

SCALES OF DISCONNECTION: MISMATCHES SHAPING THE GEOGRAPHIES OF EMERGING ENERGY LANDSCAPES

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Abstract

The networked nature of energy systems produces geographies of connection, but the focus of this paper is on geographies of disconnection, exploring the multi-scalar processes which shape the context in which energy landscapes emerge. It does so, first, by presenting a case study of farmers' attitudes to perennial energy crops in south-west Scotland. Their strong antipathy to converting farmland to short-rotation coppice, and the reasons for their negative attitudes, exemplify some of the wider mismatches and disconnects which the paper goes on to discuss. These include socio-political and socio-cultural mismatches, and a range of essentially geographical disconnects which are scalar in nature, such as the familiar local-global tension and the mismatch between the scales (both temporal and spatial) at which environmental and human systems organise and function. The discussion shows how these disjunctions not only affect energy geographies but also raise far-reaching questions about the ability of current governance structures and liberal democratic systems to respond swiftly and effectively to global challenges. The way that these mismatches are negotiated will mould both the character of future energy landscapes and the speed at which they take shape.

Shrnutí

Měřítka diskonekce: nesoulady ovlivňující geografie rozvíjejících se energetických krajín

Síťová podstata energetických systémů produkuje geografie spojitosti, nicméně tento článek se zaměřuje na geografie diskonekce, když zkoumá multiúrovňové procesy, které utváří kontext, v rámci něhož se rozvíjí energetické krajiny. Nejprve je prezentována případová studie postojů zemědělců k víceletým energetickým plodinám v jihozápadním Skotsku. Jejich silný odpor k přeměně zemědělské půdy pro pěstování rychle rostoucích dřevin a důvody jejich negativních postojů ilustrují některé z obecnějších nesouladů a diskonekcí, které jsou v článku diskutovány. Tyto zahrnují sociopolitické a sociokulturní nesoulady a řadu v jádru geografických diskonekcí, které jsou z podstaty skalární, jako známé napětí mezi lokálním a globálním a nesoulad mezi měřítky (časovými i prostorovými), na kterých jsou postaveny a fungují environmentální a sociální systémy. Diskuze ukazuje, jak tyto disjunkce nejenom ovlivňují geografie energií, ale vyvolávají otázky schopnosti současných vládních struktur a liberálně-demokratických systémů rychle a účinně reagovat na globální výzvy. Způsob, jakým jsou tyto nesoulady řešeny, bude formovat charakter budoucích energetických krajín, ale i rychlost, s jakou se budou rozvíjet.

Key words: energy crops, mismatches, scale, governance, energy landscapes, energy geographies

1. Introduction

Energy geographies now loom large within environmental management discourses, driven by the familiar 'troika' of climate change, energy security and peak oil, and by intense socio-political debates in many countries over the landscape impacts of renewable energy technologies (Warren et al., 2012). Even from this opening sentence it is immediately apparent that debates about energy geographies integrate numerous contentious and complex issues, all of which interconnect and interact on diverse spatial and temporal scales. They therefore constitute 'wicked problems' (Churchman, 1967), in that they resist resolution due to their complexity, they are multifaceted and interconnected, and large numbers of people and opinions are involved. Energy use has long been influential in the structuring of identities, territories and landscapes, and is likely to be the primary driver of landscape transformation in the present century (Nadai and van der Horst, 2010). Consequently, energy has emerged as a major governance challenge, not least because energy questions cross-cut many other policy concerns. Indeed, according to Zimmerer (2011, p. 705), energy is "far and away the most significant international resource system and political economic nexus", and energy questions are fuelling "a general social-ecological crisis of now major proportions".

This paper focuses on the essentially geographical dimension of this challenge by discussing the multiple scales – temporal and spatial – through which energy geographies are constructed, both conceptually and practically. It argues that a clearer recognition of this multiscale reality can help us to understand why the debate is characterized by mismatches and disconnections, and why resolutions prove perennially elusive. In turn, this geographical framing may help to create discursive spaces for constructive debate.

In order to root these conceptual constructs in a real world context, the paper uses a case study about perennial energy crops to illustrate and exemplify how some of these issues play out in a specific geographic locale, namely south-west Scotland. Although the Scottish context is only one of many from which relevant examples could be drawn, it does provide a rich setting for exploring issues surrounding renewable energy and emerging energy landscapes (Warren, 2009). There are several reasons why this is so:

- the country is abundantly endowed with renewable energy potential, most notably in terms of hydro, wind (onshore and offshore) and marine renewables, but also in biomass;
- there is strong political will to harness this potential, demonstrated in the adoption of world-leading targets

(e.g. the aim of generating the equivalent of 100% of electricity demand from renewables by 2020). Scotland's First Minister has said that he wants the country to become 'the Saudi Arabia of renewable energy' (Carrell, 2011);

- as a consequence of these first two points, recent years have seen dramatic rates of deployment, especially of onshore wind farms, accompanied by intense public debate and also by extensive research into social acceptance and the dynamics of opinion formation (Warren and Birnie, 2009; Aitken, 2010); and
- finally, several widely-debated issues come into especially sharp focus in the Scottish uplands, including: (i) the spatial coincidence of sites with power potential and internationally famous landscapes of high value for tourism, such as Loch Ness; (ii) landscape debates concerning the upgrading of energy grids required by new renewable generation capacity in peripheral areas; and (iii) the role of community ownership in facilitating the energy transition.

In this paper, I first outline a case study of energy crops and then shift to a much broader perspective, discussing wider questions about the disconnections which affect the geography of energy landscapes. Where appropriate, aspects of the case study are used to exemplify these broader issues. Recognising that one single case study could not effectively illustrate all the wide-ranging issues considered, however, the subsequent discussion draws on examples from other technologies and other regions.

2. Energy crops, bioenergy landscapes and farmers in south-west Scotland

Much of the public debate in Scotland surrounding renewable energy and landscape impacts has centred on the iconic landscapes of the Scottish Highlands, and has revolved around proposals for onshore windfarms, hydropower plants and grid upgrades (Warren, 2009). By contrast, the case study summarised here addresses perennial energy crops (PECs) in south-west Scotland, an energy source and a region which have received comparatively little attention. PECs have been actively promoted to Scottish farmers as a means of diversification during difficult economic times, and official projections envisage the conversion of large areas of farmland to PECs, both in Scotland and across the UK (DfT/DECC/DEFRA, 2012). The main policy drivers are the potential of such crops to produce a carbon-neutral fuel, while also offering a wide range of ecosystem services (Rowe et al., 2009). The combination of strong policy support and projections of large-scale expansion led Coleby et al. (2012, p. 374) to assert that energy crop production is "set to drive the most extensive changes in land-use in Britain since the 1950s". If this prediction proves correct, the rapid creation of extensive bioenergy landscapes will represent a novel departure for UK energy geographies.

The reaction of the public to such a potential transformation in land use and landscapes, and the social acceptability of such changes, has begun to be investigated in recent years (Karp et al., 2009; Dockerty et al., 2012), but a necessary precondition of any large change taking place clearly would be the widespread adoption of PECs by the farming community. Simply put, if such crops are to fulfil the dramatically expanded role envisaged by policy makers, large numbers of farmers will need to plant them. But because very few British farmers have any experience of

PECs, most are wary of them (Sherrington and Moran, 2010; Convery et al., 2012), and this may help to explain the stark contrast between the official optimism about energy crops and the limited area planted to date: by 2011, the total area established in the entire UK was just 0.01 Mha (DfT/DECC/DEFRA, 2012). This 'implementation gap' is one of the issues addressed in this case study.

The zone targeted for PEC expansion by policy makers is land which can be described as the 'squeezed middle' – not top quality agricultural land which is protected for arable cropping, nor poor, exposed upland areas, but intermediate quality farmland, sometimes referred to as 'marginal land' in this context (Shortall, 2013). It is dubbed the 'squeezed middle' because this zone is simultaneously targeted by several policy objectives (including forestry expansion, public access, renewable energy and conservation), and this area cannot fully accommodate all these diverse ambitions. The Scottish Government's innovative Land Use Strategy (LUS) is an attempt to provide a 'strategy of strategies' to chart a way through such tensions by facilitating holistic land use decision making. Launched in 2011, the LUS sets out a framework and broad principles for reconciling the many competing demands on land, utilising the familiar 'three pillars' framing of sustainable development (Scottish Government, 2012). It is too soon to know how effective it will be.

The dominant land uses in south-west Scotland at present are dairy farming and forestry, but the region's soils and climate offer significant biophysical potential for PECs, especially for willow grown in short rotation coppice (SRC). This was a key reason why the energy company E.ON decided to build a 44MW CHP biomass power station at Lockerbie in the Dumfries & Galloway region, the UK's first biomass power station. Commissioned in 2009 and costing £90m (c. €104.4m), it requires 480,000 tonnes of wood fuel per annum (E.ON, 2012). The company's stated aim at the outset was to source 20% of this total from willow grown by farmers within a 60-mile (c. 97 km) radius, requiring the establishment of some 4,000 ha of SRC. Because this represented a potentially valuable alternative market for the region's farmers at a time of economic volatility, offering an opportunity for diversification and a secure local market, E.ON's assumption was that many local farmers would plant SRC willow to supply the Lockerbie plant. The case study tested this assumption by investigating farmers' attitudes to willow SRC via questionnaire surveys in 2009 and 2011 (n = 218).

From previous studies, there were several reasons to suspect that E.ON's assumption was flawed:

- PECs involve cultivation techniques with which farmers are unfamiliar, involving new skills and different machinery;
- energy crops present farmers with new risks and uncertainties (e.g. a multi-year time frame which limits business flexibility);
- in contrast to much of mainland Europe, a deep and long-established cultural 'apartheid' separates farming and forestry in Scotland (Morgan-Davies et al., 2003), and this may prejudice farmers against perennial woody species; and
- PECs are situated in a policy context which is alien to most farmers, sitting outside the 'food and farming box' at the interface between policies concerning climate change, energy security and food security (Sherrington and Moran, 2010).

The methodology and the results of the study are presented and discussed in full by Warren et al. (2015). Only the key results are presented here, focusing on those which illustrate and exemplify the themes in the discussion which follows.

The primary, overarching finding is that most farmers are strongly negative towards converting their land to SRC. The three most frequently stated reasons for their opposition are that SRC:

- is not suitable for existing farming practices and/or for the land (33%);
- introduces inflexibility (18%); and
- is associated with price uncertainty (13%).

To explore the influence of economic factors on attitudes, farmers were presented with a pair of hypothetical questions about the profitability of SRC willow:

1. *Would you consider growing willow if profit margins were equivalent to existing operations?*
2. *Would you consider growing willow if it offered greater profits than current practices?*

Only 4% answered 'yes' to the first question. Unsurprisingly, the prospect of increased profits generated a more positive response to the second question, but still 40% answered 'no' and just 21% were potentially interested. When farmers were asked to identify a single factor which might persuade them to establish SRC, the two equal highest scoring factors, both with 32%, were 'profitability' and 'nothing'; thus for almost a third of respondents, no foreseeable factor would persuade them to consider planting willow on their farms.

It was apparent from the nature of the responses that antipathy to SRC was closely linked with farmers' self-identity and with a strong attachment to their way of life. The following selection of statements by respondent farmers concerning their attitudes towards short rotation coppice and the proposal that they might establish SRC on their farms, exemplify this association:

- *"[SRC] is useless! Our job is producing food, not fuel."*
- *"It [growing SRC] is not what we do. We produce FOOD!"*
- *"We would never grow energy crops. [Dairy farming] is a way of life, our way of life."*
- *"We are livestock farmers, not tree farmers."*
- *"No amount of money would ever encourage me to grow willow because I am a farmer!"*

Some clear conclusions emerge from the data. Firstly, despite a reliable local market (the E.ON power station), SRC is perceived as an 'alien' threat to farmers' socio-cultural identity and way of life. Secondly, there is a serious disconnect between the goals of policy-makers and the perceptions of farmers who are at the 'sharp end' of policy delivery. As one farmer put it, *"some suit-wearing office boy must have thought that the hill-billy farmers of south-west Scotland would just subside, sell half their herds and plant willow."* Thirdly, and more generally, if these results are representative, they imply that energy crops are unlikely to become a significant part of the renewable energy transition in the UK uplands in the way that policies and official projections envisage.

3. Mismatches and disconnects shaping energy landscapes

The above findings are now used to illustrate a broader discussion of different scales and types of disconnection,

and to explore some of the ways in which these mismatches can shape the geographies of emerging energy landscapes. The networked nature of energy systems produces geographies of connection, notably in very material ways (e.g. the spatial forms of electricity grids and their temporal evolution). By contrast, the focus here is on geographies of disconnection. While these disconnects are, in themselves, mostly immaterial, they have very tangible implications for landscapes and society.

3.1 Socio-political and socio-cultural disconnects

This sub-section highlights the disconnects between policy makers and stakeholders. Such stakeholders may be active (i.e. people who are expected to implement policy, such as the farmers in the above study), or passive, such as communities which are asked or forced to 'host' developments in their 'backyard'. A disconnect between stakeholders and policy makers is strikingly apparent in the Lockerbie results. These findings, when combined with other studies of farmers' responses to government policy initiatives, and also with research on the social acceptability of wind power, show that technocrats ignore socio-cultural realities at their peril (Burton et al., 2008; Greiner and Gregg, 2011; Convery et al., 2012; Huber et al., 2012). Policy makers in the UK and elsewhere have often been perplexed to discover that technical assessments identifying suitable sites do not translate either simply or easily into renewable energy projects. All too often, only lip service is paid to the social science dimensions of energy debates, and yet these frequently turn out to be critical. Policy making and policy implementation require an understanding of the 'full geography'.

In itself, this is hardly a new insight. Over two decades ago, Twidell and Brice (1992, p. 477) noted that "limits to renewable resources are not the potential in the environment, but the institutional factors and collective personal response of the public", and this observation has been repeatedly proved by subsequent experience. Because it is a truth which is continually overlooked and contributes to the common phenomenon of policy 'implementation gaps', however, it remains an important live issue to highlight. It is also a contributory factor in the so-called 'social gap' between broad public support for a policy and public opposition to specific proposals, a much-researched issue which has recently been revisited by Bell et al. (2013). They argue that understanding such gaps is important not only for the fulfillment of renewable energy ambitions but, more broadly, to explicate "the relationship between public opinion and political outcomes in democratic politics more generally" (Bell et al., 2013, p. 116). The importance of the social science dimensions of policy implementation is also stressed by Warren et al. (2012), who suggest that, whereas the sustainability challenge was once thought to consist of persuading a soft and malleable society to adjust to 'hard facts', it would now appear that the inverse situation of 'soft facts' and 'hard society' is perhaps closer to the truth: facts are contested, whereas social norms and practices prove resistant to change. The story of the development of wind power policy nicely exemplifies this inversion (Szarka et al., 2012), as does the resistance of Lockerbie farmers to PECs despite the existence of positive economic and technical 'facts'.

Thus, socio-political and socio-cultural disconnects can powerfully shape energy geographies by 'frustrating' energy policy. The way that this emerges in the Lockerbie study is characterised by Warren et al. (2015) as constituting a

disconnect between ‘suits and boilersuits’ (boilersuits being work clothing worn by many farmers); in other words, a perceptual gulf separates the policy makers from the ‘ground level’ actors with responsibility for implementing policy. Quotes such as the one above about ‘some suit-wearing office boy...’ show that the farmers themselves are keenly aware of this disconnect. Official projections by ‘the suits’ envisage a major expansion of PECs, yet take-up by ‘the boilersuits’ has been minimal. This policy failure can partly be understood as a lack of understanding by policy makers of the values and goals of ‘policy deliverers’. This links with the idea of ‘place attachment’ discussed below.

The gulf that this failure creates is, regrettably, all too common. For example, attitudes strikingly similar to those held by farmers around Lockerbie are documented amongst Australian farmers by Hall et al. (2013, p. 205), one of whom they report as saying: “We should decide what happens. We don’t want city slickers coming down and telling us what’s what”. There are also strong parallels here with the well-documented disconnect that exists between agri-environmental policies and farmers’ values and motivations (Burton et al., 2008; Greiner and Gregg, 2011). This literature highlights the fact that land use managers “stand at the point where abstract policy imperatives collide with concrete realities” (Constable, 2012, p. xi). Landscape change is, in practice, the product of myriad local decisions made by individual stakeholders. As Cope et al. (2011, p. 855) observe, policy makers “typically focus on biophysical and economic criteria that influence farmers’ land use decisions at the expense of ‘intrinsic’ socio-cultural motivations”. This further emphasises the point that understanding these socio-cultural dimensions of decision making and policy adoption is critical if the socio-political gulf and the ‘implementation gap’ are to be bridged.

3.2 Scalar disconnects: temporal and spatial mismatches

A number of significant disconnects are scalar in nature (at both spatial scale and temporal scale), and here we are in quintessentially geographical terrain. As Bridge et al. (2013, pp. 332–333) observe: “*The goal of a low carbon transition... is slowly emerging as a question of which geographical futures will be created... Meeting the challenges of climate change and energy security is, therefore, fundamentally a geographical project.*”

The temporal dimension has received significant attention via the concept of ‘the energy transition’ itself, whereas the ways that spatial processes influence energy systems have been studied less. These interlocking scalar issues can be introduced via the simple graphic in Figure 1, which shows a three-dimensional ‘decision space’ with priority axes. This illustrates the potential for scale-related disconnects to arise. Whether a particular strategy or policy is judged to be good or bad will depend – amongst many other factors – on the different priorities attached to the various dimensions of this decision-making matrix. Debates surrounding energy futures have repeatedly revealed the differential weightings attached by diverse protagonists to (i) present concerns versus those of our descendants, (ii) local versus international perspectives, and (iii) the importance of human concerns versus the value of non-human nature. For example, to risk adopting stereotypes, members of rural communities might give high priority to the present concerns of local people (Point A in Fig. 1), while members of international conservation organisations might situate themselves at the other end of all three

axes (Point B) by emphasising the long-term significance of natural systems from a global perspective. Tensions flowing from different spatial and temporal priorities lie at the heart of many energy controversies (Pillai et al., 2005; Szarka et al., 2012). Judgements about these priorities are themselves formed in diverse and contested ways, depending on people’s beliefs and value systems, their political outlook, and, for example, the importance they attach to scientific approaches as opposed to other grounds of knowledge and decision making.

There are several mismatches to highlight here. The first, already alluded to, is the familiar tension between local and global. Arguments supporting renewables often rest on global and national concerns such as climate change and energy security, whereas the arguments of opponents typically focus on the specificities of local places and landscapes (Warren and Birnie, 2009). Conflict is exacerbated by the contrast between the seemingly abstract, invisible, diffuse benefits of the energy transition and the highly tangible local impacts of, for example, PECs, wind turbines or grid upgrades. The perception that the global environment is being saved by sacrificing the local environment fuels opposition.

The second mismatch is that between the rapid pace of change (in energy technologies and energy landscapes) and the slow rate at which public attitudes evolve, especially in relation to landscape aesthetics. Throughout history, the changing energy needs and choices of society have frequently been major drivers of landscape change, from prehistoric tree felling for fuel, to coal mining, hydropower dams and electrification. During the ongoing transition to renewables, energy has again emerged as a significant agent of landscape change (Nadai and van der Horst, 2010), notably through the construction of windfarms, solar farms and the associated upgrades of electricity grids, and these are set to rival or exceed the landscape impacts of previous energy technologies. Although social norms concerning landscape aesthetics do evolve, often quite radically, such changes typically take place slowly, over generations. The sharp dichotomy between the urgency of the need for an energy transition and the slow rate at which public attitudes towards landscape aesthetics evolve is explored insightfully by Selman (2010). For many people, the “energy transition is experienced as the transformation of landscape” (Bridge et al., 2013, p. 335) – often swift and dramatic in the case of modern windfarms – and the speed,

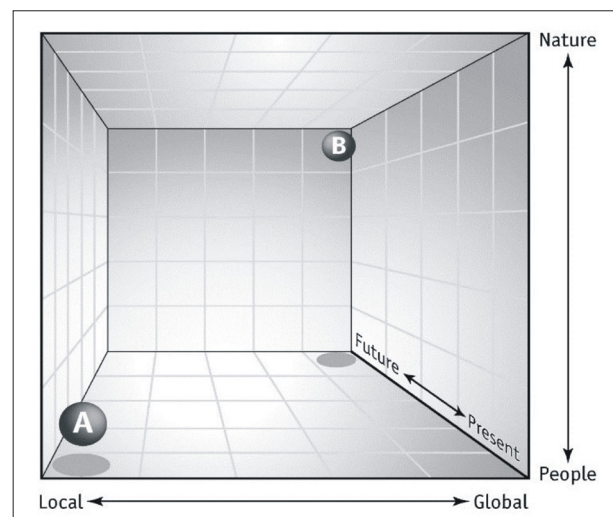


Fig. 1: Priority axes in environmental decision-making. (See text for explanation: after Warren, 2009)

magnitude and nature of change is far greater than the pace of aesthetic adaptation will enable many people to accept. It is akin to 'future shock'. Landscape concerns often feature prominently in debates over renewable energy proposals, as revealed tellingly in the names of anti-windfarm groups such as Australia's 'Landscape Guardians' and England's 'Country Guardians'. Although history and some recent evidence suggests that society may eventually "learn to love the landscapes of carbon neutrality", and that an "acquired aesthetic" could develop concerning renewables technologies, this may take a generation or more because "the social production of taste associated with landscape is quite slow, and preferences tend to be conservative, generally making it difficult for us to accept change" (Selman, 2010, pp. 157, 160). In the meantime, this mismatch will continue to act as a social brake on the implementation of renewable energy policy. It is clear, for example, that farmers in the Lockerbie region are not minded to embrace PECs either quickly or easily.

A third mismatch comprises a socio-psychological disconnect in the way that locations are socially constructed - a mismatch between 'sites' and 'places'. In the context of renewable energy, this has been revealingly explored by Devine-Wright (2009, 2011). It comprises a conflict between the top-down perspectives of politicians, planners and developers, and the perceptions of local residents. The former typically conceptualise locations which have development potential (whether for energy crops, wind power or other renewable energy technologies) as impersonal 'sites', whereas the latter tend to see and relate to them as 'places' which are imbued with symbolic and emotional meaning. Local opposition to renewable energy proposals has been shown to be strongly linked to 'place attachment' (a concept closely allied with the geographical idea of topophilia (Tuan, 1990) and to the mobilisation of 'place protectors' (Devine-Wright, 2009; Bell et al., 2013). In other words, opposition is not simply a defence of landscape aesthetics, but of places from which individuals and local communities derive meaning, value and identity. So the scale dimension here is constructed by and operates through the perceptions of the actors involved. This disconnect is well illustrated by the Lockerbie results which show that farmers perceive PECs as incompatible with - and even a threat to - their identity and way of life. Their opposition to PECs is clearly motivated by the contrast between, on the one hand, the policy makers' detached, homogenising construction of 'intermediate land' as an ideal site for bioenergy production and, on the other, the farmers' own intimate understanding of the specificities of that land as a valued local place.

A fourth and final mismatch simply comprises a straightforward clash in scales between the large size of some renewable energy technologies (notably modern wind turbines) and the scale of the components of many rural landscapes - both natural (topography, trees) and cultural (field boundaries, buildings and settlements). Rapid technological development in pursuit of ever greater efficiencies, resulting in today's giant turbines, has meant that the technology has progressively outgrown the landscape and no longer fits comfortably within it. The industrial scale of modern turbines, and their out-of-scale dominance in the landscape, is frequently cited by opponents as a factor motivating their opposition. Scale is "one of the main controversial dimensions" because contemporary installations "ignore the principles of harmony and fitness" (Selman, 2010, p. 165). The impressive gains in efficiency have come at the cost of ever greater aesthetic intrusiveness

as they have grown to dwarf their surroundings, becoming visible from great distances. To a lesser extent, this applies to PECs too; even though such crops are, in themselves, both natural and relatively small in scale, the policy aspirations for their widespread adoption represent a potentially large-scale transformation of the countryside, possibly the greatest change in British land use since the mid-20th century (Coleby et al., 2012).

3.3 Scale meets socio-politics

The above two groups of issues intersect and combine to create complex, many-layered disconnections that this paper can do little more than point towards, but they are integral to the emerging geographies of energy landscapes and socio-politics more generally. As shown below, while these disconnections stretch far beyond energy geographies and the energy transition per se, they are directly relevant to them, framing the evolving context in which energy decisions are made. Two examples of this multi-faceted and intricately woven terrain may suffice. Both are familiar examples which are used here to illustrate how geographical perspectives can enhance our understanding of the challenges of negotiating the energy transition, and how scaling, as an analytical lens, can illuminate significant aspects of energy geographies (Bridge et al., 2013). This final section, of necessity, leaves behind the regional case study of farmers' attitudes to PECs which has exemplified the above discussion, because the issues are broader in scope and more conceptual in nature.

The first example is the frequently noted and sharp discontinuity between the short time-scales of politics and the much greater temporal scales not only of climatic and environmental change, but also of the time that it will take for the energy transition to run its full course. Proverbially, 'a week is a long time in politics'. The time horizons in most democratic systems rarely stretch beyond a few years at best, and frequently decisions are taken on the basis of much shorter-term considerations. A policy which will yield no political dividends before the next election - indeed, which may only have measurable benefits over time-scales of decades or centuries - has limited political traction, and yet, compounding the difficulty, the costs of mitigation policies and strategies are borne in the present (Edmondson and Levy, 2013). This important "mismatch between the scales at which natural and human systems organize" is profoundly counter-productive, because it leads to these kinds of "failures in feedback when... benefits accrue at one scale, but costs are carried at another" (Carpenter et al., 2006, p. 257). One response to this problem has been the promotion of the concept of 'the Long Now' (Robin and Steffen, 2007). A damaging consequence of this disconnect is that short-term criteria predominate in much political decision making. Ineluctably, this downgrades the priority of long-term issues - such as climate change, landscape evolution and the ultimate goals of the energy transition - in turn rendering policy making for 'the Long Now' an intractable political challenge within democratic systems. Even though policy making for climate change mitigation and renewable energy development stand out as exceptions in this regard, in that some governments have set legally-binding targets over time periods spanning several electoral cycles, this is still a much shorter time frame than the time-scale of the issues that such policies purport to address.

The second example is the mismatch between the spatial scale of the politics of nation states and the global scale of

many energy and climate-related issues. Nation states are well-practised in the art of governance at national, regional and local scales, but cannot, acting alone, tackle supra-national phenomena. Yet many of the most urgent challenges are now global in scope. This is because, since the mid-20th century, the rapidly globalising world has become ever-more intricately and deeply interconnected (especially in terms of economics, communications, health and environmental governance), and because exponentially increasing human impacts have inaugurated the so-called Anthropocene era of human dominance (Steffen et al., 2007). The swift dawning of today's hyper-connected age, in which the "knock-ons" of local events can rapidly cascade globally (e.g. '9/11'; the collapse of Lehman Brothers), has given ever-greater prominence to global governance arrangements. In an insightful discussion of this trend, Hale and Held (2013, pp. 20, 23) reflect on Lorenzetti's famous 14th century fresco *The Allegory of Good and Bad Government*, depicting medieval city states, to highlight the transformation in scales of governance: "*The scale at which political institutions must be effective has expanded beyond cities and their surrounding fields to include countries, continents and, with globalisation, the world as a whole... Human activities anywhere on the planet now affect the climate in which every other person on the planet and their descendants must live.*"

They show how, just as the success of medieval city states set in motion changes which rendered them obsolete, so the success of nation states has unleashed forces at supra-national scales which they are ill-equipped to address. In the words of Goldin (2013, p. 48): "the challenges of the global commons increasingly render domestic solutions inadequate".

Growing recognition of these and other scalar mismatches, and of the ineffectiveness of the international community's response to many critical global challenges, has led some to question whether our political systems and institutions are 'fit for purpose' for governance of the global village (Goldin, 2013). An increasing number of those who investigate this question are coming to the conclusion that they are not. For example, the verdicts of Shearman and Smith (2007) and Edmondson and Levy (2013) are encapsulated in the arresting titles of their respective books: *The Climate Change Challenge and the Failure of Democracy*, and *Climate Change and Order: the end of prosperity and democracy*. These authors argue that liberal democracy and the current consensus-building approach to international relations are incapable of delivering the swift and effective action required to decrease rates of greenhouse gas emissions, not least through the decarbonisation of the energy sector; they even go so far as to suggest that they are responsible for global climate change. Thus Shearman and Smith (2007, p. 11) contend that "liberal democracy is ecologically flawed as a social system because it leads to the tragedy of the commons". In a similar vein, Wainwright and Mann (2012, p. 9) argue trenchantly in their paper *Climate Leviathan* that "if climate science is even half right in its forecasts, the liberal model of democracy... is at best too slow, at worst a devastating distraction".

These publications go on to construct a critique of economic growth, the fundamental engine of capitalism, and argue that achieving 'prosperity without growth' (Jackson, 2011) should instead be the over-riding goal. For, as the UNDP (2008, p. 27) recognises, climate change demonstrates clearly that "economic wealth creation is not the same as human progress". In the Anthropocene era, Gross Domestic Product is a narrow, inadequate yardstick of success (Robinson, 2012). Considerations of this kind

lead to suggestions that new political visions and economic systems are needed to support viable futures (Edmondson and Levy, 2013). Such arguments, informed by a recognition of the temporal and spatial mismatches identified above, are resulting in a hard-nosed reassessment of the value and likely ability of today's democratic governance structures to address worldwide challenges in a timely and effective fashion. In the view of Hale and Held (2013, p. 20), "*global governance has become gridlocked [and]... the multilateral institutions we rely on to solve global problems are increasingly unable to do so*". Both Goldin (2013) and Hale et al. (2013) show that institutionalised multilateral cooperation is failing at a time when the need for it has never been greater.

This "yawning governance gap" (Goldin, 2013, p. 3) is apparent in many spheres, but the example that is of most direct and pressing relevance for energy geographies is the continuing failure of global climate negotiations to deliver an effective global treaty. The gap in this arena is particularly stark. Widespread and growing disillusionment with the negotiation process, especially since the Cancún climate talks of 2010, is prompting a reversion to smaller-scale, more localised responses to the many challenges posed by climate change, including the energy transition and its landscape implications (New Scientist, 2013). As the prospect of agreeing to binding targets at the global scale has receded, so regional and municipal governments have increasingly opted to 'go it alone' - to give up waiting for top-down, multilateral solutions, and to set their own local targets and policies unilaterally. This is strikingly true at the city scale (Bulkeley and Broto, 2013). Recent statistics suggest that this trend of relocalisation is helping to decouple economic growth from emissions through reductions in carbon intensity (Pearce, 2013). Positive though this trend is, it is not a substitute for global agreements.

It is apparent even from this short discussion that any consideration of the disconnects and mismatches identified above swiftly leads to much broader and searching questions about governance, ultimate socio-economic goals, the sovereignty of nation states and the efficacy of liberal democracy, questions which far exceed the scope of this paper. Such destabilising and unpalatable challenges to the status quo are, unsurprisingly, gaining little public airing as yet: "the prospect that core political values are challenged as a result of global climate change impacts is a dawning realisation that few political actors readily accept and acknowledge" (Edmondson and Levy, 2013, p. 4). Unwelcome though this realisation is, it is nevertheless quite clear that the issues raised by the urgent need for an energy transition - as part of an effective response to global climate change - are unleashing questions which go far beyond energy geographies to challenge fundamental, normative assumptions about the structure and functioning of society. The ways in which these questions are addressed - or ignored - in the coming decades, will set the context in which energy geographies and energy landscapes develop.

4. Conclusion

A case study of the attitudes of farmers in south-west Scotland to the adoption of perennial energy crops has shown that, despite the area's technical potential for such crops and the existence of a local market, most farmers are strongly opposed to planting them. The findings of this case study have served to illustrate a range of mismatches and disconnects - socio-political, cultural, psychological and scalar - which can act as significant hindrances to the

delivery of renewable energy policies, in turn influencing energy landscapes. These then feed into a set of high-level questions and challenges concerning modes and scales of governance, questions which are becoming more pressing in the context of global climate change and consequent efforts to reduce emissions from the energy sector.

Society's energy choices have always shaped landscapes, and there can be no doubt that "energy will be a driving force of future cultural landscapes" (Selman, 2010, p. 169). But it is striking that, through the link with climate change, the scale at which society's use of energy moulds landscapes has recently leapt from local to global: our energy choices now have planetary reach. Reciprocally, that spatial leap has also operated in reverse, as global concerns have increasingly come to influence local decisions – householders install low-energy light bulbs to save the planet, and local mayors wrestle with the carbon cycle. In energy geographies, as in so many other arenas, globalisation has blurred the boundaries between domestic and international issues (Hale and Held, 2013). As the simple graphic in Figure 1 above, illustrates, the sliding scales of spatial and temporal concerns create the scope for an almost infinite number of different but justifiable positions. For this reason alone (and there are many others), energy decisions are always likely to generate sharp debate.

The various mismatches and disconnections discussed in this paper play an important role in shaping energy landscapes by influencing both the nature and rate of change. It is clear that the 'disconnections' are not only figurative but also literal, and that the former affect the latter: disconnections postpone connections. In other words, the failure of policy makers to 'connect' effectively with stakeholders delays the creation of actual physical electrical connections with renewable sources of power, thereby impeding the transition to a renewables-based energy sector. The way that these mismatches and disconnects are negotiated will mould both the character of future energy landscapes and the speed at which they take shape.

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