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PART II

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INNOVATION AND NEW PATH CREATION: THE ROLE OF NICHE ENVIRONMENTS IN THE DEVELOPMENT OF THE WIND POWER INDUSTRY IN GERMANY AND THE UK

Abstract: This paper seeks to explore the issues of innovation and new path creation in the UK and Germany, illustrated through the case of the modern wind power industry. Taking an evolutionary perspective drawing on path dependence theory, the paper examines the role of niche environments in the creation of new economic pathways. The research finds that new economic pathways are more likely to develop in places where niche conditions provide receptive environments for innovations to flourish. The policy implications of the research include the importance of supporting niche environments that encourage growth in new sectors and the need for financial support to bring innovations to market, to encourage the development of new economic pathways.
Key words: innovation, new path creation, wind energy, niche environments, Germany, UK.

1. INTRODUCTION

In times of economic crisis, much policy discourse centres on possibilities for the creation of new economic trajectories to lift a national economy out of recession. New industrial pathways are needed as a source of additional employment and economic growth (Martin and Sunley, 2006). One route to new industrial pathways is through innovations in particular sectors that build into a critical mass.

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The key issue explored in this paper is the process through which these new economic pathways are created by innovative companies, thus contributing to regional structural change and economic competitiveness.

The importance that innovation plays in this process has long been recognised, dating back to Schumpeter's writing in the 1930s (Schumpeter, 1939), with innovation in products and processes being seen as key to growth in new sectors of the urban and regional economy (Simmie, 2001). However, there is less agreement over why and where inventions (i.e. new ideas) take place, which in turn feed the innovation process (i.e. the commercialisation of new ideas). Drawing on the theoretical framework provided by evolutionary economic geography (Boschma and Martin, 2010), it can be argued that path dependence theory offers an important perspective in understanding these issues (David, 1985; Arthur, 1989). Path dependence theory gives prominence to the notion that history is a key factor in determining current and future economic pathways. Rather than the economy tending towards an equilibrium state, as rational models of equilibrium theory would suggest, proponents of path dependence theory argue that the current economic landscape is influenced by past economic activity, which in turn shapes future economic pathways (Martin and Sunley, 2006). Studying the process of new path creation can provide insights into why and where new economic pathways emerge and can thus contribute to understanding how the structure of local and national economies evolves over time. Clearly, these are issues that have significance for policy-makers in economic development, seeking to encourage new trajectories in the economy.

Within this emerging theoretical framework, however, there are a number of unanswered questions around the geography of new path creation. In the broadest terms, why do inventions lead to innovations and new path creation in certain localities rather than others, and subsequently why do new economic pathways emerge in some places rather than alternative ones. In this paper, we apply the theoretical framework of path dependence to explore these questions, taking the wind power industry as an example of a new economic pathway.

The sectoral focus here is the wind power industry, for two key reasons. Firstly, OECD patent data shows that wind power relative to other climate mitigation technologies, has had the most patenting activity since the Kyoto Protocol was signed in 1997 (figure 1). Wind energy technology is therefore central to low-carbon innovation and represents an important sector to examine in terms of new economic pathways.

Secondly, the wind energy sector has the potential to contribute to the 'green economy' that is being promoted by Governments across the world, that encourages the growth and take-up of low-carbon technologies to meet climate change obligations, as well as creating 'green jobs' to address rising unemployment. It is thus an important growth sector in many countries, offering a relatively new and evolving economic pathway to study, given the current emphasis on decarbonising the energy supply system.

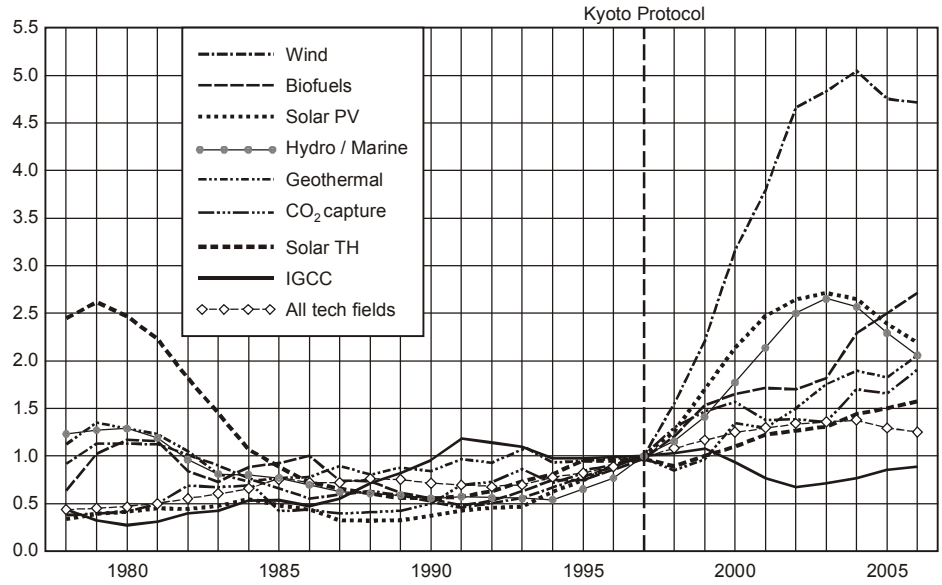

Fig. 1. Patenting in climate mitigation technologies relative to all sectors
(indexed on 1980 = 1.0, ratification countries)
Source: OECD (Pilat, 2010)

For the purposes of this paper, the wind power industry is defined according to OECD definitions, as classified in the IPC (International Patent Classification) which categorises innovation related to wind energy technology as wind motors (F03D), electric propulsion with the power supply from force of nature e.g. wind (B60L 8/00) and propulsive devices directly acted on by wind (B63H 13/00) (OECD, 2009).

The two countries selected for analysis are Germany and the UK, as contrasting case studies with different evolutionary histories. OECD data shows that Germany is one of the leading innovators in wind power technology, in contrast to the UK, which lags significantly behind, despite having some of the most favourable wind resources in Europe. The two countries therefore offer interesting comparative cases, where a so-called 'wind rush' has been experienced in one country but not the other.

The paper therefore aims to explore the concept of new path creation, taking the case of the wind power industry to examine why the sector has developed along different trajectories in the two countries.

The paper is structured as follows: the second section reviews the theoretical literature related to path dependence theory and new path creation, while the third section provides some background to the national contexts in the two countries under study, the UK and Germany. The fourth section presents the methodology that was used in the study. The fifth section looks at the case of the wind energy sector in detail, reporting on in-depth interviews with wind energy inventors

in the two selected countries. Finally, the sixth section presents conclusions and highlights the contrasts between the two countries, showing how receptive niche conditions are key to the development of new economic pathways.

2. LITERATURE REVIEW

There has been increasing recognition over the last 20 years of the value of adopting an evolutionary approach to understanding the economic landscape, at the national, regional and local levels (Boschma and Martin, 2010). Among scholars working in this field, there has been a growing dissatisfaction with rational models of neo-classical equilibrium theory, models that are rarely played out in reality (see e.g. Arthur *et al*., 1997; Nelson and Winter, 1982; Witt, 2003). According to neo-classical theory, there is little explanation for economies that progress along sub-optimal technological trajectories. However, it is argued that an evolutionary perspective can shed light on these real economies, by adopting a historical approach to understanding economic growth and change.

Embedded within the evolutionary perspective is the notion of transformation from within, over time. Thus, previous economic pathways influence current possibilities, which in turn affect future path creation. As Metcalfe *et al*. (2006, p. 9) state, 'Economic growth is an autocatalytic process in which change begets change'. What scholars of geography bring to the debate in addition is an emphasis on the spatial dimension of economic change, demonstrating that place matters in our understanding of economic growth and evolution of the economic landscape (Boschma and Martin, 2010, p. 6).

Within evolutionary economics, there are at least four strands of thought that address evolutionary change in the economy: generalised Darwinism (e.g. Metcalfe, 2005; Witt, 2003), complexity theory (e.g. Beinhocker, 2006; Foster, 2005); panarchy (e.g. Gunderson and Holling, 2002) and path dependence theory (e.g. David 1985; Arthur 1989; Garud and Karnøe 2001). Each approach has a different focus: Darwinism highlights variety, novelty and selection; complexity theory emphasises self-organisation, bifurcations and adaptive growth; and panarchy concentrates on adaptive cycles. Path dependence theory, on the other hand, focuses on historical continuity and 'lock in', and given our interest in new path creation in the evolution of urban and regional economies, we focus here on path dependence theory as a conceptual framework for understanding how and where new economic pathways emerge. As Boschma and Martin (2010, p. 8) state, path dependence theory incorporates the notion that 'the economic landscape does not tend towards some (predefined) unique equilibrium state or configuration, but is an open system that evolves in ways shaped by its past development paths'. However, as we establish below, there remain questions that are unanswered by the theory, such as where new paths come from, and why they emerge where they do (Martin and Sunley, 2006; 2010).

According to path dependence theory, the cycle of an economic pathway evolves through four stages: pre-formation, path creation, path dependence and path decay or re-invention (Martin and Simmie, 2008). It has been argued that path dependent development trajectories are the result of two parallel forces: economic incentives of increasing returns on the one hand, and the bounded rationality of technological paradigms on the other. While increasing returns and agglomeration economies offer one perspective on the drivers behind path dependence (see Parr, 2002), here we concentrate on the concept of 'technological paradigms' as a means of understanding path dependent development trajectories, given our interest in the role that technological development plays in new path creation.

A concept first introduced by Dosi (1982, 1984), 'technological paradigms' can be defined as 'a collectively shared logic at the convergence of technological potential, relative costs, market acceptance and functional coherence' (Perez, 2010, p. 186). Thus, the paradigm defines the modus operandi shared by a given community of practitioners (Dosi and Grazzi, 2010). As Dosi and Grazzi (2010, p. 180) note, 'learning is often local and cumulative', illustrating both that 'geography matters', and that path dependence is an important factor, due to the cumulative local build-up of know-how and understanding. What is less clear, however, is how and why new pathways emerge in the pre-formation stage of path dependence theory, when faced with dominant technological paradigms.

Path dependence theory suggests that it is difficult to establish a new economic pathway which breaks away from an established economic sector. In the case of the energy sector, the theory would suggest that once locked in to a centralised and grid-connected electricity generating system based on fossil fuels, it is difficult for the renewable sector to break in and become established.

However, one of the key processes behind the emergence of a new economic pathway is the transformation of an invention into an innovation. Schumpeter (1911, pp. 132–136) was one of the first scholars to make the important distinction between invention and innovation, an invention being a product or process that is conceived for the first time, as opposed to an innovation which is the commercialisation of that invention, involving a transition from what is technologically possible to what is economically viable (Perez, 2010).

In this paper, we examine the transition from invention to innovation and further, to the creation of a new economic pathway, taking the concept of 'niche environments' to explore where and why new economic trajectories develop. A niche can be defined as a limited space where new technologies can develop and mature (see Schot and Geels, 2007, for a critical review of the concept). In order to make a break with dominant technological paradigms, it is argued that niches (spaces) are required within or outside existing knowledge structures, where a new technology is temporarily protected from the standards and selection rules of the prevailing paradigm (Kemp *et al*., 1998; Hoogma *et al*., 2002; Markard and Truffer, 2006). Niches provide the opportunity for inventions to mature, without competitive market pressures being brought to bear, or the normal selection criteria that operate in the dominant technological paradigm.

Thus, we suggest that one of the key requirements for the creation of a new economic pathway is the existence of a niche, an incubation environment, where a new technology can be sheltered from the dominant technological paradigm and take root.

It is this theme that we will explore in greater detail empirically in the remainder of the paper, taking the case of the wind power industry in the UK and Germany to examine how far the concept of niches within new path creation theory has been important in explaining the different trajectories of the wind energy industry, and how far it can account for the different outcomes in the two countries.

3. CONTEXT OF THE WIND ENERGY INDUSTRY IN THE UK AND GERMANY

The situation of the German and UK wind energy industries stand in marked contrast. Analysis of OCED's REGPAT database shows that patent applications between 1978 and 2005 in the wind industry in Germany far outstripped applications in the UK for the same period (figure 2).

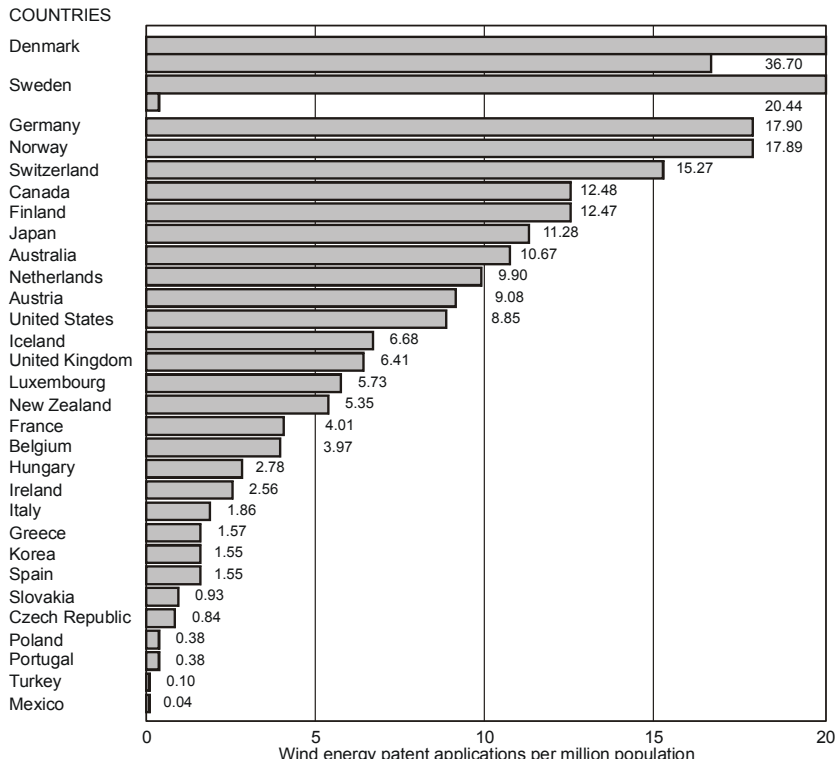

Fig. 2. Wind energy patent applications per million population
OECD 1978–2005 REGPAT

This lead in relation to patents also translates into a significant advantage in terms of wind energy capacity. Historically, Germany has been the world leader, and was only overtaken by the USA in 2008 (WWEA, 2009). As table 1 shows, installed onshore wind capacity in Germany is around ten times that of the UK, with renewable energy and in particular wind energy, playing a significant role in meeting electricity demand. There are also differences in the level of energy delivered by wind power *per capita*, with Germany delivering 270 kW per 1,000 inhabitants, while the UK delivers just 39 kW per 1,000 inhabitants (IEEP, 2009).

Table 1.Wind capacity in the UK and Germany and the potential to meet electricity demand

Country	Installed onshore wind capacity (end 2007) (MW)	Installed all wind capacity (onshore and offshore) (end 2008) (MW)	% gross electricity production generated from renewable energy (2007)	Wind's share of electricity demand (as of end 2007)
Germany	22,389	23,903	15%	7%
UK	2,389	3,241	5.1%	1.82%

Source: IEEP (2009).

In relation to employment in the wind industry, there are also marked differences between the two countries. Reliable comparable data on the number of jobs in the sector are difficult to access, due to the lack of detail in official statistics and the variety of company profiles that make up the sector. Nevertheless, the growth of the wind energy sector in Germany is demonstrated by recent figures from the German Federation of Wind Energy, which show annual employment in the wind sector increasing from 1,800 employees in 1992 to 102,100 employees in 2009 (BWE, 2012). Although the figures are not strictly comparable due to the different definitions involved, data for Germany and the UK show that direct employment in wind turbine manufacturing, installation and maintenance in the UK increased from 2,000 in 2002 to 4,000 in 2009, while it has increased from 17,200 to 38,000 in Germany during the same period (EWEA, 2004, 2009).

The landscape of companies involved in manufacturing in the wind energy sector in the two countries also reflects these differences. In the UK in the 1980s, there were three key companies in the sector: Wind Energy Group (WEG), James Howden and Vertical Axis Wind Turbines / Renewable Energy Systems (RES). Of these, RES was the only company still in operation in the UK in 2010, WEG having been taken over by the Danish company Vestas, and James Howden discontinuing wind turbine manufacturing in 1989. In contrast in Germany, there were five key companies in operation in the 1980s: Südwind, HSW, Tacke Windenergie, Flender/Winergy and AN Windenergie. Through a series of mergers and

acquisitions, three of these companies are now subsumed into the three German-owned world-leading companies in wind energy: Nordex, REpower Systems and Siemens, with the two others being taken over by the American company GE (Kammer, 2011, p.153).

It is also interesting to note that the position of the energy companies also differs in the two countries. In Germany, energy companies were forced by the Government to accept competition from third parties which stimulated investment in wind turbines (Agterbosch and Breukers, 2008). In contrast, UK policy has favoured large investors, which has prevented new players from entering the market (Wolsink and Breukers, 2010). Thus the development of the industry in the two countries has diverged over the years, and it is the roots of this divergence in trajectories that we explore in the remainder of the paper.

However, it should be stressed that this paper is exploring the technological development of wind turbines, as an expression of pre-formation and new path creation, rather than the evolution of wind power deployment, which is an expression of the establishment of the new economic pathway. We are therefore interested in the conditions which favoured the development of innovations in the wind energy sector, rather than the factors which affected the further development of the sector, such as electricity grid connection.

4. METHODOLOGY

To investigate these issues, we have adopted a qualitative methodological approach, using primary in-depth interviews with inventors to explore empirically the issues related to the emergence of the wind energy industry. The sector presents an example of a relatively new economic pathway that has developed unevenly over space during the last 30 years. It therefore offers possibilities to examine the factors that have led to its rapid development in some localities compared to others, potentially in niche conditions.

Two databases provided access to inventors in the wind power industry: the patent application database REGPAT, hosted by the OECD, and the ESPACENET database held by the European Patent Office. From these databases, it is possible to identify inventors and thus explore with them the factors that led in Germany to the development of the wind energy industry as a new economic pathway; and in the UK, possible reasons why the wind energy sector has not developed more rapidly, despite the geographic factors which might lend themselves to such development, including significant on- and off-shore winds and the largest wind energy resource in Europe (Landuse Consultants, 2010).

Using these databases, inventors who had applied for wind energy patents during the period 1978 to 2005 were identified in the UK and Germany. The sampling

techniques were slightly different in the two countries, due to the differing number of patents. In the UK, from the REGPAT database, there were strong concentrations of absolute numbers of patent applications in the two regions of Scotland and the South East, with a total of 110 in all which was taken as the sample frame. In Germany, national sample frames were drawn directly from the ESPACENET database, from which, a random sample of 200 inventors was identified.

In both countries, a letter was sent to each patent applicant requesting a telephone interview that would follow a semi-structured format, exploring the conditions that were favourable to the development of new technological pathways. The interviews lasted up to 90 minutes, and were recorded digitally with the interviewee's consent, and subsequently transcribed for analysis.

The response rates were 11% for the UK and 6.5% in Germany, bringing the total number of completed telephone interviews to 25. Whilst a relatively small number overall, it was felt that this was acceptable, given the qualitative approach and in-depth nature of the interviews. The relatively low response rates are likely to be for two reasons. Firstly, the address associated with the older applications dating from the 1970s and 1980s are now likely to be out of date. Secondly, a number of the patent applicants on the REGPAT database were not actually granted patents for their inventions, and therefore this might have been a disincentive to taking part in the research.

Although the sampling methods were slightly different in each country, they still allowed for a robust dataset of interviews to be collected and analysed addressing the research issue.

5. WIND ENERGY INNOVATION IN THE UK AND GERMANY: RESULTS AND ANALYSIS

Respondents in Germany were in agreement that innovation in the wind energy sector, and the development of the industry over the last 30 years, has been strongly supported by the existence of 'niche' environments which protected innovations in the industry from external competition as early as the 1980s. One reason given was that many innovators were working in the protected niche environment of academia, and so did not have to compete initially on equal terms with the dominant technology.

However, there was also a strong feeling among respondents that political support in Germany had been responsible for the creation of niches that favoured the development of the wind power industry. The introduction of the *Stromeinspeisungsgesetz* (the Feed-in Law) in 1990 was seen as a key moment in developing niche conditions for the sector, providing incentives for the development of renewable energy (Jacobsson and Lauber, 2006). The law ensured grid

access for electricity generated from renewable sources, and required utility companies operating through the national grid to pay premium prices for the electricity supplied from these sources (Szarka, 2007). The Feed-in-Law was followed by the 250 MW Wind Programme in 1991, which supported the piloting and demonstration of new wind turbines and wind turbine designs, by domestic companies. The specific aim was to support promising innovative wind turbine designs, rather than supporting already fully commercial technologies.

The Feed-in Law was succeeded in 2000 by the Renewable Energy Act (*Erneuerbare-Energien-Gesetz*, EEG), which helped to encourage small and medium sized enterprises to enter the renewable energy market, under favourable conditions. Clean energy technologies were not subsequently competing on equal terms with other technologies in the non-renewable energy sector, thus creating a protected niche environment. Therefore, in Germany the policy conditions from the 1990s positively favoured the renewable energy industry and encouraged the development of wind energy technologies, that could take advantage of these preferential conditions (Szarka and Blühdorn, 2006).

Interviewees in the UK, on the other hand, claimed that the government was relatively slow to encourage renewable energy technologies through specific policy measures. Before the privatisation of the electricity supply industry in 1990, the rates (a form of property tax) charged by Government to independent generators of electricity meant that it was not practical or financially viable to build wind farms to compete against the Central Electricity Generating Board (Musgrove, 2010). After 1990, this situation changed with the introduction of the Non Fossil Fuel Obligation (NFFO), although this was a side-effect of the privatisation of the power industry, rather than a positive policy move in itself. It was superseded by the UK Renewables Obligation (RO) that was introduced in 2002, placing an obligation on electricity suppliers to provide an increasing percentage of electricity from renewable sources. However, this has proved more costly and less productive than the German feed-in tariff and has contributed to a divergence in the development of the respective countries' wind energy sectors (Musgrove, 2010). Furthermore, the UK only introduced a feed-in tariff relatively recently (April 2010), so the effects of this new policy measure have yet to be seen in terms of encouraging innovation in wind energy and other renewable energy technologies.

Therefore in Germany, the niche conditions established by government policy positively supported the development of a new economic pathway through the creation of favourable conditions that supported the wind energy industry. In contrast, in the UK, such positive initiatives were lacking until recently, leading to 'lock-in' to carbon-based forms of electricity generation. This has meant that the trajectories of the two countries' respective wind industries have diverged significantly since 1990.

Furthermore, in the UK respondents also cited strong community opposition to wind farms due to their noise and size, and respondents felt that these

attitudes may have contributed to the Government's reticence in supporting the wind power industry in the past. This lies in marked contrast to local reactions in Germany, where despite concerns about 'asparagusisation' of the landscape (so-called *Verspargelung*) those interviewed for the research reported that many people are supportive of wind farms, given their contribution to the production of clean energy and to mitigating climate change. This cultural difference between the two countries, reflected in the strength of the Green Party in Germany, is also echoed by findings from Wolsink and Breukers (2010) who showed that the development of the wind energy industry in North Rhine Westfalia was characterised by a collaborative approach with an emphasis on local issues, factors which have contributed to the growth of the industry in Germany.

A further difference between the two countries highlighted by interviewees relates to wind farm ownership. In Germany, wind farms are largely in the hands of farmers or cooperatives who often have a commitment to renewable energy in addition to ensuring their operation is profitable. In the UK, however, wind farms are mainly owned by a small number of incumbents, often ambivalent about renewable energy, particularly in the early days (Lipp, 2007; Stenzel and Frenzel, 2008).

Once niche conditions are created, in particular through government policy encouraging a receptive environment, other drivers are then required for innovation to flourish. Respondents in the research identified in particular the need for R&D investment to support the development of innovation, to exploit the opportunities that niche environments offer. However, R&D funding was much more generous in Germany in the 1980s and 1990s than in the UK, and was distributed much more widely amongst SMEs. Renewable energy also had much stronger and more diversified institutional support in German Universities and research institutions such as *Fraunhofer* and ISET, whereas in the UK, there has been a more ambivalent approach, particularly during the 1980s and 1990s.

Interviewees also highlighted the importance of the inherited industrial structure in Germany, and the role that this heritage has played in encouraging innovation in the wind industry. The strong position of the German automotive industry was seen as an indicator of the potential for engineering excellence, and the legacy of the shipbuilding industry in Northern Germany was cited as being important for the development of the sector.

In Germany, therefore, support from government to create niche conditions in the 1990s helped the wind energy industry to flourish, encouraging innovations in the sector that challenged the dominant technological paradigm (Dosi, 1982). This support has been lacking the UK until recently, and has been one of the key factors in preventing the development of wind energy innovations in the UK.

Niche conditions can also be supported through the existence of the venture capital sector. The development of the wind energy sector has high capital start-up costs, and lenders in the past have been relatively risk-averse in their approach to the wind energy industry. However, the growing acceptance of wind energy

means that this is less of a challenge in raising capital to finance the development of wind power innovation. However, respondents in the UK reported that it is difficult to access capital to fund alternative approaches to wind energy generation, for example, using vertical axis machines. In an example of path dependence, commercial banks and venture capital companies are reluctant to fund this relatively recent development, as it runs counter to what has been 'tried and tested' in the market place.

This risk-averse approach can be traced back to the historic lack of niche conditions in the UK, which have meant that, in contrast to the situation in Germany, the wind energy sector has not, until recently, been widely accepted by institutions, be they financial or political. Other differences in relation to laws and framework conditions that regulate wind power in the two countries also make it more difficult to raise capital for such ventures in the UK (Mitchell *et al*., 2006).

Interviewees also suggested that powerful economic interests have in the past hindered the diffusion of innovations in the wind industry in the UK. Well-established and powerful energy-generating companies were initially against the development of the wind power industry, and exerted their influence to prevent the diffusion of innovation in the sector. However, over the last decade, respondents identified that a cultural shift has taken place with the general acceptance of the challenges of global warming. There is now a certain cachet to being involved in green energy activity and investment. As a result, many large scale energy companies such as G.E. and Siemens are embracing renewable energy as part of their energy portfolio, and have taken over the wind energy divisions of smaller companies, lifting some of the previous barriers to innovation diffusion in the sector. However, this has not impacted on the outcomes of early policy decisions which failed to provide the supportive niche conditions for wind energy innovations to flourish in the UK, and which have left the UK in a lagging position, relative to its German neighbour.

6. DISCUSSION AND POLICY IMPLICATIONS

The key difference to emerge from the development of wind energy innovations and thus a new economic pathway in the UK and Germany was the support that the sector received through Government initiatives in the 1990s. The Government in Germany acted early to create a feed-in tariff in 1990 which introduced favourable conditions for new path creation, developing the wind energy sector. Coupled with this, a wider cultural acceptance of wind energy as an alternative to traditional fossil fuel electricity generation in Germany, contributed to the advanced development of the wind power industry compared to the UK.

In the UK, the Thatcher Government's move to privatise the electricity supply industry in 1990 had the unintentional consequence of creating limited niche

conditions for the wind power industry. However, the overriding motive was not to support the renewable industry sector, and as a result, other enabling mechanisms such as R&D investment, were not forthcoming. It is these enabling mechanisms which allow the transition from marginal and protected niches, to mainstream and exposed dissemination, building to a critical mass and new path creation, mechanisms which were largely absent in the UK. In Germany, by way of contrast, the government made positive and intentional moves to support the renewables industry, as an aim in itself, and was subsequently more successful in encouraging innovations in the sector. Supportive niche conditions and other mechanisms have provided a fertile environment for innovation in the wind energy sector to flourish, reinforcing the differences in the two countries' trajectories.

There has also been considerable resistance to the development of wind farms in the UK from local communities, which could be argued has created barriers to the development of innovation in the sector, strengthening path dependence and 'lock in' to carbon-based electricity generation.

In sum, the experiences in the UK and Germany show that new economic pathways are more likely to develop in places where niche conditions provide receptive environments for inventors to develop their ideas. In the context of debates around new path creation, these findings illustrate the importance of factors which contribute to new economic pathways, which can illuminate the process of regional economic growth. In particular, institutional conditions, such as policy initiatives that create niche environments, are especially important in promoting new economic pathways. The different trajectories of the wind energy industry in the UK and Germany relate to the historical and institutional legacies in each country, that created receptive niche environments in Germany but which failed to do so in the UK. This finding is particularly salient in the current economic climate, where the private sector is expected to lead the vanguard of economic recovery, in the face of financial constraints in the public sector. The research would suggest that policy makers consider carefully the potential contribution that they can make to the creation of niche environments, through legal or fiscal mechanisms to support new economic pathways that will sustain regional economies in the future.

Similarly, financial support such as access to financial backing through venture capital or commercial lending, can support development of new approaches, and help bring innovations to the market. The example of the wind energy industry in Germany shows the importance of strong support for R&D that helped develop innovations in the wind energy sector, and this lesson could be applied to other sectors.

However, these policy implications are set within a caveat related to economic 'variety'. The experience of new path creation shows that innovations flourish in areas where related sectors have also prospered (Boschma and Frenken, 2011). New economic pathways cannot be created in a void. A key policy message is therefore the need to support sectors that build on variety within a regional economy, rather than seeking to specialise in new, and unrelated, activities.

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