some clear indicators arising from numerous strands of this research that I want to draw together on this topic. Firstly, many festivals, science centres and talks help break down barriers between science and public by taking science into community venues or bringing publics into university open days. Demystification is important, and I would argue is a necessary precursor to more substantive forms of engagement with abstract science topics. It is also clear that people enjoy it, find it 'fun', and a worthwhile activity to do as a family, as couples, and individually. Likewise scientists enjoy it – the ability to

work on a one-way mode of communication allows for a creativity in format that many public engagement staff thoroughly enjoy, are motivated by, through which they are also able to express their personalities. It is also a site of reflexivity akin to 'midstream modulation' (Fisher, Mahajan and Mitcham 2006). The scientist does not come out of the process unchanged and the act of articulating their work in non-specialist terms involves a process of reflection too; it is not a shallow process in that sense. As one neuroscientist who had worked on a science busking cart in a shopping mall commented, *"I think about my work completely differently now."*

In sum, traditional science communication with publics as enthusiastic recipients (as opposed to more upstream, dialogic work) is an extremely valuable part of the public engagement landscape in its own right, and I have suggested some grounds on which this argument can be made on its own terms, to counter the increasingly prevalent idea that dialogue should take its place at all costs, as the ultimate form of participation (see section 2.1.3.). To counter this, I would point to indicators that an explosion in science communication activities is gradually drawing science into what is perceived as 'cultural experiences' as opposed to consumerist visitor attractions. As one science centre interviewee commented, "….I think the [cultural networks] feel like the people who do arts and dance, they're more about giving experiences to different people whereas they see us as out to get people through the door to get money…" (INT-FES02). If the aim of science communication is public familiarity that potentiates greater involvement, then efforts to ensure science is seen as a cultural activity that gives something to the community rather than a business enterprise that takes from the community are not wasted.

However, justified science communication might be, it cannot be considered an expression of citizenship of and in itself. In light of our three core tenets, we can see a range of ready participation mechanisms, some of which are more accessible than others largely on the basis of cost and geography. Rights and responsibilities can be identified, but are somewhat unbalanced; even though the opportunity to explore and challenge is in place (particularly for

example at Cafés Scientifiques), publics do not generally get the opportunity to choose what is communicated, when and how. Yet a sense of a coherent public aligned together around an activity or issue is distinctly lacking. The idea of the recipient citizen lacks is any real notion of *citizenry*. The concept of the consumer is also a relatively individualised understanding of what the concept of a scientific citizen might mean.

7.2.2. The Consumer Citizen

The idea of the scientific citizen as a consumer has evolved considerably over the course of the research. Originally, it was tied to ideas of the 'active' citizen, interacting with exhibits in science centres to introduce a different form of learning. Elam and Bertilsson (2003) used the notion of the 'advanced consumer' to highlight the idea that science communication can be an enabling process, leading on to deeper engagement on the terms of the participant. Such a transition is embedded in the 'lifelong learning' agenda that was mentioned by interviewees from science centres (see section 6.3.1).

Interactivity is seen as important for a high quality engagement experience because it reinforces learning, sometimes providing a mechanism by which visitors can navigate their own way through a topic or exhibit, in essence tailoring their experience. In the decade that has passed since Elam and Bertilsson (2003) and Barry (2000) published their view of the field, science engagement has moved outside the institutions of science. Efforts to make science engaging, exciting and interactive have flourished in recent years. To science festivals, science centres and Cafés Scientifiques we can now add Bright Club (research themed stand-up comedy), Science Showoff (a "chaotic open mic night") and Science Busking (2-3 minute science tricks in public spaces and non-science public events). It is usual that these activities originate from a science policy base – specifically research councils, NCCPE and universities. No longer in dedicated halls of science (whether science centres or universities), science engagement now takes place in shopping malls, coffee shops, pubs and bars, along riverbanks, and at cultural festivals. This

relocation of science engagement into public spaces is an interesting trend over recent years, a point to which I will return (section 7.5.1).

However, the public consumption of scientific research topics is only one side of the story. An interesting pragmatic aspect is that there is frequently a financial cost involved, (Chapter 4). In this sense, the role of consumer–citizen extends beyond simple participation into an economic transaction, an aspect of engagement that emerges the more closely we look at how Scottish publics engage with the low-carbon transition. Whitelee WindFarm Visitor Centre and the Electric Garage are examples of the role that corporations play in engaging communities and potential customers in understanding foundational technology (see chapters 4 and 6). Publics buy electric vehicles, choose energy suppliers and transport modes, promulgate recycling, co-produce trends for product replacement rates alongside product developers. Aside from individual levels of energy consumption, citizens can deliver traction for a low-carbon transition through the choices they make as consumers, and Scottish and Southern Energy and ScottishPowerRenewables have moved beyond services and products to communicate messages on general concepts of habitat and landscape, climate change and energy.

However, the idea of citizens as consumers is not unproblematic. The critique of the active consumer as a form of citizenship is similar to that of the recipient citizen – that they are not explicitly political enough, and do not enact participation at the point of policy decision-making. Instead, the influence is at once more subtle and more widespread. Participants here express choices, manifesting a trend as consumers, which is recognisable within market-dominated management philosophies. In turn, organisers respond with innovative forms and locations of engagement and new products and services. There is an increased sense of affective engagement in this conceptualisation though, in which interactions facilitate emotional experiences like humour, or wonder or offer the experience of interacting with a landscape or object (see sections 4.2 and 4.3). Whilst it is true that market mechanisms can be exclusionary on the issue of cost, many other forms of

participation are equally, if differently, exclusionary on grounds of location, cost or knowledge requirements. Here citizen-consumers can visibly forge a sense of identity through their market choices, tapping into the social structures required for societal level transition that can be elusive to the reach of policymakers. The market can reach parts government can't reach. However, the degree to which a consuming public can be considered a citizenry is debatable, and it is in the sense of mutually sharing and common good that the idea of the consumer-citizen becomes most problematic.

7.2.3. The Activist Citizen

Activists are also scientific citizens and counterpublics are a significant actor in debate and opposition (section 2.1.5). When we look at activism around onshore wind energy (see section 6.4.2.) we can detect signs of citizenship at different levels. At ground level, local opponents engage both rationally and emotionally with the specific materiality of a proposal – its location, size, scale, installation plan (Cass and Walker 2009, Devine-Wright 2011c). Local communities are categorised as stakeholders and have the opportunity to formally contribute to the process. In return, local residents carry the responsibilities of funding and voting for the local government infrastructure that facilitates this process, though they must accept some restrictions on personal preferences along with the role of local government as the ultimate arbiter. More tacitly residents carry some responsibility to engage in the development of their community, again through formal consultation processes (section 5.5). This set of processes is indicative of a form of what I will call 'material citizenship', which has an affinity with issues associated with the development of the built environment. I will return to this emergent form of citizenship, and the particular role of materiality within it (sections 7.4.2 and 7.5.2.).

Outsiders enter into this community activity, in person as external activists catalysing and mobilising communities, or in the form of national opposition networks sharing data on the scale and impact of cumulative development along with a narrative of opposition. Both activists and networks can be called

upon to bring a wider perspective to a local issue and alter the grounds of debate. Perhaps in the form of expert knowledge associated with sourcing solid fuels for a proposed biomass plant enabling the community to challenge its inherent sustainability, or in throwing light on entrenched injustices as communities seek to recover from long-term mining (see section 5.5). In the example of onshore wind, the emergence of a national network of opposition offering source material over the last decade points to resistance as a more connected and targeted activity that challenges at deeper levels: monitoring international reports on the thorny issue of possible health impacts, pointing to flaws in the subsidy system for developers and challenging the capability of onshore wind to achieve the climate change mitigation goals that make Scotland a fertile landscape for developers.

I have shown how activists in a community can have an influence that reaches beyond an interpretation of science and how it is understood (Section 5.5). In fighting explicit ideas of justice, science and technology become the landscape upon which older arguments are played out. Science loses a little of its special status in the examples here, as technology implementation reveals injustices that reach beyond questions of understanding and knowledge. Instead, I would suggest that in essence they are disputes about *meaning* rather than *knowledge,* and the struggles we see are not about understanding, but about the kind of future we as a society want.

7.2.4. The Dialogic Citizen

I have already pointed to the accelerating academic and policy emphases on dialogue and its perceived role in facilitating a step-change in citizenship (Section 2.1.3.). I have problematised some of the assumptions inherent in this view. I have highlighted the lack of opportunities for dialogue around Scotland's low-carbon transition. The emphasis on the priority of Scotland's low-carbon transition, its scale and impact on the one hand, and the absence of dialogue on the other is a conundrum: why, if dialogue is so desirable and the low-carbon transition so important, is there a vacuum in relation to dialogue?

The first clues lie in the nature of the relationship between Sciencewise-ERC and the Scottish Government. Whilst a member of the Scottish Government is on the steering committee for Sciencewise, this is a civil servant from the Science and Society section rather than one from the policy-making departments. This has led to some disconnect between opportunities for policy intervention and a potential role for Sciencewise-ERC within that. The second reason is more broad-reaching; whilst deliberative processes for science and technology have gained ground, they rely heavily on departmental sponsorship to find traction, and so have remained isolated pockets of deliberative democracy in a political landscape of representative democracy. In this context, dialogue is one of many inputs into the policy-making system rather than a bedrock of the policy-making process itself. In the low-carbon case, the SNP is a majority political party elected with a manifesto that explicitly supports renewable energy. One might then ask, what is there left to talk about?

A further piece of the political puzzle is the role of the market, or more specifically the policy context that envisages the low carbon generation transition as being led by corporations and their markets stimulated by subsidies and feed-in tariffs and not by political strategic aims. The opportunity of the public to have a voice on anything but the largest developments in generation technologies and sites is complicated in that decisions for siting and design are taken by the private sector. This means that they are largely processed at an individual project level by way of invitation to input through the planning system or frameworks for regional and local spatial management. So, in a transition operationalized through the private sector, there is little place for formal dialogue.

So, if we are to entertain the idea of dialogic citizenship in the low-carbon transition, a relative absence of dialogue points to some problematic areas particularly for rights and responsibilities. Perhaps the point most clearly made in this study is that publics do not have a right (or a means) to *instigate* dialogue.

7.2.5. The Epistemic Citizen

I outlined the notion of an epistemic scientific citizen as a response to calls for 'citizen science', in which members of the public become collaborators in the scientific endeavour (see Chapter 2). This kind of activity lies on a spectrum, with citizens engaged as 'sensors' (e.g. SpringWatch, Scottish Environmental Protection Agency)at one end, or analysts (e.g. Galaxy Zoo) and only in quite rare circumstances are they involved in a full cycle of research from questions to data collection and results outputs. Over recent years this level of collaboration has become known as 'extreme' or 'radical' citizen science with research projects such as *ExCiteS* seeking to develop toolkits so that communities can start their own projects on topics of relevance to them, regardless of their previous education (EPSRC 2012).

There are contexts in which citizen science is more prevalent than others. Traditionally associated with ecological surveying and astronomy, more recent trends have capitalised on Web 2.0 technologies to harness the power of the public as a 'crowdsource'. Energy technologies for generation are not an obvious locale for citizen science, and whilst one might envisage more possibilities with respect to energy consumption through energy monitors it is not yet apparent what the public' epistemic role in such a project might be - a research topic in itself.

In retrospect, outlining an overtly epistemic scientific citizen was somewhat clumsy framing, given my use of a literature drawing on a rationale that refers to publics as research participants. The empirical work quickly highlighted that across other areas of the typology, citizens clearly act epistemically. For example, recipient citizens learn about novel ideas at science communication events, consumer citizens research new technology related purchases (such as solar panels), activist citizens build arguments to challenge a proposed developments, and dialogic citizens contribute lay expertise to policy development.

A breakdown in boundaries between elements of the typology is not restricted to points of knowledge mobilisation. The consumer citizen, for example, shares a close relationship with the recipient citizen, an interdependency explored in science centres and science festivals (See 4.2.3 and 4.3.1 respectively). This is another reason why the reconceptualisation proposed here takes a different approach to membership, which better reflects all three dimensions of citizenship.

What I reach for instead is the idea of the citizen as a co-creator in the scientific endeavour - a partner rather than participant. However, even when this mode of participation is available and the 'citizen scientist' emerges, it does not necessarily follow that this is a citizen-making exercise. I argue that two other foundational aspects of citizenship also need to be present in a meaningful way – public participants as members of some public or group greater than the sum of its individuals, along with the *right* for members of the public to participate in such ways.

These reflections on my original typology come about as a result of a breadth of fieldwork on public engagement with science in Scotland, and considering the typology in the context of an ongoing transition to a low-carbon society. I now shift the focus of attention to the transition to consider how we might think about citizenship given the patchy manifestations of some of the models from the typology.

7.3. Low Carbon Citizenship

It is difficult to discern any substantive efforts on the part of The Scottish Government to stimulate a sense of scientific citizenship on the issue of low carbon transition that are anything more than drives to encourage co-operation with a transition that is already proceeding. There is no clear pathway for publics to develop and exercise an opinion on how this new economy might best be achieved. Because renewably sourced energy is not yet differentiated in the consumer market, consumer publics have limited

opportunity to influence the available options by selectively increasing demand for 'green energy'. Although suppliers have recently begun to offer green energy tariffs, they are technology-blind so do not allow consumers to differentiate between their preferred strategies. Green tariffs also attract a price premium, and the current price environment means that it is a very blunt proxy for gauging public views. So instead of incorporating the public in shaping this transition, it would appear the Scottish Government is relying wholly on an information strategy to educate a passive public on the benefits of transition, in anticipation of citizens who are happy to make a local or personal sacrifice for national benefit. In this case citizens are to assume responsibilities, but are given no rights.

What is particularly visible in relation to low carbon transition is *emergent* forms of low carbon citizenship, particularly in the form of activism. This is readily observable in the context of onshore wind, as the most mature and most visible technology. Anti-wind activists have asserted themselves as a public by invoking issues related to intermittency and subsidy in an attempt to avoid a NIMBY framing of their response. 'Not In My Back Yard' is an unhelpful label lacking insight used to describe any and all local opposition to development. Walker et.al. 2010 offer an insightful analysis on the performative effects of NIMBY constructions, showing how imagining and anticipating such responses from the public shapes the way in which they are approached by developers who anticipate antagonistic engagements. Walker highlights the way imaginaries circulate in the system, and this case shows how this works on the part of the public too. In expecting their concerns for place to be treated in a dismissive manner, pan-Scotland opposition networks are building expertise and arguments relating to technological strategy (intermittency) and economics (subsidy).

However, arguments of this nature have more traction in public debate than specific planning decisions where the specific configuration of particular technologies remains at the core of discussions. Issues such as siting, scale and operating parameters become the locus of dialogue and disputes. The

materialization of technology makes a substantive difference to the kinds of publics that emerge to their mode of citizenship. Indeed, it is difficult to see how calls for upstream engagements with a carefully created publics, could ameliorate this type of conflict. In contrast, the evident seizure of rights to debate and opposition along with their effective interventions in the planning process indicate a robust form of citizenship focussed on the material and the affective.

Not all activism or counterpublics are one-dimensional in their opposition, sometimes opposition to dominant ideas is their driving force, but sometimes they are focussed on promoting and mobilising interest in different visions of the future (see section4.4.2). Both are exercises in citizenship, but one is more material in nature, the other more anticipatory. Biomass generation stimulates these kinds of responses for different reasons. Here, more distant consequences of global sourcing and movement of feedstocks on 'low-carbon' credentials come into play. Responses are equally agonistic and some campaigners and local publics have been successful in getting development proposals withdrawn.

Activism related to energy decisions is a key area for showing up alternate visions of democracy. It is not that forms of expertise or access to decision-making are at stake because many activist citizens are pursuing something other than a liberal democracy. Instead of universal rights, they call for significantly different democratic, economic and social organisation: local energy targets, lowered consumption, use of local resources. This is perhaps a democracy more 'communitarian' (after Leach and Scoones 2005) or 'republican' (after Barry and Ellis 2011). Perhaps the most common manifestation of this kind of citizenship is in community energy, where communities take responsibility for energy supply through various financing models, and hence energy consumption (the Scottish Government has a policy target of 500MW renewable energy in community ownership by 2020). Although outside the practical constraints of this project's empirical work that led to a focus on cities, community energy has substantive roots in a country

with a geographically dispersed population. Communities in the Highlands and Islands region have pioneered community energy, a lifestyle that is enjoying uptake in many hundreds of projects across Scotland using technologies including wind, solar, biomass, hydro and heat pumps. Consistent with 'communitarian' and 'republican' visions, benefits reach beyond those of simply lowering carbon emissions – communities that generate and use their own energy are imagined as being stronger, self-reliant, and as socially and economically resilient (Community Energy Scotland 2013, JRF 2010).

Furthermore, we can readily see other activism in Scotland that is equally active without being agonistic. To isolate these expressions of such fundamentally different visions of the future from mainstream processes of public engagement may in some sense "purify" decision-making processes (see, e.g. Durant 2011 for debates on this), but does nothing to resolve unspoken tensions (Jasanoff 2011). Numerous civil society groups have formed with the purpose of exercising a form of energy citizenship to promote behaviours that reduce local demand and engage fully with new generation technologies. The Church of Scotland sets carbon emission reduction targets for their congregations and Greener Leith engages a local community in pro-environmental behaviours, mediating new local technologies for the public. Many Carbon Challenge Fund projects operate at exactly this scale, and are in many ways designed to work with a public comprised of environmentally engaged social housing tenants. CFC project managers translate guidance about carbon emissions into accessible and relevant measures such as fuel bills and health benefits, because this is what is relevant to these publics.

In the examples given here, citizens act with varying degrees of epistemic agency and purpose. In practice, the movement of knowledge around a citizenship landscape is more nuanced and differentiated than originally envisaged in the typology, which was derived from existing work on 'citizen science'. Although citizen science was barely visible in the decarbonisation case, epistemic work is scattered across other parts of the fieldwork. These

span deep interactions with technical topics in order to learn about energy through product consumption and proactive research on the wider effects of development proposals or on what the outcome of previous implementations have been.

Having reconsidered some of the difficulties that lay within the initial typology of scientific citizenship, I now draw together three strands of study that emerged from the fieldwork, which shaped my ideas on citizenship.

7.4. What Influences the Manifestation of Citizenship?

I have drawn a typology of guises of the scientific citizen from previous studies on public engagement with science, publics and renewable energy and ideas of citizenship. I have described fieldwork collected from a variety of contemporary public engagements with science in Scotland with an emphasis on engagements related to low-carbon transition. I used dimensions of citizenship: membership, rights and participation to analyse the fieldwork (see chapters 4, 5 and 6).

I have revisited these types to ask how clearly the proposed archetypes can be observed in practice. I find that the oldest (recipient-based) models are the clearest to see, whilst the others are patchy or slightly altered compared to the original typological conceptions. Now I lay the groundwork for a reconceptualisation that draws out three cross-cutting themes of political-cultural context, materiality and the role of the market. I conclude with a remapping of scientific citizenship. First to the specific national context that is the backdrop for this work.

7.4.1. Scotland's political-cultural context

It may be less surprising to the reader than it was to the author to find that the national context for this study bubbled up to the surface fairly quickly. The Scottish context was most prominent in three areas: the political environment as Scotland pursues full independence; the cultural environment, with

reference to the Scottish identity and Scotland's enlightenment heritage; and in the economic environment given the role of energy resources in Scotland's recent past and near-future.

When I began this research in 2010, Scotland had been led by a devolved government (The Scottish Government) for over a decade, accountable to the Scottish Parliament for policy areas including transport, education, economic growth, justice and its National Health System. Since 2007 The Scottish Government has been controlled by the Scottish National Party, first as a minority Government, and then, after the 2011 Scottish parliament election, as a majority government. One of the new government's first acts was to establish a referendum on full political and economic independence for Scotland, which will be held in September 2014.

Clearly, visions of the future play a key role in the independence debate and energy has a big part to play in this, which offers energy independence, economic growth and skilled employment, some of it in rural areas that are a challenge to revitalise in other ways. This continues to be an important trajectory for energy resources in Scotland, a story that started with the discovery of North Sea Oil in the 1970's. So, the role of renewable energy has a social and political resonance way beyond 'keeping the lights on', which elevates the stakes for politicians and publics. Given the longstanding unease of Scotland's relationship with England as the centre of the Union's political and economic power, it is perhaps unsurprising that national identity (a sense of being Scottish rather than British) is expressed more strongly than is a specific English identity (Bond and Rosie 2010). This sense of identity is frequently associated with a sense of place, often in very local terms, as a Glaswegian vs. a Scot for example (e.g. Smout 1994, Braber 2009). This sense of place is especially salient in situations where proposed technologies require significant land siting. To install a material technology is to change the environment. "Wild Scotland" is dependent on a healthy tourism industry and is described as 'one of the last remote landscapes' and so it is unsurprising that as technologies are materialised so too is public reaction and engagement.

The Scottish cultural context also raises the idea of 'self-improvement' and 'worth'. Although science popularisation has deep roots in London, with the Royal Institution public lectures (est. 1825), the Natural History Museum in South Kensington (1881) and the Science Museum (1857), such public engagements are strongly associated with the city's institutions. In contrast, Scotland is perceived by some as the home of more diffuse, civic popularisation. One interviewee, leader of a Scottish science centre, commented on the appeal of worthwhile activities to Scots who, from their Scottish Enlightenment heritage, recognise value in a process of '*seeing something you wouldn't otherwise see, expanding the mind, thinking about other processes'* (INT-CEN01). The concept of civic engagement is played out by the prominent role the Church of Scotland plays in public debate. The Church of Scotland proactively engages with publics and policymakers on a range of technoscientific issues (see chapter 6). From the Church's point of view, this is a continuation of their longstanding role in public debate stemming, in their words, from the need for national level civic discussions in the absence of a national Parliament.

I draw attention to these elements of the Scottish context as a precursor to a broader discussion on cultural citizenship which follows. Lying behind and shaping Scotland's low-carbon transition are visions of what Scotland has been, what it will be and what the role of science and technology is in it. These socio-technical visions (Jasanoff and Kim 2013) shape different understandings of opportunities and threats, of governance and involvement which in turn impact the type and nature of public engagement that will gain traction in any context. In the Scottish context engagement is influenced by questions of independence, the importance of the material landscape and the value placed on self-improvement and civic involvement. I will return to these factors in section 7.4.

7.4.2. Materiality

Looking back across the course of this research, it seems surprising that public engagement with Scotland's low-carbon transition could be considered anything other than a story of materiality, even so it is neglected in the literature. This story is part of a widespread tendency in the social sciences towards discursive approaches in a '*marginalisation of the material*', in which society and culture have been interpreted and described as cerebral inventions that rise above matter, physical design and objects (Boivin 2008:16-23).

The idea of materiality can be conceptualised in terms of the effect it creates between the physicality of technology and the social groups it comes into contact with, direct or indirect. Carlile et. al. (2013) lay out a series of different understandings of materiality, ranging from embodiment (with the material as mediators of action), relationality (characterised by a primacy of association), interpenetration (suggestive of a mutual intimate positioning) and finally, inseparability, (indicative of fusion or an "irreversible coalescence"). These different understandings of materiality have ontological consequences in terms of how much agency we ascribe to objects as they come into contact with humans. Some trends in STS have moved towards stronger ontological statements, suggesting that objects can and do become inseparable from humans, most notably in work associated with actor-network theory which has clearly pointed to the array of non-human materials that are available to, and manipulated by, humans in achieving their goals (Callon and Law 1997). The fallout from ANT philosophy creates controversy over the loss of an important distinction between humans and things (Winner 1993) and a risk of falling into perpetual relativity (Collins and Yearley 1992).

The arguments in this thesis have touched on materiality in two ways. The first is what I will call *materiality of interaction*, where the material emphasis is on exhibits and devices that embody and transmit messages through interactivity and affective response and lead to an understanding of a broader principle. I explored examples of this in interactive science centres (6.3.1), thermographic surveys (6.4.2) and products that facilitate a reflection on

energy and climate (6.3.3). In recent studies, the materialisation of engagement has been used as a lens to look at cases including smartmeters (Marres 2011) and gaming visualisation (Davies et.al. 2012), each drawing different degrees of ontological implication.

Yet, there is another manifestation of materiality that is not related to conveying messages or initiating engagement. The counterpublics that are stimulated by wind turbines or woody biomass plants raise the question of materiality according to the body of research that has carefully explored the reasons behind this. It is not the energy that is provocative here, it is more often the specific configuration of the technology that is problematic, whether it is its size, location, number of turbines or operating parameters. Here is interpenetration of the social and the material suggesting their mutual shaping. The social influences the physical configuration of technology in ways that are both implicit (when developers 'guess' what is acceptable) and explicit (when parameters are negotiated through a consultation process). On the other hand, the technology shapes the social at a fundamental level by bringing it into being. The argument running through this work posits that the (counter)public would not exist without the technology. In this sense the technical and the social are mutually constitutive.

In this second sense I highlighted a *materiality of substance,* in which the material emphasis is on implemented infrastructure. This occurs in developments or products that stimulate a cognitive and affective response leading to debate and sometimes opposition to the project and what it is perceived to stand for. Examples included a range of material objections to onshore wind (4.4.1) and woody biomass (4.4.2). In previous studies of public response to specific technological proposals, materiality is uncommonly used as an analytical lens, although it has been made note of in cases of oil pipelines (Barry, 2013) and hydrogen energy (Flynn, Bellaby and Ricci 2011).

There are implications here for both public engagement and scientific citizenship. Whilst the connection between issues and publics has been

acknowledged (e.g. Marres 2005), the public that is 'sparked into being' can only express its citizenry when an opportunity to engage becomes available. Of course, it is unlikely to be a single unified public that emerges. The complexity of objects lies in their ability to form multiple, differing, often competing publics (and counterpublics) around a single technology, and because these publics are frequently stimulated by aspects of the physical design they differ significantly from the public that would be *created* around an issue. Of these publics, each makes an unarticulated trade between rights and responsibilities. Upstream engagement in emerging technologies has been found to be particularly problematic in the case of emergent technologies (Corner et.al. 2012, Flynn, Bellaby and Ricci 2011), and this study extends their conclusions to what seem quite mundane technologies. It is not just "….a meaningful and realistic appreciation of the environmental and personal benefits, costs and risks which might result…." (Flynn, Bellaby and Ricci 2011:255*)* that fully engages the public, but a material appreciation of the technology in situ, and the dynamic, unpredictable shape of the socio-technical network that rails in its wake. This cannot ever be addressed in upstream engagement. Instead, there is real danger that upstream engagement with the public leads to overstated assertions of legitimacy that privilege certain sections of '*community*' and extends long beyond the momentary meeting of minds. How then, does materiality impact citizenship? Who might be involved? What rights might be in play and what participation mechanisms might be suitable? These are the questions to which I turn (section 7.5.2) after concluding the themes arising from fieldwork with a discussion on the role of the market.

7.4.3. The Role of the market

Establishing the key contribution that materiality is important and necessary leads directly onto the third core strand in this discussion, namely that an under-theorised vision of the relationship between the public and commercial technology developers is unhelpful and misdirected, and actually impedes the

development of scientific citizenship. Citizens as consumers are an important part of the public engagement picture, for reasons I now outline.

It has become popular to claim that modern society is enslaved to the market and that considering publics as consumers appeals to our most basic instincts. Even at its most rudimentary, consumption can have positive effects by providing certain groups of individuals a means to establish a common identity, perhaps through early adoption of technology (for example low carbon vehicles and domestic solar panels). This is a mode of engagement that incorporates parts of the public that would otherwise be neglected in a low carbon transition. Buyers of electric cars are not necessarily science engagement enthusiasts, or participants in public dialogue (if such a route were available), yet along the route to purchase they have the opportunity to learn about climate change, emissions reductions, renewable energies and low-carbon vehicles before trying one out.

Bevir and Trentmann draw on the work of philosopher John Dewey to argue that choice is an inherent part of everyday life, fostering a sense of personal identity as well as attuning oneself to one's social peers and civic environment (Bevir and Trentmann 2007:15). Whilst keeping this influence in mind, I do not wish to go so far as to suggest that the market is of itself an effective manifestation of direct democracy or the right place to moralise public life and global relations. The low carbon transition has a particularly nuanced relationship with consumption, in that it is almost always associated with increased carbon emissions, whether through the manufacture of new products or net effect increased transportation (for example).

To counter the risk of increased resource use through new demand, some appeal to an alternative economic environment featuring small, more co-operative structures of generation and consumption; but such visions are not fully developed and lack traction in the mainstream political system. I am not arguing here that carbon emissions could not be reduced through more societal emphasis on localism and less emphasis on growth, although whether

this would be the case or not is not at all clear. Instead, I take Scotland's current economic organisation as a point of departure to reflect on the importance of the market in reinforcing a politics of identity. I use it to observe how different forms of participation are opened up and - although exclusionary in its own way – how the market creates a more diverse space where citizens act independently of policy institutions in enacting a personalised (Michael 1998) vision of a low-carbon future.

It is important to hold on to the thought that the market is an important site of action in the context of a low-carbon transition, given that policy that urges behavioural change is at best taking too long, and at worst is ineffective. If climate change is a moral issue, and public discourse has not driven normative influences to demand greener energy, appliances and routines, then is there anything to be lost by engaging more constructively with the idea of the market as a moral space. Given the economic context of advanced liberal democracies with heavily privatised utilities, infrastructure and manufacturing, the low-carbon transition can only be realistically viewed as a matter of choice since government has divested itself of so much agency. However, even as we recognise the potential for choice to undermine decarbonisation, it is also the case that choice can work towards achieving a decarbonisation goal by binding individual actions together into social structures. Previous work has already established the need for approaches that look to the level of society beyond the individual. (Walker and Shove 2007). Choices are not simply rational or neutral, but are socially influenced by those around us and ideologically shaped (Tormey and Townsend 2006:89) just as much as demand for technologies is socially constructed.

The evolving role and action of corporations in helping citizens negotiate complex interactions with science in ways that go above and beyond market development has been noted previously, for example in a dialogue project with NGOs that debated the development, regulation and commercialisation of GM technologies, organised by Unilever. Unilever's involvement is the result of "….recognising an institutional responsibility to understand and respond to

citizen concerns that went well beyond conventional market definitions of corporate responsibility and that in practice, existing state institutions were not acknowledging…." (Doubleday and Wynne, 2011:247). There are some parallels here to Scottish Power Renewables' opening the Whitelee Windfarm Visitor Centre, to explain the complexity of decision-making involved in siting and operating a windfarm, and the environmental reasons behind that. It is worth remembering that because of its rural location, the average age of visitors is much higher than may be seen in other engagement fora – a new age demographic has been achieved and a group that is notable for its political activity but may not otherwise engage with low-carbon topics is learning about low carbon energies.

However, there is an unavoidable truth in that other parts of the public are excluded from 'participating through purchase' through lack of disposable income, and overall social division might be increased through market engagements. Yet all ideas of the public contain exclusions; it is an unavoidable fact that underpins the breaking down of a homogenous undifferentiated public into multiple, fluid publics. Engaging with the idea of the consumer-citizen can bring the analytical field of commercial consumption into view, allowing us to consider ideas as broad as the materialisation of technology, embedded values, the different types of publics being developed, engaged and excluded and the type of change that can take place. In his 1998 study of the conflation of the consumer and citizen, sociologist Mike Michael made exactly this point – that considering the consumer as a citizen would usefully open up the field upon which we can study, discuss and debate [scientific] citizenship. When relieved of a heavily sceptical normative stance, the market opens up new ideas for societal transformation.

7.5. Reconceptualising Scientific Citizenship

I have pointed out the shortcomings in the typology of scientific citizens suggested by the literature. In multiple instances, these shortcomings corresponded to partial accounts of the citizen where exclusions are

overlooked. Rights and obligations are relatively unexplored and ideas of participation are dominated by ideas of science communication and dialogue, a framing that I tested in the later empirical turn to 'practice'. Whilst examples of practice are readily available it is only when a public emerges around an issue, and seizes the right to debate and opposition, that the citizen can be said to have exercised the 'right to have rights', which is frequently described as the central nexus of citizenship. In this sense, the typology's emphasis on the 'citizen' limited its own ability to speak to 'citizenship'.

In the central section of this chapter I drew out some of the recurring threads that have occupied me throughout the research, largely arising from two points. The first are references to Scottish culture that repeatedly arise in interviews; I argue that the Scottish strong public policy context for the transition was shaping modes of engagement and this prompted a number of reflections: what is the role of national context? When citizenship is dislocated from its political context how does national identity and culture permeate the field? What is the sense in the fact that some publics are very specific in their objections to technology development? What does this add to our theoretical understanding? Finally, what is the role of money and consumption? What is the relevance of publics who choose to consume science engagement events or new products?

I have sought to show that scientific citizenship requires a scientific citizenry that comprises groups of membership that arise in a public, which is multiple and fluid, emergent around issues just as often as they are conjured by engagers. On the topic of rights, I highlighted how these are often tacit and bound up with consequent responsibilities, seeing science and society through the lens of 'rights' opens up productive dialogues around exclusion, justice and trading of one for the other. Finally, I showed that the ability of publics to participate in science and technology as we commonly understand it, is largely determined by opportunities provided by policymakers and experts, but that a wider view of technoscience in society brings other forms of participation into focus.

The fieldwork and subsequent analysis has facilitated a vision of scientific citizenship that is not defined by national boundaries, nor as a fixed relationship between national and individual as mediated by explicitly sanctioned rights and responsibilities. Scientific citizenship cannot rely on handed-down understandings of the kind that describe political citizenship. Science engagement is so relational that it is personal and does not appeal to universally shared ideas of right and wrong in the way that political citizenship does (although this idea of universality has always struggled for acceptance in a sociological setting; cf. Turner 1993). In this sense, it has found consistency with current academic work to understand citizenship 'regimes' in cultural terms, for example 'post-state citizenship' (Faulks 2000), 'ecological citizenship' (Dobson 2006) and 'utopian citizenship' (Firth 2013). Uncoupling scientific citizenship from literal interpretations of democracy and artificial national boundaries allows me to embrace something of a sense of scale in science-society relations, from the trans-national nature of socio-technical systems, through national dialogues, regional planning systems and local festivals and events.

Expanding on this, I now illustrate the idea of technoscience and cultural citizenship. Although I have sometimes relied on the less clumsy term 'scientific citizenship' through this thesis, I return now to the concept of technoscience with a particular purpose in mind. As I noted in section 2.1.2, I use the phrase to maintain the idea that science, technology and engineering are not synonymous, not even when we are discussing them in a societal context.

7.5.1. Technoscience and Cultural Citizenship

There are a few strands in the previous discussion that seem to coalesce in a field that does not prioritise explicit ideas of science in the sense of knowledge or science-based governance. Instead, 'edutainment', science festivals as a leisure activity, counting butterflies as an exercise in citizen science,

scientifically-themed visitor attractions, the idea of buying our way through a low-carbon transition with consumer technologies, are concepts that seem to belong in the cultural sphere rather than an overtly political one.

One of the most complex aspects of technoscience and cultural citizenship in this context is the question of membership, for it has the broadest, least focussed reach and draws most closely on ideas of a 'general public'. On the surface, much of the science engagement in this field is open to anyone who cares to join and some effort is made to ensure a geographical spread of activities. In this sense, a 'general public' is seen as general enthusiasts hungry for a taste of different scientific topics packaged in fun, engaging and affective formats (within which materiality of engagement is an important facet). In this sense, there are no external exclusions and all comers of society are considered equally legitimate and welcome.

There are however, significant internal exclusions at play. The first, as I have already recounted, lies in the cost associated with science engagement. Event organisers and policymakers sometimes forge a blunt instrument, whether through neglecting to seriously consider socio-economic representation in their evaluations, or in introducing schemes that merely move – rather than eliminate – accessibility bottlenecks (such as the minibus scheme that offered to transport rural or distant communities to science centres but did not address the £12 individual/£35 family entry fee - see section 4.2.3). Housing associations seemed much more adept at navigating this territory, simultaneously accessing multiple schemes to acquire free energy-efficient white goods and reductions in utility bills as part of their carbon accounting projects (see section 6.3.2). It would seem the time spent within and amongst communities in their own homes pays off.

However, cost is not the only dimension of internal bases of exclusion; there is also the matter of social accessibility. It is not, as Dawson (2014) argues, that inclusions will automatically occur when 'barriers' (such as ticket prices) are removed. Whilst recent years have seen science engagement activities move

out of learned institutions, there is still some way to go. Events in cafes, theatres and university rooms inevitably attract a particular section of society because, in essence, they still require publics to move towards science. Although science centres have found it difficult, costly and of uncertain success, the only way to overcome the hurdle of inclusion is to co-opt existing community projects or to build long-term relationships on new terms. Taking on these projects is not a particularly new idea, but it is a point that has to be (re)made, particularly in an argument about citizenship. Whilst scale of visitors is a cornerstone of evaluation, what is lost is a reaching out to new parts of the community.

Positioning science and technology as a cultural activity is far from universally accepted and the role of science within culture has been widely debated here and elsewhere. Lord Rees, speaking in the Reith Lectures 2010, clearly sees a scientifically-oriented appreciation of the origin of humans and the earth as an important part of our shared story, "...it is a cultural deprivation not to appreciate the panorama offered by modern cosmology and Darwinian evolution...." (Rees 2010). This is a view that differs from the idea that the natural home of science is as a leisure or commercial activity (as discussed in section 7.2.1.). Lord David Puttnam (Director of the Cultural Learning Alliance) and Sir Roland Jackson (then Chief Executive of the British Science Association) had a lively debate over the former's perceived implication that 'culture' was a term that encompassed arts and heritage to the exclusion of science (BSA, 2012). Practically speaking, this has also proved difficult at a civic level, as Scottish science festivals and science centres have found themselves excluded from community working groups, battling from the outside to have science considered in the same terms as the arts.

Yet looking with a fresh perspective, there is something distinctly cultural about many of the science engagement activities that arise from the skeleton of funding from The Scottish Government's Science and Society Unit (see section 4.3.1.), and in the popularity of festivals, science stand-up and even science busking. These activities do not develop a deep basis of knowledge,

and are not connected to processes of governance. Instead, these forms of engagement emphasise 'worthy' leisure, social interaction and consumption as a means to form and assert identity – the hallmarks of cultural citizenship.

What we can say is that the conceptualisation of public engagement with science as a matter of cultural consumption remains underdeveloped and may prove fruitful for further research. It works on two levels. The first points toward an analysis of the habitus and cultural capital associated with public engagement with science, to explore the value identified and acquired by participants, and this leads to a broader consideration of who is included or excluded since participation is influenced by cost, location, and other attendees. The second area is more of an institutional consideration of the dominant strategies of public engagement, and how they in turn affect the ability and willingness of participants of differing gender, age, sexuality, race and class to engage (not forgetting that one individual will embody each and every one of these labels). If there is one thing that is certain about consumer society it is that it is not impartial or lacking in politics (Edwards, 2000: 146) Neither are publics acting as consumers of science in science centres, science festivals, purchasers of products, audiences at science stand-up etc.. As exclusions are pervasive throughout society, it is important for science to reflect on how it is mitigating or reinforcing these in its engagement activities. This is no small point. Science and technology make significant claims as to their ability to redress some of the most entrenched problems of our time – healthcare, poverty, climate change –these are also influenced by exclusivity. An awareness of this is important to avoid creating new differences or magnifying those already in existence.

Cultural citizenship consists of a set of practices by which enthused publics come into contact with technoscientific research and principles. An emphasis here is on a generalised exposure that takes science and technology out of the laboratory into local, non-specialist spaces with particular emphasis on enjoyable, accessible and affective formats. Levels of cognitive engagement vary although they err towards one-off encounters, and are predominantly

unidirectional albeit with added question and answer opportunities. There has been a growing focus on the passive rights of the citizen in recent years, although this is disrupted by ongoing exclusions on the basis of cost and familiarity.

I conclude this section by proposing a definition of *technoscience and cultural citizenship* that arises from this research so the concepts developed can be taken and tested in other contexts. **Cultural citizenship is a condition of access equality**. It consists of membership of a community that is political in the sense of its collective role in sustaining a social contract for science. It incorporates the aspiration that all citizens can easily and enjoyably access visions of current scientific knowledge and how this impacts social life on an equal basis, and that there is a range of effective mechanisms for determining the terms of this engagement, for example through programme content, locations or pricing structures for festivals, Cafes Scientifiques and science centres. This status not only secures equal rights to the enjoyment of the collective goods provided by technoscientific innovation but also involves equal duties to fund and participate in them.

What we can learn most usefully from this conceptualisation is the important role of cultural engagement as a platform for tackling perceptions that science and technology are mystical and separate from society or dominated by corporate interests. We can also be confident that so-called deficit model style communications do play an important role in the science-society landscape. That is not to say that we can expect attitudes or behaviours to change as a result of engagement at festivals, clubs or cafes, but that in urging that all of these events need to be two-way or to include dialogue, we risk their very nature shifting away from the affective towards the cognitive. With this, we risk losing all of the attributes that make these activities so popular in the first place.

Isn't the deficit model discredited?

The vision of a public that is educated and enthused by science engagement designed to garner support and appreciation, is strongly reminiscent of the deficit model of public understanding of science. Indeed, some see the persistence of 'deficit-model' type communications as a paradox given the now quite widely-accepted knowledge of its limitations. Felt (2003) ponders the paradox of prevalent projects that enthuse publics about science with the aim of winning them over, alongside a pronounced discourse amongst STS scholars that such projects do not achieve these aims. The fieldwork helps us navigate through the overlapping issues involved in this observation.

Firstly, there is a set of conditions that indicate that competence (measured on two dimensions of familiarity and confidence) are important precursors to more substantive forms of participation; in this sense these qualitative findings are consistent with the quantitatively-based premises of Mejlgaard and Stares (2009). How can one participate in something completely alien? One representative from a science centre commented on a participatory project aimed at exploring what kind of low-carbon profile they wanted the town to have in the future, "…I don't know to what point people are engaged in the debate that much and that's where some of our campaigning work is, to try to get people to that point…." (INT-POL02). This is a question of capacity building within publics and it is an important part of the science communication landscape (see Spatial Frameworks section 5.5).

Secondly, many events look to cater for both adults and children to maximise their potential audiences, to obtain core funding for engaging children with science and because children are relatively easy to involve through families and schools. A science communication infrastructure that meets the needs of children in formal education is a key objective for the Scottish Government, reflecting priorities around equipping the next generation across the Government's policy portfolio. Whilst meeting the needs of schoolchildren is at the core of many funding streams, leading to largely pedagogical communication strategies, these activities do support an infrastructure that

more innovative activities can spring from, such as Glasgow Science Centre's Science in the Dock exhibit or the Gene Jury project, a two-way interaction in which children learn about gene technology and then have a virtual vote on ethical dilemmas. More reflective, dialogic activity *can* be achieved with children (and, hence, mixed audiences).

And thirdly, to *teach* is a default mode for any expert who is placed in a new environment with the public – at least initially. It is what they think their role is and it is probably what their audience think the expert's role is as well. However, given enough flexibility a more nuanced interaction comes to light, one in which there is a considerable degree of personal reflectivity on the part of the scientist. As one young science communicator (neuroscience) said, "….Oh yes, I see my research in a completely different way since I've been doing science busking…." (INT-PUB30). This reflection on the part of the scientist has been described as 'midstream modulation' – an important stage in the governance of emerging technologies (Fisher, Mahajan and Mitcham 2006).

It is important to remember that Scotland is engaged in a high-stakes, highly ambitious programme of technological and social reform, and consequently all public engagement around the transition is experimental and under-theorised. This is particularly true when we consider the different publics invoked and public responses to different technologies, which are evolving, and at different stages of development. Technological uncertainty is compounded by the need for wide-scale social change in order to reduce demand for electricity and embrace a variety of possible renewable technologies. The overt policy commitment to decarbonisation coupled with the need for public consent for new renewable energy technologies brings the specifics of technology proposals clearly into focus. I now turn to the notion of materiality.

7.5.2. Technoscience and Material Citizenship

The materiality of substance has been a substantive and recurring theme throughout the research, I have explained its relevance to concepts of citizenship elsewhere (see section 7.4.2.). I now extend the argument to outline what a conceptualisation of technoscience and material citizenship looks like and what some of the core issues are. I have drawn on the nature of vibrant objections and opposition to renewable energy technologies to illustrate the role that material configuration and downstream design decisions had on the acceptability of a specific proposal. I argued that understandings of science in society could more fully reflect how citizens engage with technology that is near-implementation in very different ways than they do to abstract scientific concepts – the two spheres involve different publics, exercising different rights through quite different practices.

At first glance, the question of membership around material citizenship offers a specious simplicity, leading us to consider stake-holding communities – those directly impacted by a technology and its specific shape or form, regardless of their position on the socio-technical landscape. In this context These identifiable (generally local) publics have, alongside developers, an acknowledged right to contribute to decision-making processes in the local planning system, which is arbitrated by elected representatives who seek a solution that best serves the current and future needs of the community and region.

This right to engage at a strategic level in planning energy and infrastructure for the local region needs to be associated with a responsibility. At a local level, infrastructural parameters can more easily be flexed and a discussion around the low-carbon transition can be had in a broader framing. In Scotland, this opportunity is available through the Spatial Planning Framework, but interviewees reported difficulties in securing engagement from local communities, and considerable work is going into furthering this process and innovating within it. Considering how differing levels of engagement relate to different publics at differing scales is a fruitful area for

further research in considerations of science, technology and material citizenship.

Not unexpectedly, conflict frequently occurs (see section 5.4) and highlights how materiality is a key concept in understanding different perspectives in this process. A question comes into view of how science and technology can be adequately governed among such agonism. Some interview data suggests that materiality can also offer a way of navigating a solution, where the parameters in dispute can be used as points of negotiation in securing an acceptable development proposal, for example in the operating times of turbines which can ameliorate flicker. Here, the degree to which the technology is 'black boxed' or closed off from view and made opaque, is a key site for scientific citizenship, offering the potential for problematizing dominant proposals and facilitating new configurations of rights and responsibilities for different publics.

Hillier puts forward a framework suggesting that when consensus is not considered as a realistic aim and informal politics hold sway, bargaining is the natural way forward (Hillier 2002). Indeed, this is becoming commonplace in Scotland in the form of community investments/donations from developers, and more of these community benefits designed for communities that house renewable energy projects have been the target of campaigners for social justice (JRF2012). In this context, the fieldwork raised further questions as to the perceived homogeneity of 'community' – as one of the interviewees in this research pointed out, benefits can often go to facilities that are not needed or used by the biggest part of community. Furthermore, whatever benefits a community may receive do not address the injustices in selecting site locality. If developers do not even try to place new technologies in areas that are 'pale, male and stale', the injustice is built in from the start. As political theorist Iris Marion Young pointed out, promoting justice is not at all the same thing as undermining injustice (Young 2001).

Looking more broadly, there are other kinds of publics exercising material citizenship and materiality but not always at a local scale. When activists make their voice heard, they emerge as an active public often on behalf of other publics who do not have access to the decision-making process. This may be because they are disempowered (in the case of Coal Action Scotland) or distant (for example, communities in South America at risk from deforestation, as fuel is taken for woody biomass plants in Leith). Drawing on specific material elements, these emergent publics seize a right to 'make meaning' amongst different actors (Watson-Verran and Turnbull 1995:117), and reject meanings assigned by scientists, policymakers or corporations and they recast the problem as something else entirely.

So we have an interesting mix of rights and responsibilities in material citizenship that do not always neatly correspond. On the one hand, I am advocating that local populations and those who might be directly affected by the configuration of a technology in society have a special right to be involved in consultations and negotiations. Yet this in itself is not straightforward, for even this public is not unified. Those who purport to 'hold a stake' do not necessarily conform to an unambiguous or unproblematic categorisation and there is no single identity. The special right to consultation also stands in stark contrast to appeals for the 'common good', particularly in renewable energy because some local populations somewhere have to host the material technologies in order that 'the commons' might benefit, regionally, nationally and globally, now and in the future. This is quite a burden to place on a community given site selection is such a complex process, with its own political drivers. Developers choose sites based on their probability of approval, or on principles of historical land use, not merely on impartial geographical or logistical grounds.

Accepting the mutual performativity of technology and the social has significant consequences for an understanding of public engagement given the limitations of 'upstream engagement with material technologies. Whilst upstream engagement offers the possibility for publics to shape future

trajectories through learning and dialogue, we need to accept that as a technology takes shape, new publics will be formed whose reactions will be contingent on the particular configuration of technologies. Such responses should not be confused with a lack of support for the principles or evidence of an inconsistent/irrational public (Chapter 3). Indeed, this has been termed a 'democratic paradox' (Humphrey 2009), where publics say they want renewable energy but notoriously resist specific proposals, which has sometimes been attributed to 'cheap political talk', where publics support ideas but retract their position once specific changes are proposed.

Instead, I put forward an alternative reading – the so-called democratic paradox confuses two quite different things. On the one hand we have a public 'created' for social research purposes (through survey or dialogue), offering opinions on floating, unanchored ideas of technologies-in-principle. On the other hand, we have multiple stakeholding publics emerging, often directly affected by proposed technologies, able to engage and address specific aspects of its material configuration. The major challenges of implementing a decarbonisation transition amongst such a heterogenous landscape invite ongoing questions related to equality and justice (Walker 2012:214-221).

I conclude this section by proposing a definition of *technoscience and material citizenship* that arises from this research so the concepts developed can be taken and tested in other contexts. **Material citizenship is a condition of transactional equality**. It consists of membership of a community that is political in the sense of its plural (and sometimes competing) needs and preferences in relation to near-term or immediate implementations. It incorporates the aspiration that all citizens can substantively influence the implementation of proximate technologies on an equal basis, and that they have effective mechanisms for determining the terms of this engagement, for example through active participation at different stages of the planning processes. This status not only involves duties for all communities to accommodate technologies that are occasionally unwelcome, but must

develop and ensure the communities' rights to enjoy proportionate benefit from the collective goods produced.

Implicit in this discussion is what we might consider the ultimate expression of material citizenship – where a community understands, specifies and finances a renewable energy technology that they take responsibility for. Transactional processes still take place between the community, suppliers and financiers and amongst the community itself, but these take place at a more local level and – by virtue of initiating the process – communities inherently hold more power in the transaction and are able to exercise more democratic potential.

Clearly, there are relations between science and society that are at once asking more political questions than those at stake in addressing cultural citizenship, but are not yet fully formed enough to invoke the kind of publics or participation involved in material citizenship. To make sense of this conundrum, I introduce a third field: technoscience and anticipatory citizenship.

7.5.3. Technoscience and Anticipatory Citizenship

Anticipatory citizenship offers maximum potential to upstream fields of technoscience. By this, I mean where implementation could take a wide range of forms, where the shaping of the idea relies heavily on discursive means and where there remains considerable uncertainty as to the eventual applications of the innovation. This can include topical areas as disparate as synthetic biology, geoengineering or human enhancement. I do not mean to draw firm lines between the material and the anticipatory that cannot be substantiated in practice. However, where uncertainty remains genuinely open and where the 'politics of novelty' is manifest, there may be a 'public experiment' (Barry 2013:17, Born and Barry 2010) around which ideas of citizenship can start to coalesce.

The publics that prominently engage in anticipatory citizenship generally fall into two areas in the UK. Firstly, counterpublics can emerge around technoscientific proposals to challenge their public meaning or ethical underpinnings. Operating in the same sphere are the counterpublics who emerge around new technologies in support of them or to campaign for their development through increased resources and attention. I have referred to these as campaigning publics, and discussed their role in formal dialogues (Mohr, Raman and Gibbs 2013). In Scotland, the Church of Scotland's Science, Religion and Technology Project (SRTP) acts as the voice for a campaigning public. It is a 40 year old project publicly examining and arguing on the interface between science, religion and emerging technologies such as cloning, genetically modified animals and stem cells. In common with other counter publics, SRTP seeks to produce position briefs, to influence public debate and work directly with policymakers.

Policymakers do recognise a need to engage with publics proactively as science is develops, which raises a second public conceptualised around anticipatory citizenship. The 'created' dialogic public is envisaged and assembled by policymakers for the purposes of public dialogue as a source of data for science policy. It is here that ideas of 'upstream' and 'dialogue' offer their maximum potential, when there is still something to be shaped. Of all of the parts of the context, it is this regime, and the preceding outline of dialogic citizenship (see section 7.2.4.) that most closely correspond with the literature, in rationale, mode and understanding. I will, however, point to the question of scope, and I repeat that anticipatory citizenship is suited to dialogue as a mechanism. That said, there remain problems of representation and longevity.

The question of representation in public dialogue with science is one that has been explored extensively in policy and academic contexts (see Chapter 2). It is a core interrogation of all expressions of citizenship that goes to the centre of our considerations of membership, exclusions and inclusions. What a public is, and what it can be said to speak for, is a recurring question in this thesis.

As for longevity; it intimates issues associated with rights and responsibilities. Dialogue is a discrete event, and if citizens rely on invitations for participation then this limits their ability to participate in any formal way as a technology continues to develop. Citizens here have no rights to dialogue, and this is an area for exploration. Dialogue opportunities often coincide with policy making windows and there are strong arguments to suggest that publics are given their own choice of topic. Just as formal (political) citizenship is evolving as publics make their voices heard outside formal mechanisms (such as in online campaigns and petitions, e.g., Dalton 2008), so too anticipatory citizenship embraces the informal.

I conclude this section by proposing a definition of *technoscience and anticipatory citizenship* that arises from this research so the concepts developed can be taken and tested in other contexts. **Anticipatory citizenship is a condition of deliberative equality**. It consists of membership of a community that is political in the sense of its collective (but plural) opinions on the early benefits and risks of a technological innovation. It incorporates the aspiration that the views of all citizens (including those in the future) can be represented in decision-making, and that they have effective mechanisms for determining the terms of this engagement, for example through participation in – and prioritisation of – effective and meaningful processes of public deliberation. This status not only secures equal rights to the enjoyment of the collective goods provided by technoscientific innovation but also involves equal duties to participate in such processes when the opportunity becomes available.

In summary then, in the context of science and technology we might describe anticipatory citizenship as the set of practices by which publics emerge and are created around unformed science that is in a research phase. Participation is focussed on making and challenging of meaning, through campaigning and activism, or more consensually through the performance of carefully managed dialogue aimed at soliciting public perception, which at best allows science

and society to coevolve towards a shared meaning, from which a common direction emerges.

7.6 Conclusion

My purpose in this chapter has been to answer the question, "How are membership, rights and participation synthesised to produce an effective nexus for the performance of scientific citizenship?". In answering this, I took a three-pronged approach that re-examined the literature in comparison to the empirical findings, drew out new themes that had emerged in practice and finally, used these themes to re-structure three nodes of fruitful debate on scientific citizenship.

In revisiting the guises of the scientific citizen three key points emerged. The first related to the relative absence of the dialogic citizen, which I suggested was partly due to the national political context and partly to operational vacuums. I observed a difficulty in finding the epistemic citizen in practice. I drew on the literature of citizen science which was not replicated in current fieldwork that actually offered many more nuanced examples of new or competing knowledges within almost all parts of the typology. Finally, the relative strength of emergent forms of citizenship was surprising. Counterpublics are not a niche phenomenon they are readily visible in Scotland's low-carbon landscape.

In my second move I drew out three themes that had recurred across the empirical work: socio-political context, materiality and the role of the market. In drawing together threads relating to Scotland's socio-political context, I highlighted the role of energy in national politics and the possible ways that it shapes ideas of participation in energy policy, including a relationship between Scottish identity, a sense of place (particularly regional) and self-improvement. In examining materiality, I proposed the concepts of a materiality of interaction and a materiality of substance, and drew out the implications of recognising materiality on engagement practices. Finally I

argued that the market should be considered a valid site of public action, offering a multifaceted space for the establishment of shared identities and the development of personalised enactments of the future. I noted the way corporations extend their traditional operating space in issues of science and technology, and suggested that the exclusions should be considered alongside the exclusions that exist in policy and civil spaces. In amalgamating present work with past, I have proposed three nodes around which we might debate scientific citizenship.

First, I put forward the idea of technoscience and cultural citizenship as a way of framing the expanding efforts to enthuse publics and make science into a familiar and part of culture. I highlighted the important role of affect in building cultural citizenship, and given that this can be expected to have the widest reach of all forms, I spent some time outlining issues of exclusion in science engagement and market-based models of cultural citizenship.

Secondly, I proposed the idea of technoscience and material citizenship as a way of discussing emergent publics' responses to the material dimensions of technology, the rights they seize and the ways in which they practice their citizenship. Here, I contrasted local and global ideas of membership to show that rights and responsibilities do not always neatly correspond, and that materiality starts to disrupt ideas of a common good. The assertion of rights in a developing material environment cannot easily be resolved by upstream engagement or dialogue, but answers to this challenge may lie in unpacking the black box of materiality or in community benefits.

Finally, I outlined the idea of technoscience and anticipatory citizenship as a way of discussing the publics' rights and practices associated with unformed, largely immaterial technoscientific innovations where different trajectories remain open and the politics of novelty play a part. I contrasted the created public drawn into dialogue as a practice of anticipatory citizenship with the emergent nature of a counterpublic that uses public debate to open up the

framing of a technological possibility, or to campaign to take direct action to directly oppose it.

CHAPTER 8 Findings, Implications and Prospects for Scientific Citizenship

This thesis set out to unpack the notion of scientific citizenship by drawing on the experience of Scotland's low-carbon transition to illuminate analytical and practical insights for understanding science–society relations. In this work, I have shown that Bellamy's model of membership-rights-participation can be applied to open up new understandings of scientific citizenship and at the same I have highlighted the interdependencies between these three dimensions. I found that the typology of scientific citizens that I developed in Chapter 2 tends towards partial accounts of the citizen in which exclusions are overlooked, rights are unexplored and ideas of participation are dominated by ideas of public understanding and dialogue.

In its place, I have argued that only when all three dimensions of membership-rights-participation are being fulfilled or pursued can the idea of citizenship be invoked. It is only with an effective mode of participation, and the right not only to participate but to shape at least *some* of the terms of that engagement that a public can gather enough political capacity to effectively be considered a citizenry. I have also argued that scientific citizenship spans three zones: the cultural, the material and the anticipatory. Each offers a different emphasis, for different kinds of technoscience, at different scales. Whilst each form is subject to critique, the arguments exposed in the debates illuminate important aspects of realising twenty-first century scientific citizenship.

In response to the question of what scientific citizenship means, I argue that only when all three dimensions of membership, rights and participation are fulfilled or pursued simultaneously can the idea be invoked, and three such nexus are outlined. The idea of *technoscience and cultural citizenship* offers a way of reconceptualising popular science communication activity that is at risk of being dismissed as manifestations of an outdated 'deficit model' of publics and science. *Technoscience and material citizenship* offers a route into questions of governance, making the case that the materiality of a project

makes a profound difference at the point of implementation, when consensus may not be possible and the rights of multiple publics to be recognised and to participate will need to be carefully negotiated. And finally, as a counterpoint, the idea of *technoscience and anticipatory citizenship* provides a space around emerging technologies for ongoing debates about the effectiveness of public dialogue and the relative roles of emergent and created publics.

In this chapter, I summarise the key findings of each research question, (section 8.1.) I consider the practical implications of the work, for policy and practice. I consider the limitations of this work and draw attention to some outstanding questions that would benefit from further research (Section 8.3). Finally, I conclude with a reflection on the role of scientists in modern democracy.

8.1. Aims of Research and Key Findings

I set out to explore the nature and role of scientific citizenship with five research questions (Section 1.4) This section revisits those questions and relates the main findings of the thesis.

8.1.1. Scientific Citizenship, Sites and Actors

The first research question was: "How has Scottish science engagement evolved so far, who are the key actors, and how do they understand their roles in science and society?"

The primary finding here is that sites of practice occupy a space that is much broader than originally envisioned, which in turn expanded the empirical field that informed this research. In addressing Question 1, the mapping of established public engagement actors facilitated by the Scottish Government's Science and Society Unit (section 4.3.1), the National Coordinating Centre for Public Engagement (5.3) or the Café Scientifique movement (6.2.2) highlighted a dearth of activity relating to Scotland's low-carbon transition plans. There were sporadic and infrequent lectures on, say, renewable energy or climate

change but there was no dialogic or community work on related topics, and the "*Low Carbon Scotland: a strategy for public engagement*" (TSG 2010) was badly received by civil society stakeholders and quickly forgotten by policymakers. So, a process of "following the problem" (rather than the mechanisms) led to an exploration of sites of expression, articulation and negotiation somewhat off the public engagement radar – through commercial companies, the planning system and civil society. This immediately suggested a disjoint between what is considered "science" appropriate for "engagement" and the more mundane technologies that become pervasive or salient in an energy transition.

Looking beyond science engagement towards a broader conceptualisation of public involvement with energy or climate change introduces a range of actors who see their roles in stark contrast to those who wish to enthuse audiences about science. I have shown how commercial companies see their role as bringing new products to market amongst a society of consumers or neighbours, in which the latter group is often unnecessarily viewed as hostile (Sections 4.3.2 and 6.4.2). Section 6.4.2 illustrated the importance and relevance of the planning process in thinking about public engagement with technoscience, and explored the challenges of stimulating participation at decision points of maximum possible influence (specifically, in consultations around local Spatial Frameworks when energy needs can be considered at the same time as perhaps transport, economy and education). Finally, I showed how civil society can act outside state-driven consultation processes to develop epistemically advanced positions on issues that have high levels of sophistication (Sections 4.4, 5.4 and 6.4.1). The need to widen the view of what is generally considered to be public engagement with technoscience is the most significant contribution associated with this research question. It resonates with other work on renewable energy and public engagement that commented, "…the literature on public dialogue and engagement with sociotechnical change, even in its more critical modes….has too often failed to go beyond the surface of staged engagement events…." (Walker et.al.2010).

8.1.2. Scientific Citizenship and Membership

The second research question was: *"How can we begin to understand the territories a scientific citizen inhabits?",* which I explored and discussed in Chapter 4. At the core of this question is what brings individuals together to form a public and how robust the association between the citizen and a nation state can be when examined through a lens of technoscience. A traditional reading here is of a political citizenry, verified by birth or residency, bounded in geo-political terms and generally regarded as a public that can be defined in demographic terms. I argued that this kind of reading has proven to be increasingly inadequate in citizenship studies as borders are increasingly transgressed or become leaky as in current globalisation trends.

Through the medium of sociological work on plural, multiple publics, I delineated three forms of membership to answer this question. The first was the idea of an enthused public (section 4.2) inspired by scientific information that is shared in fun and engaging ways by experts. Here, the population is self-selected, bonds through a shared cultural identity and a keenness for lifelong learning or enthusing the next generation, but remains firmly constrained by the imagination of the event designer. I next turned to the market, and identified a public of consumers (4.3). The contention that consumers can be counted as citizens is supported by a literature of cultural citizenship, where the market is seen as a valid mediator of identity and a site of political action. Finally I highlighted the counterpublic (4.4), an emergent public forming around an issue arising in response to a socio-technical assemblage regardless of the national boundaries that it may cross. Concerns regarding internal and external exclusions run across this analysis, where individuals may be discouraged, unable or not allowed to stand as members of particular publics.

The carefully designed publics who take part in attitudinal surveys and public dialogues about technoscience, which are so popular in the academic

literature were notable only for their absence in this study. This conceptualisation of the public most readily lends itself to a traditional relationship with the nation state, as participants are invited and selected on the basis of demographic representation. I discussed a de-emphasis of this type of engagement (section 7.2.4), and reflected on operational barriers to linking engagement with public policy, as well as highlighting the potential problems of opening up these questions when they are already locked-in in a political sense.

8.1.3. Scientific Citizenship and Rights

The third research question was "What rights and responsibilities are being ascribed to, or asserted by scientific citizens, how effectively are they enacted and under what circumstances do they become contested or expanded? " and I explored this in Chapter 5.

Central to this question is the heterogeneity and opaqueness with which many rights appear on the public engagement landscape, particularly once we recognise that multiple transient publics are present. Climate change offers further complexity as differing publics, global and local, are given, infer seize different rights that frequently have long-term consequences for shaping their local environment and society.

The first finding here questions the attempt to codify rights in the generic context, exemplified by the UNHRC call for a 'human right to science' (section 5.2). Having some appeal to the libertarian tradition of rights-based citizenship, the practical operation of such a right is unevenly applied and dependant on other rights not yet codified – specifically the need for openness and the subsequent consequences of this for funding. The escalating nature of rights and the responsibilities cast on other actors was a theme of this discussion. That symbiosis between rights and responsibilities was seen clearly in a deconstruction of the 'right to openness', which turned out to be a recurring theme from interview data and policy documents (section 5.3). The

complex notion of accountability arose in this context, and I argued that this was an inherently constrained idea given its relationship with the competing 'right to research' needed by scientists.

Moving on from rights that are given in law or inferred by practitioners, examples from 'uninvited' or 'wild' publics (section 5.4) show how rights can also be seized by members of the public, even when those rights are not sanctioned. This is particularly sensitive in the context of failures in procedural and outcome justice in processes for managing land use around energy resources. In this regard I also highlighted the inevitable complexity of ensuring justice not just between but *within* communities. In contrast to rights being seized, I explored cases in which rights were neglected as publics failed to engage in the Spatial Planning Frameworks that are the natural home of discussions about what a future community might look like including its role in the low-carbon transition (section 5.5). Of course this does not mean to say that all options are always available, and I reflected on an absence of 'the right to have rights', particularly in respect to strategic dialogue on technoscience.

8.1.4. Scientific Citizenship and Participation

The fourth research question was, "What modes of participation can scientific citizens be said to practice and how do the subject matter and participation mechanisms shape one another?" (see chapter 6).

A general theme of materiality emerged across the examples discussed here and I synthesised and labelled two notions of materiality. *Materiality of interaction* (consistent with work by Marres and Lezaun 2011 and Davies et.al. 2012), involved a material emphasis on exhibits and devices that embody and transmit messages through interactivity and an affective response leading to understanding of a broader principle. Examples of this included interactive science centres (6.3.1), thermographic surveys (6.4.2) and products that facilitate a reflection on energy and climate (6.3.3).

The second sense of materiality is a *materiality of substance,* where the material emphasis is on implemented infrastructure, developments or products that stimulate a cognitive and affective response leading to debate and sometimes opposition to a project and what it is seen to stand for. This is fundamental in considerations of mundane technologies, where material arrangements are often more important than novelty. Examples include a range of material objections to onshore wind (4.4.1) and woody biomass (4.4.2). In previous studies of public response to specific technology proposals, materiality has not been routinely used as an analytical lens, except in cases of oil pipelines (Barry, 2013) and hydrogen energy (Flynn, Bellaby and Ricci 2011).

In addition to the affective components of materiality are the affective engagements of the public with participation mechanisms that are considered as 'public understanding of science' models. Sensory and emotional responses to scientists as people and to their scientific information are as embedded as cognitive content in engagement mechanisms, and participation here is stronger when linked to group identity or local context (section 6.2).

Finally, the range of legitimate participation mechanisms in respect of publics and technoscience is much larger than often envisaged. Some of the illustrations relating to sites and actors (section 8.1.1) reveal forms of participation not traditionally considered in discussion on public engagement with science, for example in the planning system (section 6.4.2), in civil society debate (6.4.1), within community-based projects (6.3.2) and when corporations move beyond project sales into generating interest and response to an issue (6.3.3). Naturally, the range of the actors involved also expands, incorporating local government, activists, civil society institutions, landlord communities, and corporations.

8.1.5. Integrating Scientific Citizenship

The fifth and final research question sought to integrate the work of the thesis by asking, "How are membership, rights and participation synthesised to

produce an effective nexus for the performance of scientific citizenship?" (see chapter 7) and "What are the policy implications for future ways in which publics will engage with both 'science-in-general' and specific SET policy priorities, and future science engagement and low-carbon transition strategies of the Scottish Government?",(see 8.2).

Central to this question is a reconciliation of the distinction between publics and citizens. In Chapter 4 the discussion of membership drew on constructs of multiple fluid publics in order to be able to imaginatively articulate ideas of membership in technoscientific contexts. However, to suggest that any public can automatically be construed as citizens demeans the idea of citizenship as an engaged, active process. Instead, I encourage readers to draw on all three foundational elements (of membership, rights and participation) to challenge what effective citizenship should look like. In drawing on citizenship literature in particular the work of Bellamy (2008) (section 2.3) I made the case that only when all three foundational elements are working in harmony could we legitimately initiate a conversation based on citizenship. Of necessity, this involves consideration of the elements arising from this thesis' findings: multiple (and unexpected) sites and actors, processes of inclusion and exclusion, the responsibilities that must be taken up to facilitate rights, rights within and between communities, making engagements robust by coming to terms with the material aspects of technoscience.

In considering where coherent manifestations of citizenship might be found, I outlined three areas in section 7.5: technoscience and cultural citizenship, technoscience and material citizenship and technoscience and anticipatory citizenship. The discussion of technoscience and cultural citizenship (section 7.5.1.) had at its core a re-reading of current manifestations of the deficit model of public understanding of science. I argued that many of the newer forms of informal engagement can be more usefully seen as successful activities that are gradually moving science out of the laboratory into mainstream culture rather than popularisation events that lack the legitimacy

offered by dialogue. These non-dialogue events do have the advantage of science into society-at-large as professional and corporate endeavour.

Following this I explored technoscience and material citizenship (section 7.5.2). Material citizenship requires a careful consideration of stakeholding publics, what their rights are and should be, and what mechanisms for negotiation and amendment are necessary. The idea of material citizenship comes into its own when technoscience approaches implementation, and there are multiple publics assert and are granted competing rights. At this point the limits of rational debate and ideas of consensus emerge as we reach "....the inescapable moment of decision – in the strong sense of having to make a decision on an undecidable terrain...." (Mouffe 2013:184).

Finally, as counterpoint to what had gone before, I propose the idea of technoscience and anticipatory citizenship (section 7.5.3). Here, I discuss technoscience which is at a conceptual or unformed stage, when it is reasonable for to expect to find a range of citizens (some invited, some uninvited) engaged on axiological terms or debating visions of future society. Here, dialogue offers a good deal of value as policymakers, scientists and citizens can share and listen to different views debating what is to be valued and by whom, and how effectively regulatory regimes might be able to optimise benefits across different communities. That said, dialogue is not an unproblematic tool and considerable uncertainty remains around the question of who is allowed to participate and what they actually represent (Mohr, Raman and Gibbs 2013).

8.2. Practical Implications

Moving beyond the knowledge implications of the work, the findings are also significant for policy and practice in public engagement.

There is a distinct patchiness in levels of adult involvement in the science communication infrastructure. I highlighted structural forms of exclusion that affect all publics of science. These include cultural barriers to attending festivals or science centres, financial barriers to attending festivals or buying

eco-friendly products, and the systematic disempowerment of counterpublics (Chapter 4). Increasingly the answer that is reflected in this work lies in partnership and intermediaries (both human and artefact), such as boundary workers and devices in Climate Challenge Fund projects (section 6.3.2.), activists in communities providing energy resources (section 5.4) or community work on the part of science engagement specialists in jointly developing projects for the 'Talking Science' programme (section 4.3.1.).

Part of this involves learning a new vocabulary when talking about publics, or 'the public' from the moment an engagement idea is conceived. If policymakers wish participants of science communication activities to be anything more than passive, then embracing the idea of the citizen is very useful. However, making the leap from public to citizen requires a different way of thinking about the people who are imagined. On one level, this involves dismantling the idea of a recipient homogenous mass of people and building a more fluid picture of different parts of the community. Sometimes this will be demographic, sometimes identity-based, sometimes issue-based and many times categories will overlap. It is also useful as a heuristic to ask oneself what rights are being given or withheld from all participants, and what responsibilities the activity raises. Only when those two questions have been considered, can the form of engagement (or participation) be delineated, which may also require a full consideration of intermediaries as outlined above. This line of thinking can be promoted through calls for grants, grant appraisal and evaluation procedures.

An understanding of the differences between publics and citizens (particularly considered in the light of section 7.4) furnishes a means of avoiding the trap of thinking that all science engagement should be upstream and dialogic in nature. I argue that my work encourages the use of more than one rationale for engagement work. Whilst upstream dialogue events have a role, I made the case (section 7.5.1) that supporting cultural citizenship through science is crucial in helping to address later issues of internal exclusion. Placing the figure of the citizen and their rights at the centre of debate instead of the

mode of participation also makes space to consider whether alternative techniques (perhaps located outside science engagement fields) are more suited to the topic at hand. In this we may find that the relationship between technoscience and citizens is more suited to processes that better accommodate a permanent plurality of views.

The nuanced idea of rights and responsibilities would also benefit from closer policy attention. In section 5.4 I explored the difficult problem of what rights are in operation and for whom, when communities (or parts of communities) oppose renewable energy development. Questions of justice are raised not only in procedural and outcome terms but between and amongst communities. This is an extremely complex landscape worthy of policy attention around the nature, scale and timing of community benefits. In the UK, the Scottish Government have had something of a leadership role in facilitating and promoting the community benefits in operation in Scotland (Local Energy Scotland 2014). A directive for disclosure of and a normative evaluation of benefits in operation could bring a level of transparency that would open this kind of bargaining up for study and increase fairness.

8.3. Limitations, Further Questions and Future Research

The general needs of PhD research introduce constraints on field of work. The time-limited nature of this (and most) research, the limited scale of funding for fieldwork, the directives of funders (including the Scottish Government) and the general limitations associated with qualitative research have all introduced limitations to the work.

One limitation is the centrality of policy actors and what is in essence an institutional approach to notions of citizenship. Whilst exploring ideas of scientific citizenship directly with members of the public might have provided different insights into the meaning of the term, such an approach would require a substantial research focus of its own. Instead, this research draws on

a body of surveys and qualitative research on public perceptions of both 'science-in-general' and renewable energy technologies (see Chapter 2) and goes on to consider what they tell us about citizenship and *how* these findings might best be used in policy development and implementation. Further research along these lines would benefit from exploring publics directly to consider under what circumstances they become mobilised as scientific citizens – for which issues, at which times and by what means?

A second limitation was manifest in an inability to explore community renewable energy schemes in the empirical work. Whilst this form of engagement was discussed in theoretical terms (section 2.2.6.), as being of relevance to low carbon citizenship (section 7.3) and as a particular manifestation of material citizenship (section 7.5.2.), there are still many intriguing questions that would have benefitted from first-hand study if time and budget had allowed. Research along those lines could usefully ask how such schemes come about, for whose benefit are they started, how the putative benefits are realised across the community and what meaning the technology holds across the community.

This thesis has explored prospects for scientific citizenship in the context of a national transition to a decarbonised society. The findings point to some particular areas that might benefit from further research.

International comparisons

The first point for further work lies in comparative work of citizenship in other countries that are seeking to decarbonise. This might include Iceland, aiming for carbon neutrality by 2051 through the renewable production of hydrogen fuel or Costa Rica, pursuing carbon neutrality by 2021 alongside extensive deforestation. Such comparisons would test the three foundational issues of membership, rights and participation proposed in this thesis and explore how different political, cultural, technological and geographical landscapes influence the emergence of scientific citizenship.

The thorny question of the midstream

One of the clearest tensions to come out of this research lies in the gap between prospective ideas of emergent technologies, amenable to upstream engagement, and more concrete mundane technologies that largely fall out of the view of STS governance models as they approach implementation. Further research into the gap between these two stages could shed light on the kind of publics who could and should be engaged, what they might expect and what processes of participation could be implemented to bring about more exclusive processes. This is by no means a straightforward proposition and wanders outside the interdisciplinary bounds of STS into areas of product development, planning and land use and potentially into patient involvement. However, relocating broad discussions of citizenship into STS would reflect the field's journey from the local, contextually specific work of Irwin (1995) and Wynne (1996) to dematerialised ideas of upstream governance and emerging technologies (e.g. Wilsdon and Willis 2004).

The Role of Intermediaries

Because of their fluid nature, publics require mediation in a way that a static citizenry does not. As DiSalvo has commented, "….publics can only form and become resolved once issues are enunciated and communicated…." (2009:51). Thus, the question of who acts to identify and communicate issues – who acts as an intermediary and how - becomes central to the constitution of the publics that are formed. The key findings about questions of scientific citizenship and participation, suggested that the field of public engagement needed broadening out to include new sites and actors (section 8.1.4). Many of the examples in this thesis and the literatures referenced in it include cases in which people (and sometimes devices) act as intermediaries between new publics and technoscience, to challenge narratives around technological development, or to make it a focal point for action or response. The mediating activity of some of these actors was explored briefly (section 6.4.2.) but further research could build on this, drawing on this framework to ask how

intermediaries shape publics, facilitate rights and enhance participation in the development of scientific citizenship.

The role of public engagement with science in the implementation of technologically-intensive public policy

One of the most prominent gaps in practise to be picked up in my research is between the science engagement enterprise and public policy priorities. In a context of extensive policy focus on a transition to low-carbon, the day-to-day salience of energy costs, concerns over land use, and the significant cultural shift in scientific research to openness, engagement and dialogue do not reflect the priorities of the policy. At the beginning of fieldwork there was practically no science engagement in Scotland on the theme of energy. A question remains as to how and when science engagement can help facilitate the implementation of public policy, and what the risks of a closer relationship are to impartiality or to the motivation of scientists as both professionals and citizens.

8.4. Closing Thoughts: Scientists as Citizens

Before closing this discussion on scientific citizenship, I would like to briefly consider the question of the citizenly responsibilities of scientists. Whilst a thorough analysis of this point is beyond the scope of this thesis, there are particular locations where 'scientific citizenship' is interpreted in this way – what responsibilities do scientists have to the common good? Scientists benefit from advanced education and training, significant cultural capital and increasing influence in public policy as scientific advice and technologies *per se* are perceived as solutions to a wide range of complex challenges facing society. What then, can and should we expect of scientists as citizens?

Focussing on professional scientists, as opposed to publics, as the subjects of scientific citizenship theory seems to reflect the way in which the profession

sees itself anyway. In 2008, physics student honor body Sigma Pi Sigma chose 'scientific citizenship' as the theme of its Quadrennial Conference. As well as covering science communication, science policy and public engagement ground, this conference also took on more overtly (albeit historical) political topics to challenge the organisation's members including the scientific, social and political aftermath of the Manhattan Project and Einstein's refusal to teach racially segregated classes whilst at Princeton University. Lord Rees, Astronomer Royal and outgoing President of the Royal Society, in his 2010 Reith Lecture "Scientific Citizenship" comments that "….scientists shouldn't be indifferent to the fruits of their efforts" although "in domains beyond their specialist expertise, scientists speak just as citizens…." (Rees, 2010). Professor Larry Goldstein, professor of molecular and cellular biology at Stanford University, is a little more explicit in his propositions regarding scientific citizenship, arguing that the right to autonomy, the right to disagreement and the right to achieve excellence are delivered through a responsibility to teach the next generation, to participate in peer review and to conduct scientific work ethically (Goldstein 2011). In explaining to the public the research as it is happening, how the scientific process works and why the work is important, Goldstein suggests that scientists can anticipate a stable work environment to pursue excellence in research and teaching and an interdisciplinary capacity facilitated through the development of communication skills. Clearly, this is a restatement of the deficit model of public understanding of science, albeit cast in terms of benefits to *scientists* rather than *science*.

As well as these more formal or high-profile interventions in public debate, there is a discernible base of social activism amongst the UK scientific community. Two scientists actively involved in public engagement who were interviewed in the course of this work mentioned that one of their reasons for action was a passion for populating a more diverse 'face of science'. A groundswell of professionals devote large amounts of energy and expertise to addressing gender gaps in science, engineering and technology (for example, ScienceGrrl, WISE), to defending science as a public good (e.g. Science is

Vital), and to challenging problematic influences on science (e.g. Scientists for Global Responsibility's work on the influence of defence research in science and engineering). Around more contemporary questions of public policy, not strictly related to the development of the profession, scientists can be more reticent; the promotion of science or the profession would appear to be a politically safe area. As for speaking out in other areas of public policy - such as poverty, housing, or employment – scientists seem curiously quiet. The question of which issues scientists and engineers do or do not mobilise around, who they act with and how they get their voice heard is a research topic that would be fruitful for both technoscience and democracy.

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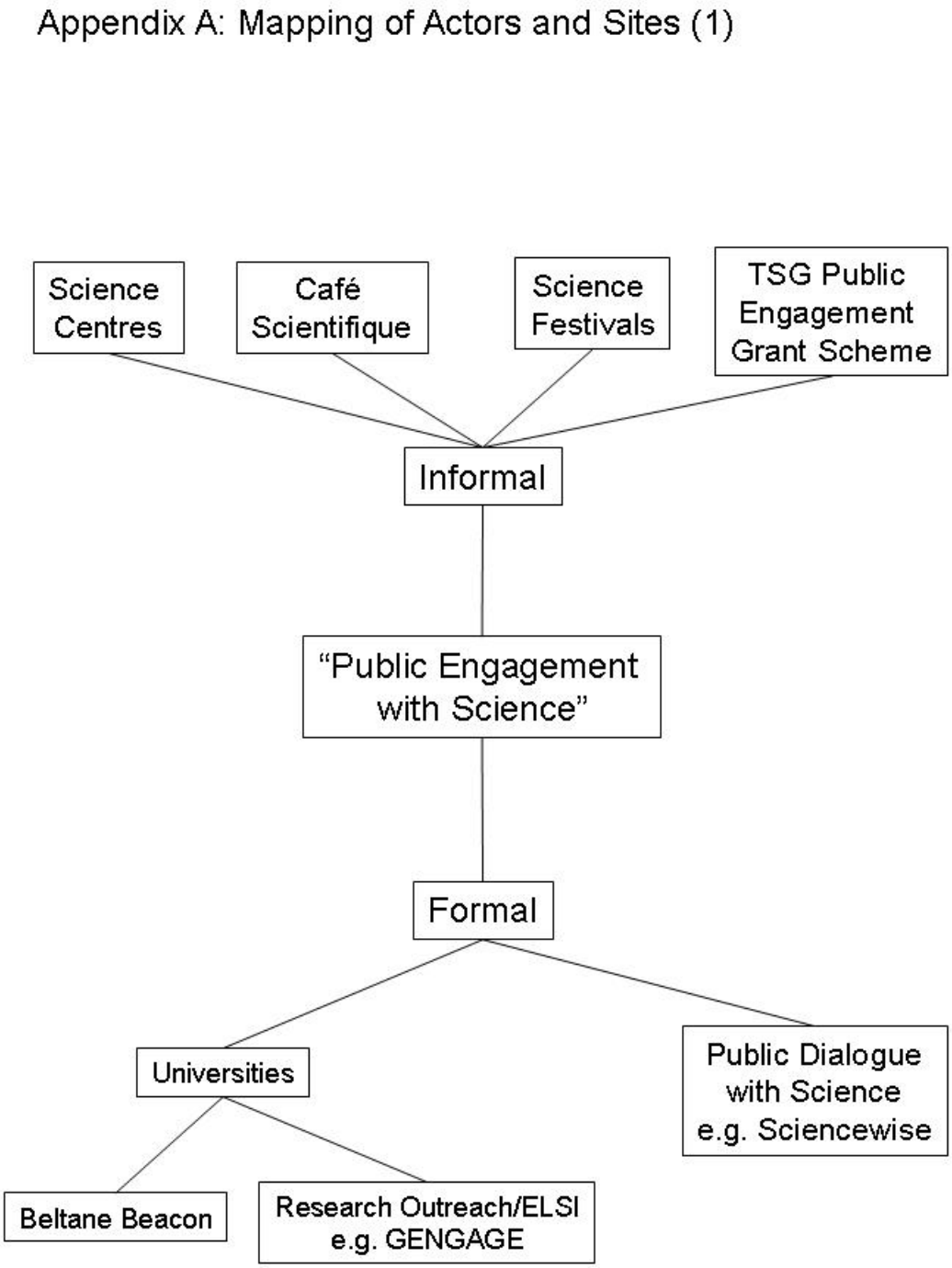
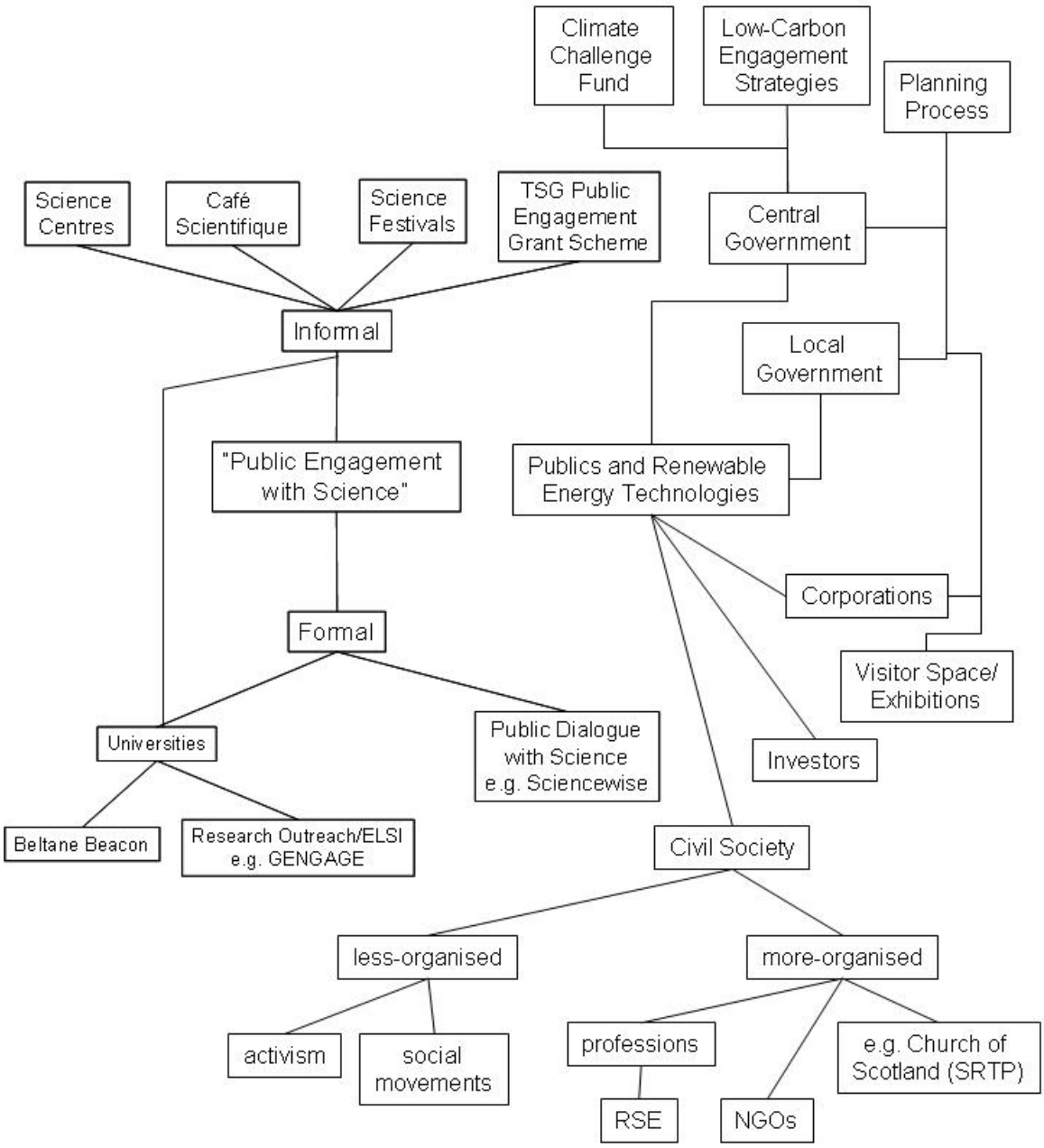
Appendix A: Mapping of Actors and Sites



Appendix A: Mapping of Actors and Sites (2)



Appendix B: Summary of Participants, Sample Consent Form and Participant Information Sheet

INTERVIEWS	Sites	Codes
Elite interviewees: …policymakers, event designers, commercial actors (formally consented, recorded, unnamed and ungendered, purposive/referral sampling)	Senior Manager, Science Centre (4) Senior Manager, Science Festival (4) Policymakers, Engagement Commercial Renewables Developer Civil Society, Environmental Activist Project leaders, Climate Challenge Fund (2) Civil Society, Church of Scotland (2) Policymakers, Planning (4)	INT-CEN01-04 INT-FES01-04 INT-POL02-03 INT-COM01 INT-CIV05 INT-CIV06-07 INT-CIV02, INT-CIV08 INT-POL01,INT-POL04-06
Facilitators/presenters: …at events/institutions (formally consented, recorded, anonymised, purposive sampling)	Public Engagement Practitioner (3)	INT-CIV01 INT-CIV03 INT-COM04
Individual members of the public: …regarding their engagement with science (verbally consented, non-recorded, anonymised, random sampling)	Glasgow Science Centre- Alice in Wonderland/MindWorks exhibit (6) Glasgow Science Centre – Science in the Dock exhibit (6) Satrosphere Science Centre (2) Glasgow Science Festival (5) Dundee Cafe Sci Extra (3) Aberdeen Cafe Med (5) Aberdeen Cafe Scientifique (3) Glasgow Cafe Scientifique (4)	INT-PUB01-06 INT-PUB07-12 INT-PUB13-14 INT-PUB15-19 INT-PUB20-22 INT-PUB23-27 INT-PUB28-30 INT-PUB31-34

PARTICIPANT OBSERVATION	Sites	Codes
Members of the public: …in science centres, festivals or Cafes where audience size is estimated at being greater than 10. Fully public events, ticketed (verbally consented by organisation, manual fieldnotes, anonymised, random sampling)	Glasgow Science Centre- Alice in Wonderland OBS01/MindWorks exhibit Glasgow Science Centre – Science in the Dock exhibit Satrosphere Science Centre Aberdeen Cafe Med Aberdeen Cafe Scientifique Glasgow Cafe Scientifique Glasgow Skeptics in the Pub Glasgow Science Festival, Science Saturday	OBS02 OBS03 OBS04 OBS08 OBS09 OBS10 OBS11 OBS12
Facilitators and presenters: …in science centres, festivals or Cafes where audience size is estimated at being greater than 10. Fully public events, ticketed (verbally consented by organiser, manual fieldnotes, unnamed and ungendered, purposive sampling)	Edinburgh International Science Festival 2010 – Brian Cox Edi Edinburgh International Science Festival 2010 – Synthetic Biology Debate Dundee Cafe Sci Extra Edinburgh International Science Festival 2010 – Climate Change	OBS05 OBS06 OBS07 OBS13
Visits and Tours …to engagement sites in policy, corporate and civil society sectors. Fully public sites (covert, manual fieldnotes, individuals not observed, snowball sampling)	Dundee Science Centre The Scottish Parliament in session Whitelee Windfarm Visitor Centre Electric Garage Coal Action Scotland Public Event	OBS14 OBS15 OBS16 OBS17 OBS18

DOCUMENTS	
Policy documents: …from government and learned societies, and selected responses from civil society (all publicly available)	Public Engagement Strategy for a Low Carbon Scotland, Scottish Government, 2010 Facing up To Climate Change: Breaking the Barriers to a low-carbon Scotland, Royal Society of Edinburgh 2011 Briefing Paper 11-04 The Low-Carbon Economy – A Briefing for Members of the Scottish Parliament, Royal Society of Edinburgh, 2011 Letter from Grangemouth Community Council to Scottish Government regarding Renewables Obligation (Scotland) Order 2011, dated 17th December 2011 Briefing on Scottish Government's Public Engagement Strategy for a Low Carbon Scotland, Stop Climate Chaos, 2011
Records: …of event programmes and grants awarded (all publicly available)	Historical Science Festival Programmes: Edinburgh (2012,2011,2010), Glasgow (2012,2011) , Orkney (2012,2011) British Science Festival, Aberdeen programme (2012) Historic Cafe Scientifique Programmes: 12 Cafes, (2012,2011,2010) Historical TSG Public Engagement Grants Awarded (2006-13)
Accounts: …of events and projects (all publicly available)	SRT @ 40, A short history of the Science, Religion and Technology project 1970-2010, John Francis, undated

Sample Participant Consent Form

Institute for Science and Society
School of Sociology and Social Policy, University of Nottingham

Participant Consent Form : *Forms of Engagement and the Role of Intermediaries in the Making of Scientific Citizenship in Scotland*

In signing this consent form I confirm that:

I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me.	Yes ☐	No ☐
I have had the opportunity to ask questions.	Yes ☐	No ☐
I understand the purpose of the research project and my involvement in it.	Yes ☐	No ☐
I understand that my participation is voluntary and I may withdraw from the research project at any stage, without having to give any reason and withdrawing will not penalise or disadvantaged me in any way.	Yes ☐	No ☐
I understand that information gained during the study will be considered in light of my role and generic organisation type. However, although I would not be identified by name I understand that my anonymity cannot be guaranteed because of the small professional community of which I am a member.	Yes ☐	No ☐
I understand that the researcher may be required to report to the authorities any significant harm to a child/young person (up to the age of 18 years) that he/she becomes aware of during the research. I agree that such harm may violate the principle of confidentiality.	Yes ☐	No ☐
I agree that extracts from the interview may be quoted in any report or publication arising from the research, and that such quotation will have an affiliation for the speaker (eg job role/generic organisations type). So, although I would not be identified by name I understand that my anonymity cannot be guaranteed because of the small professional community of which I am a member.	Yes ☐	No ☐
I understand that the interview may be recorded using an electronic voice recorder	Yes ☐	No ☐
I understand that data will be securely stored	Yes ☐	No ☐
I understand that I may contact the researcher or supervisor if I require further information about the research, and that I may contact the Research Ethics Officer of the School of Sociology and Social Policy, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.	Yes ☐	No ☐
I agree to take part in the above research project.	Yes ☐	No ☐

Participant's name (BLOCK CAP)	Participant's signature	Date
Researcher's name (BLOCK CAPITAL)	Researcher's signature	Date

Sample Participant Information Sheet (2 pages)

Appendix C: Protocol for Participant Observation

ESTIMATED DURATION: 2 hours

VENUE/LOGISTICS

1. What kind of building is it? How visible is it? How is it located/general situation
2. What time of day is the visit?
3. How do/can people arrive?
4. How much is the entry fee? Can one get in for free?
5. What kind of people are there?
6. Is it targeting a specific group/any sense of focus?

ARTIFACTS

1. What exhibits are there? Which areas of science do they communicate?
2. How topical is the material?
3. Who is there?/how long do they stay?/how do they interact?
4. Are some exhibits more popular than others?
5. topicality/open-endedness/sensor stimulations/novelty
6. What do people do when approaching an exhibit?
7. Are visitors typically coming from/going to a consistent place?
8. What is the artefact translating?
9. How are publics supposed to interact if at all? [Active/passive?]
10. How will public input be used if at all?

TEXTS

1. what explanatory material is available?
2. How is this presented?
3. What language is used? [scientific vs lay? Are a range of views present? (spectrum/for-against?)]
4. How do the visitors interact with the information and labelling?
5. Is the manner of publishing drawing people in?
6. Who might the texts be excluding?

FUNDING

1. Who is funding the event?
2. What is the relationship between the: sponsor and event? sponsor and public?
3. Is there a visible or covert sponsor's message?
4. Is the sponsor integrated into the activity/event?
5. What might the sponsor's motivation be? [PR? some other benefit?]

ROLE OF PUBLIC

1. How do visitors get brought in to the activity?
2. What is the network they are being brought into?
3. Are there opportunities for feedback?
4. What are people supposed to DO?
5. Is there an opportunity to disagree with the message?
6. Is there an opportunity to test understanding?
7. How is the public being conceptualised?
8. How are the public constrained?
9. How are the public constructing themselves?

ROLE OF EXPERTS

1. What are the credentials of the 'expert'?
2. Why have they been chosen?
3. What is the expert there to do?
4. What prior knowledge/exposure is the expert assuming on the part of the audience?
5. Does the expert present himself as something separate or as one of the people?
6. What tools are used to reinforce expert status/ body language/labcoat or suit/language?
7. How do experts interact with one another?
8. How are the experts received? [eg credibility of various scientists, natural vs social]
9. What role is the personality of the expert playing?

ANY OTHER OBSERVATIONS

Appendix D: Interview Schedule for Semi-structured Interviews : Elite

Interview Schedule for Semi-structured Interviews: 'Professional' Respondents

ESTIMATED DURATION: 1 hour

1. Could tell me a little about yourself and how you came to be in this role?
2. What is the purpose of [your organisation]? What is your role in the organisation?
3. How does [your organisation] fit within a broader landscape of publics and science in Scotland?
4. What do you think you have in common with / how do you differ from other [actors in field]?
5. Why do you think science communication is particularly important?
6. What are the key challenges in communicating science?
7. What are the most important messages about science that you/your organisation have tried to communicate? Were you successful in communicating these messages? How do you measure success?
8. Do you have sponsors? What's their relationship like with you? What's their role? How do you and they benefit from the relationship?
9. How would you describe your audiences – target/current?
10. Which other networks are you part of?
11. Do you perceive yourself or your organisation as having a role in achieving a Low Carbon Scotland? How do you perceive your role?
12. Is there anyone else you think I should speak to?
13. Are there any policy documents you'd direct me towards?
14. Would it be possible for me to speak to your visitors/come and observe? Who could I talk to about that?

Appendix E: Interview Schedule for Semi-structured Interviews : Public

Interview Schedule for unstructured chats for triangulation purposes: Participating members of the public

ESTIMATED DURATION: 3 minutes

[Introduction, offer business card, get verbal consent]

1. What has brought you here today?
2. Have you been before? / How did you hear about it?
3. Who are you with?
4. What do you think of it?
5. Is this the kind of thing you'd normally do in your spare time?

Appendix F: Document Analysis Proforma

Document Analysis Proforma

Name of Document:

Author:

Date:

For Whom Was the Document Written?

Who is the Audience?

Why Was It Written?

Who is supposed to do what?

How Is The Public Constructed?

What does it say about “Membership”?

How Does it Construct “Rights & Responsibilities”?

What Does It say About Participation?