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The Role of Informal Institutions for the Development of the Wind Energy Industry in Britain and Germany

Abstract

This paper argues for an explicit consideration of the influence of informal institutions on all agents' behaviour within innovation systems. A framework is presented for the inter-relationship between informal institutions and the co-evolution of the institutional arrangements with technological development and changing circumstances. Using the case of the wind energy industry in Britain and Germany the paper presents evidence for this mechanism and how it leads to divergent industrial outcomes in different regions. It is shown that despite similar outcomes in terms of reaching internationally agreed 'decarbonisation' targets the two countries have followed very different trajectories in reaching this point. The paper provides evidence of the effect that the strong aversion against nuclear power in Germany had on the behaviour of agents across society and therefore on the capacity of the formal institutional arrangements to co-evolve with the needs of the nascent wind energy industry. In contrast the absence of such a strong sentiment in Britain meant that a powerful elite was able to uphold existing power structures benefitting incumbents and not encouraging new entrants resulting in an industry that is dominated by large companies where important decisions are made abroad and the major profits go the same way.

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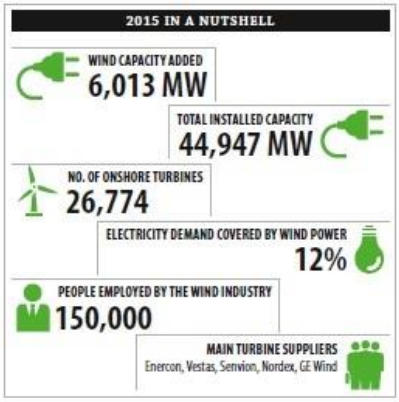
Introduction

Whilst the role of institutions in general for economic development is widely appreciated the role of informal institutions beyond that as ‘social capital’ remains a lot less explored (Raiser, 1997; Cortinovis et al., 2016). This study aims to offer qualitative insight into the role of informal institutions for the co-evolution of institutions and technological development and to produce a framework for the exploration of this interaction.

The study seeks to explain why socio-economic outcomes of the diffusion of a technology differed across two places. The chosen case countries have achieved similar outcomes in terms of ‘decarbonisation’ targets but took very different paths in order to get there with Britain apparently not managing to profit from the development in socio-economic terms as well as Germany.

The illustration below is from the Global Wind Energy Council’s Annual Market Report and describes the status quo for the two countries. The author recognises the remarkable effort to ‘catch up’ in order to reach internationally agreed targets by Britain and the success is evident in the ‘electricity demand covered by wind power’ but she would like to draw the reader’s attention to the employment figures and the main turbine suppliers below this. Despite its record growth in recent years the sector in Britain employs about a fifth of the sector employed in Germany whilst its total number of employed persons [as an economy] is about three quarters of that of Germany (Global Wind Energy Council, 2015; eurostat, 2015). Furthermore the companies noted as main turbine suppliers in Britain are with the exception of one company all German companies.



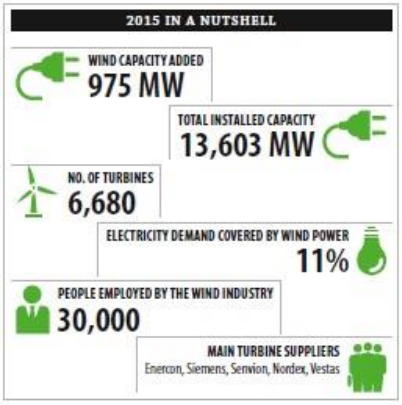


Illustration 1: The wind industry in Germany (left) & Britain (right) in 2015 (Global Wind Energy Council, 2015)

Germany’s ‘Energiewende’ policy is known across the world with its decision to phase out nuclear energy generation evoking either bemusement or envy in other places. The necessity to decarbonise our energy systems and to focus more on renewable energy due to climate change is now widely agreed upon certainly since the COP21 UN climate conference in Paris in 2015 where 196 countries committed to “holding the increase in global average

temperature well below 2 degrees Celsius above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels" in recognition of the risks of climate change (United Nations, 2015, p.29). But Germany has succeeded in becoming not just a participant but a provider to this global development. The country is home to a highly active wind industry with a great number (more than 600) of companies across the supply chain and specifically 11 wind turbine manufacturers (Bundesverband Windenergie, 2015b), most of which are exporters to the growing industry worldwide. Despite the existence of pioneering firms in the 1980s and exceptional recent growth of the sector both in employment and in active companies in the supply chain no turbine manufacturers survived in Britain. The turbine itself constitutes the biggest cost in the construction of a modern wind mill and construction yields the most employment. A lack in this part of the supply chain therefore has socio-economic implications. Britain is proud of its recent growth in wind energy deployment which is primarily down to its aggressive expansion of offshore wind energy but for the provision of the machines themselves and their many parts is largely dependent on imports, often from Germany (RenewableUK, 2015b; RenewableUK, 2015a; RenewableUK, 2012; IRENA, 2012).

The author argues that informal institutions, and in particular the attitude towards nuclear energy in the two countries have fundamentally influenced how well the institutional arrangements could co-evolve in order to accommodate technological development and to react to changing (global) circumstances. This next section will explain the theoretical foundations that this work is built on followed by an introduction to the framework that has been developed to understand the relationship between informal and formal institutions.

Theoretical Background

This is a study of the development of industries over time and space and is therefore embedded in evolutionary economic geography. The maximisation premise from neoclassical economics is rejected as an explanation of human behaviour. A view of (regional) economies as open systems with emergent properties that co-evolve with each other enables an explicit account of power and agency (Nelson, 2002; Boschma & Frenken, 2007; Hodgson & Knudsen, 2010; Martin & Sunley, 2015).

Technological Development and Industrial Emergence

Technological development is non-linear, characterised by feedback mechanisms and inter-dependencies between the different stages of the process (Kline & Rosenberg, 1986). It is necessarily linked with societal organisation and cannot be seen in isolation from the society which it has been created in. Schumpeter (1983) views capitalism itself as an 'evolutionary

process', explaining that it will by nature never be stationary and identifies innovative processes as the fuel of this 'capitalist engine'. The introduction of new products, new production processes and technological improvements to machinery will unavoidably lead to difficult processes of sectorial and social restructuring and often the loss of employment within established industries, famously termed 'creative destruction' by Schumpeter (1959). 'Technical regimes' are seen to reduce the options for technological change and set directions of progress. They are defined by the technicians' beliefs about what is possible or worth doing and can thus constitute a cognitive barrier to development (Kemp, 1994). An important concept of the emergence of new industries is that of 'related variety'. Academic debate juxtaposes the advantage or disadvantage of the presence of other companies in similar and complementary industries (Glaeser et al., 1991; Jacobs, 1970; Boschma & Frenken, 2010) and Frenken et al. (2007) suggest that there is evidence that the entry and exit of industries to a region is strongly conditioned by that region's industrial past.

Path Dependency and Path Creation

A key element to these perspectives on the emergence of technology and industry is the path-dependency of technology and the related systems. Change of the economic system is crucially influenced by decisions made in the past, by random historical events and accidents (Gertler, 2005). This emphasis on history is a relatively new concept in economic debates and it opens them up towards understanding novelty introductions in terms of a process and thus reinforces the role of longitudinal observation within the economic sciences. In a seminal paper David (1985) uses the case of the QWERTY keyboard to illustrate this phenomenon. He shows how once the 'Universal' standard became embedded in production, in the use by the military, in 'touch typing' by assistants, and in complementary industries a change to another system seemed unthinkable (which continues to this day) (David, 1985). Another important aspect is the dominance of economic short-termism over longer-term optimised technologies. It can be the reason why a suboptimal technology may be chosen at a particular point in time over a better, more efficient technological solution and may then prevail. Garud & Karnoe (2001) emphasise the importance of human agency and direct the focus towards the phenomenon of 'path creation'. They shift the behavioural premise of economics and redefine the role of agents, away from passive and reactive towards a reflective and pro-active role as 'mindful' agents. This re-focusing on the agents involved in the development of new industries is an attempt to understand how agents pro-actively seek to escape 'lock-in' situations.

Technological Transition

Technological transitions may be understood as major transformations in the way that societal functions (transport, housing, food, etc) are fulfilled (Geels, 2002). Geels (2002) presents a multi-level model of technological transition where 'niches' are part of a 'patchwork of regimes' which forms part of the 'landscape'. The success of new technologies does not only depend on processes of reinforcement within the niche, but also within the wider regime and the sociotechnical landscape. Technologies get created and developed in technological niches. They then need to progress through a layer that is made up of socio-technical regimes, this can be wider restrictions like the predominant culture and symbolic meanings, existing infrastructure or more specific restrictions from existing sectorial policy, user practices, and the techno-scientific knowledge base. Innovations can fail if no arrangement can be found between the existing structures and the new technology or if the new technology is not fit for the landscape (Geels, 2002).

Co-evolution of Institutional Arrangements with Technological Development

The author argues for a co-evolutionary relationship between technological development and institutional change, meaning that institutions need to change alongside technologies so that these can develop unhindered (Nelson, 1998; Perez, 1983; Strambach, 2010). Accepting a co-evolutionary relationship between technological development and institutional change suggests that institutions themselves may have path dependent properties. North (1991) provides a useful definition of institutions as the "humanly devised constraints that structure political, economic and social interaction". He distinguishes "informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)" (North, 1991, p.97). He points to their influence on the economy in reducing uncertainty and conceptualises history as a story of institutional evolution. He suggests that the evolution of the institutional structure is the incentive structure for economic growth, stagnation, or decline. Previous decisions and historical coincidences will determine the practices and accepted rules of a society and its organisations much like in the case of technological pathways explained above (Setterfield, 1993).

The role of informal institutions and their inter-relationship with formal constraints is considered academically. North (1996) advises to emphasise the important role of actors' perceptions and ideologies that determine their choices. He also specifically points out the complexity of relationships between formal and informal constraints and in particular the role of cultural inheritance and power relations that underlie the perseverance of many informal constraints. Despite this influence of institutions on agents and their choices there is scope for (deviating) action of individual agents but this remains an under-explored aspect (Jackson, 2010). Anthony Giddens (1979;1984) suggests that institutions do not just exist

behind the backs of people but that they are an important product of their minds and that they create and reinforce them actively. He, too, emphasises that often those rules that do not superficially appear to have great impact on social activity, like seemingly trivial daily routines, are actually having a greater impact than formalised rules.

Citizens & Society

Hassink et al. (2014) argue for a broad consideration of institutions across multiple levels beyond micro-economic firm-focussed analyses which they argue ignores the enabling capacity of those institutions that made the creation of internal organisational routines possible in the first place. Civil society as such plays a role in finding innovative solutions, building community, and introducing social innovation and needs consideration for an approach within Economic Geography that pays “attention to human agency and embrace[s] a people-oriented as well as a system-oriented perspective” (Bristow & Healy, 2014, p.928).

The policymaker is seen as having a key role in maintaining an awareness of development and an ability to adapt institutional frameworks to changing circumstances in order to gain the wider socio-economic benefits of technological development (Perez, 2009; Rip & Kemp, 1998). The literature on ‘institutional entrepreneurs’ further emphasises the role of the policymaker. The concept refers to individuals who have interest in particular institutional arrangements and mobilise resources for the creation of new institutions or the transformation of existing ones (Garud et al., 2007). It constitutes an appreciation that the process of economic change is complex, ridden by politics, and determined by ongoing negotiation. It firmly focuses the debate of institutional change on interests and power.

Research Design

Framework

Based on the above explained theoretical concepts the author has developed her own model of the underlying dynamics involved in the creation of new industries in path-dependent systems. The author has created a multi-level framework in order to account for the multi-scalar character of the systems that are being studied. She ‘sliced’ the energy system of innovation along three layers. The civil society is at the core, the agents’ roles being those of citizens, consumers and, collectively, social movements but also including inventors, innovators or entrepreneurs. Closely tied to the civil society are the informal institutions (values, norms, practices) that influence individuals’ behaviours. The path dependent economic landscape describes the spatial character of the various firms that are active in the energy generation sector. This includes whether they are spatially clustered,

their different sizes and how they fare over time. Such landscapes are historically grown and will thus be dominated by pre-existing incumbents and have a tendency towards technological lock-in. Tied to the economic landscape are formal institutions in the forms of written rules, regulation, legislation. In a role as negotiators between the core and the landscape layer are organisational forms of institutions that can either be assistive or inhibitive to emergent technology. Institutional arrangements (concurrent informal, formal and organisational forms of institutions) are seen as pervasive as they concern and influence all agents' choices and behaviours. New ideas or technologies are understood to be created by inventors who seek for these to reach the landscape layer but must negotiate institutional support. Institutional change may occur in response and the institutional framework may become supportive or alternatively such change does not occur and the institutional framework inhibits or even prevents technological development. Following the fieldwork a preliminary analysis yielded a version of the model that provides more detail on the inter-relationships between the different kinds of institutions and their impact on the emergence of new technologies and industries (see Illustration 2 below). It focuses on the impact of informal institutions on agents on all levels and the resulting ability of the institutional framework to co-evolve with technological development.

The key concept of the analysis framework is the ongoing process of (re)creation of the formal institutional arrangements by agents on all levels of society. This process happens in response to changing circumstances and technological development (i.e. co-evolution). How 'well' this works is strongly dependent on the influence of informal institutions. Which informal institutions prevail is dependent on the socio-cultural, geographical and historical context.

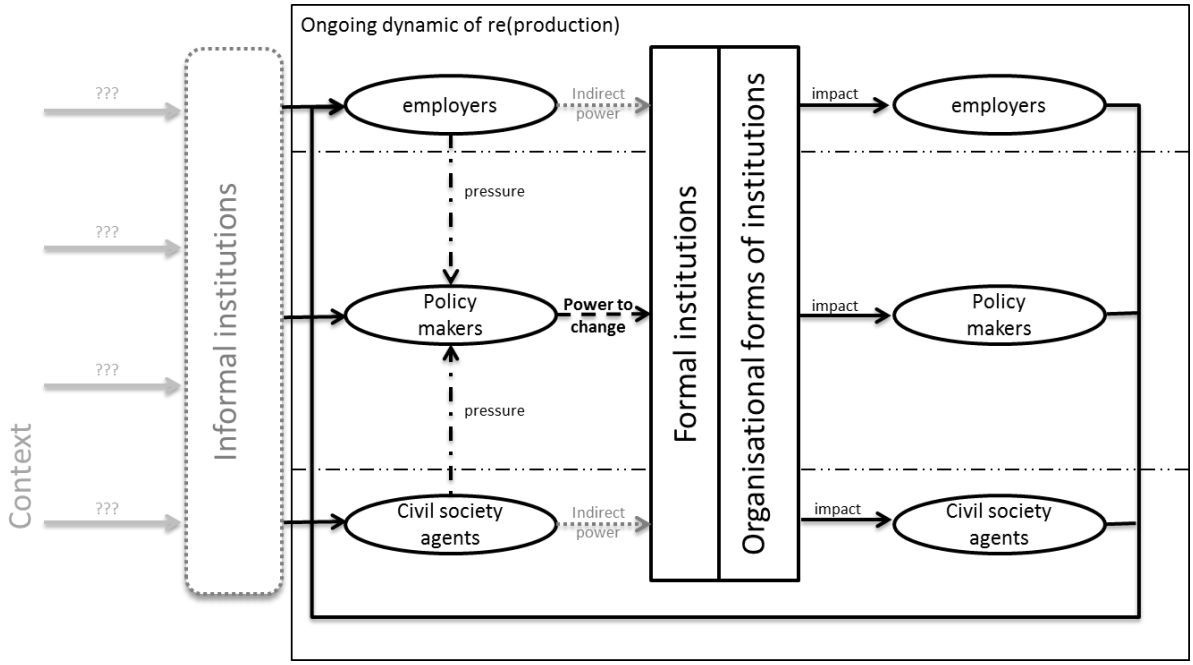


Illustration 2: Analytical Framework, author's work

Philosophical Approach and Methodology

The study is rooted in a realist world view where social life consists of open systems (Bhaskar, 1979). Because people have the capacity to learn and adapt their behaviour urban and regional systems are not only necessarily open but they also evolve rather than being equilibrated (Sayer, 2000). Realism seeks to explain change in such open systems. Critical realism focuses on the way in which causal tendencies can produce quite different outcomes in different contexts like those of geography or historical circumstances. Realism claims that beyond the immediate events and the empirical perceptions of individuals there is a further layer of reality which consists of the underlying structures, mechanisms and power relationships that influence the course of history (Smith, 2003).

Realists suggest a circular relationship between human agency and social structure, a flow of socialisation of individuals who reproduce and transform society which in turn socialises them and others again and so forth. This is reflected in the author's own conceptual framework, which describes a continuous flow of conditions, mindful path deviation and creation, path development, and outcomes which will become pre-conditions for other mindful agents and so forth.

This study is fundamentally theory led where following a cross-disciplinary literature review a model was developed which aims to show the underlying mechanisms and structures that are at the root of observed phenomena (Bhaskar, 1979). The aim of the study is therefore to provide evidence for the suggested underlying dynamics. It is not aiming to make predictions

as social systems are inherently open systems and therefore only ‘tendencies’ can be described but not ‘laws’ (Blaikie, 2000).

Based on the literature review and model and following a pilot study with four academics the following research questions were set:

1. What were the main interest groups in Germany/Britain in terms of electricity generation and what influence did they have on the institutional arrangements?
2. Why were civil society agents in Germany better able to gain institutional support for innovative wind energy technology than in Britain?
3. Why were incumbent utilities in Britain better able to gain institutional support for the status quo than in Germany?
4. What were the most important forces that led to the main institutional changes and why were they effective at that point in time?
5. Can co-evolution or hysteresis of institutions in response to the forces that affected them be identified?
6. What were the reasons for this co-evolution/hysteresis?
7. Is there any evidence of a mismatch of previous institutional arrangements with new technologies?

These were translated into a semi-structured questionnaire which was put to 32 experts with a broad range of experience from across the wind energy industry. Interviews were in-depth and equal numbers of British and German respondents were achieved. About a third of the interviews had to be carried out by phone, two thirds were done face-to-face. This material formed the main body of information for the analysis. Further information was drawn in from a range of secondary sources and documents. The information was analysed using Nvivo with a code frame derived from the analysis framework shown above. This analysis yielded mainly qualitative information and some indicative numerical data. Numerical results from the analysis of this deeply qualitative data must be triangulated with other sources when used to support arguments.

This section has provided the theoretical grounding for this inquiry. The following section will provide the historical context and describe some key events for the development of the wind energy industry in Britain and Germany.

Historical Setting

Despite only average overall wind resource Germany has embarked on the project of generating electricity from wind much earlier and arguably with greater initial enthusiasm

than Britain has. This implies that beyond resource availability other reasons, rooted in society, determine which technologies gain support and succeed.

Preconditions - Post War

Ulrich Huetter was a German post war pioneer working at Stuttgart University. He developed a number of very advanced and resilient turbines (the Huetter Allgaeuer model being the best known - it featured fibreglass blades). But this early wind turbine development programme in Germany was abandoned as low oil prices led to a decrease in interest in further investment in alternative energy source technologies in the late 1960s (Musgrove 2010).

The three bladed model common today is referred to as the 'Danish model' due to its origins. The inventors often were individuals, often tinkerers in their own garages and well connected into a network of researchers as part of the Danish folk high schools and the environmental movement. Much of their work resulted from growing concerns over how Denmark would deal with the growing demand for energy since it lacked natural resources (Gipe, 1995). Germany had a slightly later start into more serious efforts. Inventors were rather disparate at first and only became more organised with the establishment of the German wind societies in the mid 1970s, forerunner to today's German wind energy association. Regional fairs like that in Husum and test centers which received funding from local and regional government helped to coordinate efforts and build the network (Rave & Richter, 2008).

The internal composition of the electricity supply industry in Britain was shaped by nationalisation in 1948. The much smaller scale structures that had existed previously disappeared and the industry was focused on the use of coal as its main resource for electricity generation. Monopolistic structures were not only allowed but encouraged to develop (Taylor, 1996).

Figure 1 below is a timeline showing entry and exit years of British (green), German (red) and Danish (blue) turbine manufacturers. The list is not exhaustive but still provides a very good insight in the development of the sector. What is immediately apparent from this figure is the lack of British manufacturers beyond 1990[2]. It is also obvious both from the Danish and the German sector that there are only a handful of longstanding companies surviving throughout all turmoil of the industry over the years. The figure illustrates that as mentioned above Germany had a slightly later start into building an industry than Denmark did. Whilst Denmark started with a great variety of companies the sector appears to have consolidated

[2] Wind Energy Group, in existence as a company until 1997, had refocused its activities on project development in the 1990s.

into three key players whilst the German sector has maintained a broad variety of different manufacturers over time.

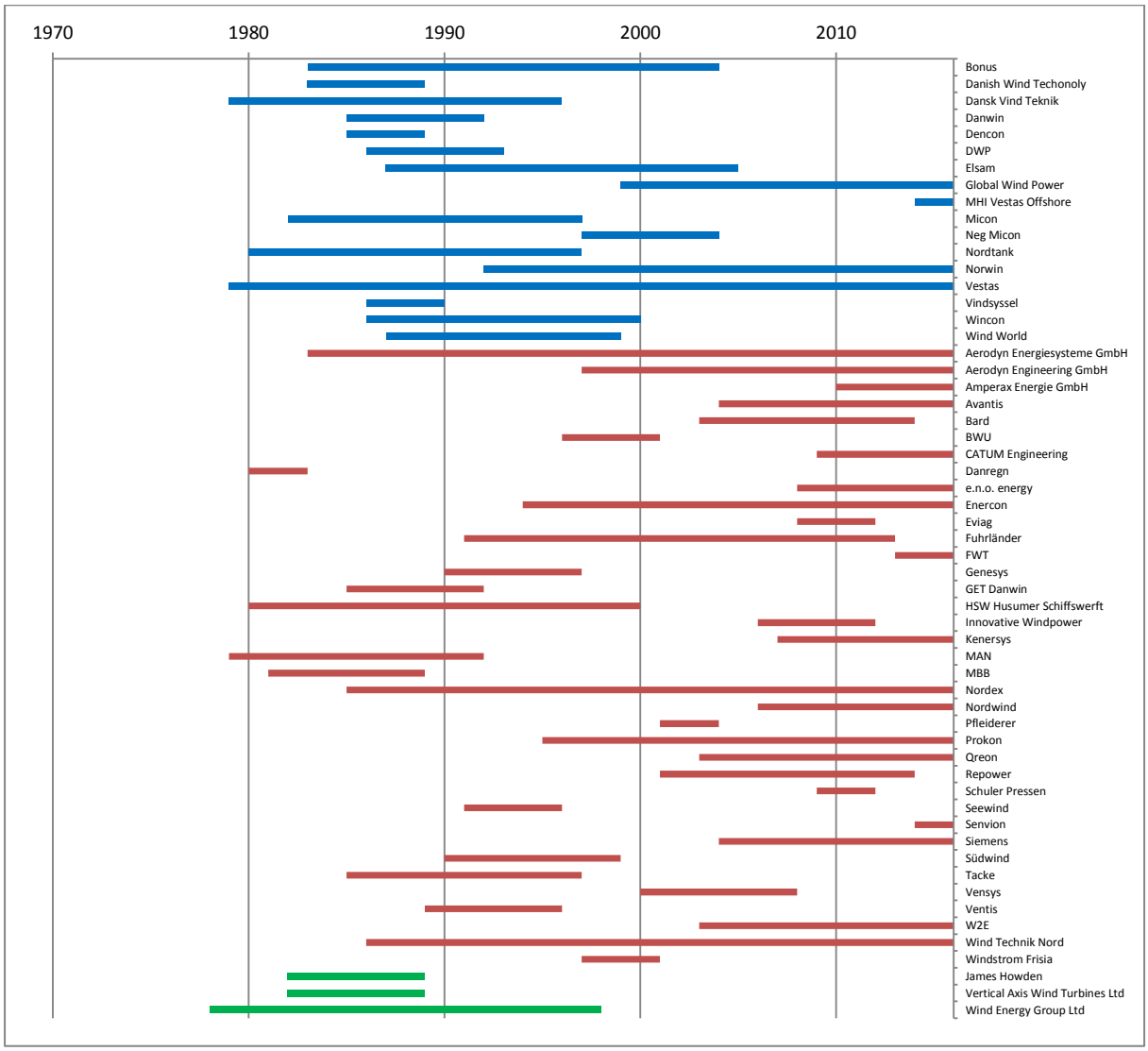


Figure 1: Time series of wind turbine manufacturers (Pierrot, 2016, adjusted by author)

Period of Path Creation – The 1970s and 1980s

Following the oil crises Germany, like many other states, embarked on a publicly funded large wind energy programme from 1976. The GroWiAn (Große Windkraftanlage) only worked for a few hours before it broke beyond repair, an expensive and embarrassing failure (Musgrove, 2010). A lot of valuable knowledge was created through these efforts, however, and many involved engineers remained in the wind industry (interviewee G9).

Most large scale projects of the time failed apart from one notable exception, a cooperatively built MW turbine in the village of Tvind in Denmark. A group of teachers decided to demonstrate the potential of wind turbines for electricity generation by building one of their

own. Apart from a minor blade failure in 1993 the turbine never experienced any noteworthy problems since its completion in 1975 and is still in operation today (Musgrove, 2010).

Exceptional tax arrangements allowed a niche market to form in California in the 1970s and early 1980s which meant that the Danish wind energy industry as a good quality exporter could increase production volumes (European Wind Energy Association, 2009).

The vast shallow waters around its coastal areas make the UK the country in Europe with the highest offshore (and onshore) wind energy potential. The eventual recognition of this fact in the late 1970s led to three strands of wind energy funding activity by the Department of Energy including the formation of a consortium of three construction companies, the Wind Energy Group (WEG) (Musgrove, 2010), a piece of desk research which concluded in principle that wind energy was feasible but provided rather high cost estimates which dampened further interest, and finally the promotion of research and development of vertical-axis wind turbines. A further consortium of two construction companies, Vertical Axis Wind Turbines Ltd, was formed. Following technical problems it was decided that the company should refocus its efforts in the development sector from 1989, changing its name to RES Ltd which remains one of the largest global developers today (Musgrove 2010; interviewee B10).

Period of Path Development with Institutional Support – The 1990s

With public funding discontinued because of the recovering oil price there was no drive amongst British citizens to individually invest in renewable energy comparable to that in Germany to compensate. In the same period a lack of gas and oil resources made energy security a high priority for the German government. In a mixture of political deal making, perhaps visionary thinking and coincidence Germany also allowed funding for smaller scale renewable energy efforts out of which largely grew the industry (Ohlhorst, 2008). Following on from and in parallel to a number of different support schemes on the national and regional level a law was put in place in 1990, the Stromeinspeisungsgesetz, which determined that renewable energy generators were to get guaranteed access to the grid and were to be paid for the electricity they produced (Deutscher Bundestag, 1990).

In order to be able to privatise the nuclear industry in Britain it needed financial support. A mechanism, the Non-Fossil-Fuel-Obligation (NFFO) was introduced in 1989. It defined the obligation for suppliers to carry a certain share of electricity which wasn’t sourced from coal and had a small tranche allocated to renewable energy. The subsidy granting was organised via a number of auctions where suppliers were able to bid for government guaranteed purchase contracts. Prices became so low that many projects were hardly economic. Many wind projects failed at the planning stage due to increasing local opposition. In the same

period England's existing nuclear power plants received significant government funds which were unavailable to the rest of the energy sector (Musgrove, 2010).

Reaching Maturity and Building an Industry – The 2000s

Internationally there had been increasing recognition of climate change and its potentially disastrous consequences throughout the 1990s. The EU Directive on Electricity Production from Renewable Energy Sources taking effect in 2001 set out national targets for rates of renewables in the production of electricity (European Parliament, 2009). In the UK a mixture of international pressure for a transition to renewables in combination with the incoming Labour government from 1997 seeking a fresh approach led to a new mechanism that became effective in 2002. The Renewables Obligation (RO) put the obligation on existing energy companies to produce a certain percentage of the electricity they provide from renewable sources. The original RO system was technology-neutral, i.e. not prescribing the energy source used and left the price-setting to the created market. Despite its complexity and many weaknesses the RO changed the domestic market drastically (Musgrove 2010). The Energy White Paper of 2007 recognised the merits of a technological differentiation which resulted in an amendment of the RO mechanism in 2008 encouraging extended use of biomass and offshore wind deployment. Support for onshore wind remained the same (Department of Trade and Industry, 2007). The RO triggered considerable wind energy deployment but this was mainly driven by relatively large companies. Lobbying eventually led to the introduction of a feed-in tariff system in 2010 in order to support smaller agents that were willing to engage in renewable energy production (HM Government, 2008; interviewee B9).

In 2000 the German government decided on exit from nuclear energy by 2022. To reach Germany's ambitious GHG emissions reduction target (25% of 1990 levels by 2005) it became clear that the feed-in law for renewable energy needed a fundamental overhaul (Ohlhorst, 2008). In early 2000 the Erneuerbare Energien Gesetz (renewable energy law) was agreed upon which not only guaranteed that independent producers could feed in their electricity but also gave electricity from renewable sources preference, defined fixed tariffs for a period of 20 years (with a reduction over time) and a duty on the network operator to expand the network if this was necessary for the connection of new schemes (Deutscher Bundestag, 2000). A change of government in 2005 meant that the German government started wavering on its commitment to an end to nuclear power generation. In 2010 chancellor Merkel announced a delay of the nuclear phase-out to 2030 (Taylor, 2016). Citizens responded by attending demonstrations against this in great numbers. Following the events of an earthquake and Tsunami in Japan there was a serious incident at Fukushima nuclear plant in 2010. Although the chancellor claimed to have made a deeply personal and

emotional decision most observers assess that political calculation was involved as her party was facing a number of by-elections the same year (Taylor, 2016). This was the beginning of 'Energiewende' as a policy slogan, cementing the end of nuclear power into German energy policy. The incident at Fukushima has had a big impact on German energy policy and catalysed attitudes but seems to have had little or no impact on British attitudes towards nuclear energy and certainly not on British policy where government seems keen on investing in new nuclear generation with apparently consistent levels of support by the general public (Poortinga et al., 2014). A recent report by the National Audit Office points out the high costs and risks of such investment and emphasises the significant cost reductions of particularly wind and solar energy (National Audit Office, 2016).

This section has presented key events from the history of the wind energy industry in Britain and Germany. The following section will present an analysis of the role of institutions and in particular of informal institutions in this.

Analysis

This section summarises the analysis of the role of informal institutions for the ability of formal institutional arrangements to co-evolve with technological development and changing circumstances.

Indicative Nvivo Results

The detailed analysis of the available interview data in Nvivo has produced indicative numerical results. The first section below will present these followed by the qualitative analysis of the role of formal and informal institutions for the development of the wind energy industry over time.

Figure 2 below shows the total word counts across the main concepts taken from the analysis framework. Since agents and all forms of institutions are most talked about it justifies the focus on the role of institutions and agents and their inter-relationships.

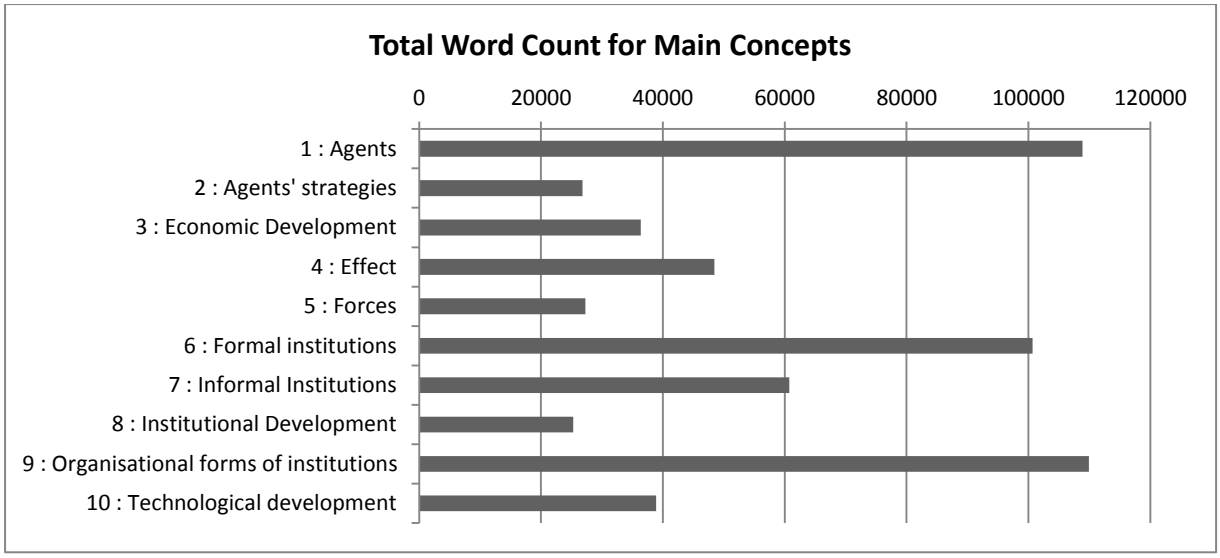


Figure 2: Word Count for Main Concepts, own analysis

Amongst different agents the most talked about types were ‘citizens, users, consumers’ and ‘privatised providers’ as well as ‘professional politicians’ (see Figure 3 below). This confirms the importance of these types of agents and justifies the firm focus on them. Citizens in particular are at the core of the framework because it is argued that informal institutions impact on citizens’ behaviour on all levels of society. This is also in line with Bristow & Healy's (2014) support for a citizens and systems focused economic geography.

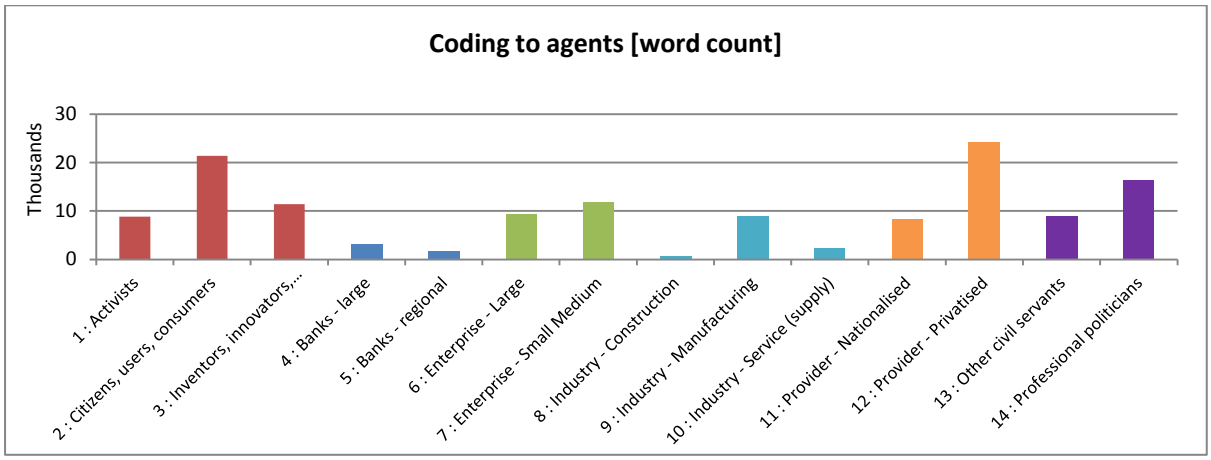


Figure 3: Coding to different types of agents [word count], own analysis

An analysis of the prevalence of informal institutions across both countries showed that the attitude towards renewable energy and that towards nuclear power as well as energy affordability were the most discussed concepts across both countries (Figure 4 below). Further analysis showed a strong correlation between conversation about negative attitudes towards nuclear power and positive attitudes towards renewable energy, indicating that there is a strong connection between the two concepts where the former possibly leads to the latter (Figure 5 below). Similar associations appear to exist between the concepts of

‘concern for energy security’ and a positive attitude towards nuclear power as well as ‘concern for energy affordability’ and a negative attitude towards renewable energy, indicating commonly held assumptions about renewable energy being expensive and about nuclear power providing greater energy security.

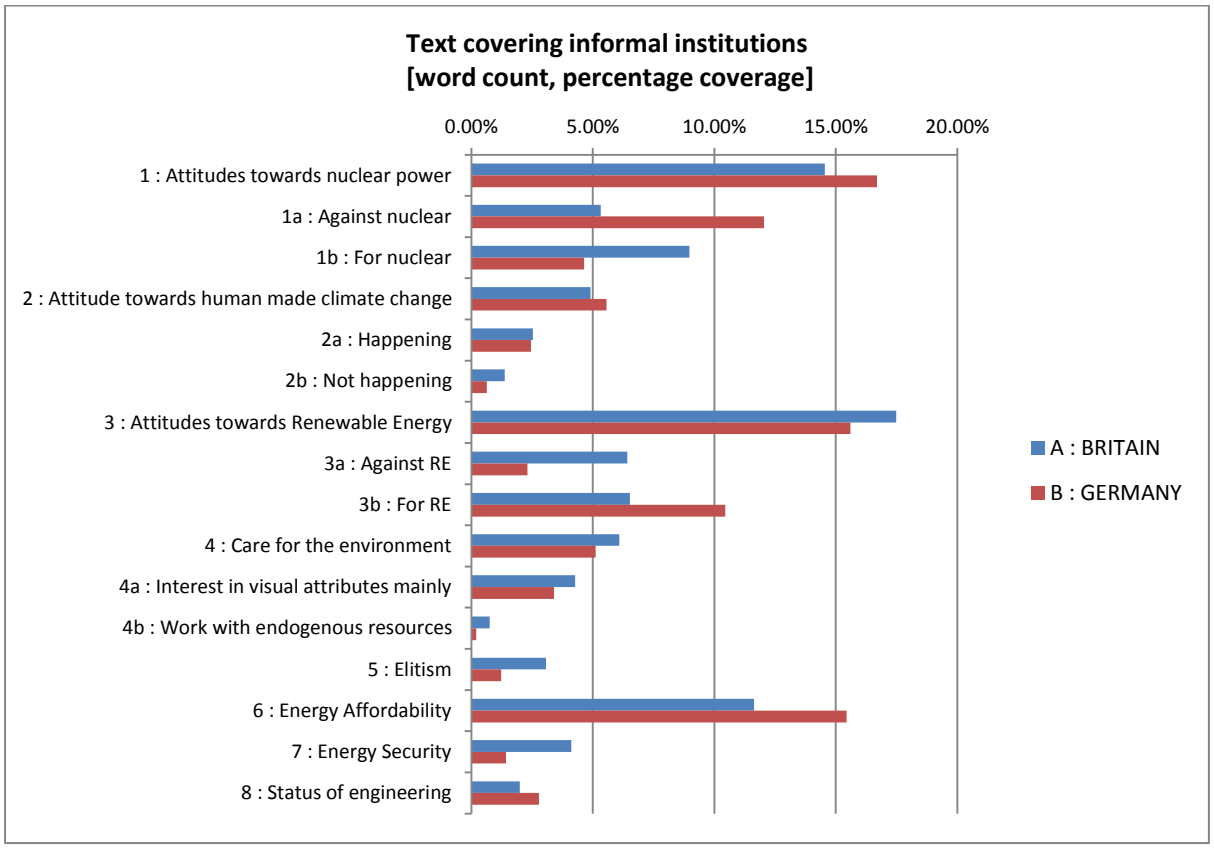


Figure 4: Informal Institutions in Britain vs Germany [word count], own analysis

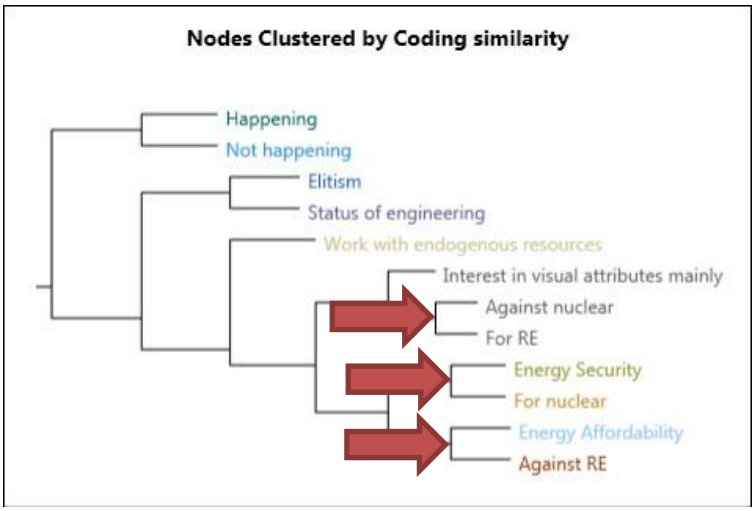


Figure 5: Correlation by coding similarity, informal institutions, own analysis

Findings of Qualitative Study

This part of the paper sheds a light on the role of key formal and informal institutions for the development of the wind energy industry in Britain and Germany. The first section will focus on the role of formal institutions and specifically on the role of central government in setting a strategic direction for industry. The second section further below will focus on the influential role that informal institutions played in the development of this industry.

Industrial Strategy

Throughout the fieldwork the vital importance of the confidence created by government through an industrial strategy which stays in place beyond party-political change but is sufficiently flexible to react to changing circumstances and technological development for the development of the wind energy industry in Germany has become clear. Unfortunately for Britain it seems that the lack of such a longer term strategy for industry has affected its industry in the fledgling stages.

"[…] there was a significant public desire to do something […]. For example there was a 'Round Table Wind Energy' in Hesse where the regional government brought government and opposition to one table and said, we are now doing this properly and this needs to hold beyond this government. Now we have a [different regional] government and basically we still follow what has been decided at this round table discussion. So nobody dares change these decisions because everybody feels bound by them." (interviewee G5)

As part of the governmental programme in Britain there was a small industry of wind turbine production at the cutting edge of technology in the 1980s. The British government at the time (Conservative under M. Thatcher since 1979) followed very much a neoliberal ideology. Manufacturing was to be increasingly outsourced to where input factors, labour in particular, were cheaper and thus production costs were lower. All of the economy was to be set up to encourage 'competition' as good as possible. This undermined the creation of a fertile environment comparable to that of Germany (Childs, 2001). These ideologies (introduced by Thatcher and her government but accepted and continued under Blair's Labour government) meant that there was ideological opposition to supporting fledgling industries before they can compete in a market merely on the basis of an expected future contribution they may make to the economy. There was a systematic decrease of British involvement in the production of goods, reflected in an exceptionally negative trade balance to this day (eurostat, 2016b). Following the recovery of oil prices therefore most of the funding ceased and companies were folded or the wind part sold off to foreign companies. The often passionate engineers were sold off with them or joined one of the consulting companies which, as service providers, were much more aligned with the government's 'industrial strategy'.

"Wind was ever so out on the periphery. So having developed and built those machines, most companies were moving away from industry. […] Margaret Thatcher had very little interest in Renewable Energy. The focus of government at that time was moving towards the financial services sector. […] Britain gave very little industrial support money." (interviewee B8)

The introduction of the Renewables Obligation in 2000 did lead to some diversification among incumbent energy producers but did not sufficiently encourage new entrants. It did not challenge the existing power structures as despite the UK's international public appearance there was no genuine commitment to such a change or even to renewable energy itself (Mitchell, 2008).

One aspect of governmental industrial strategy is the availability of funding to further develop, scale up, and industrialise inventions. From Figure 6 below it transpires that there is no lack of wind power related patent activity in Britain. Whilst absolute numbers of the two countries do show higher numbers in Germany from about 1990 (following the introduction of the feed in law) the relative rates (share of total patent applications) are surprisingly similar. Through the early 1980s Britain does in fact have higher rates of invention than Germany. This is consistent with the strong role of academic research in the early years in Britain. Recently, from about the mid 2000s, Great Britain shows a new higher share again. A closer look into the data reveals that these numbers are pushed upwards by the Scottish applications in particular and therefore they may well be attributable to research centres like the Strathclyde University Wind Energy Research Centre in Glasgow which was established in 2009. These relatively similar rates support the claims made above that Britain does not tend to support emergent industries into production. It further raises a question over what actually drives inventors – potential profits to be made or ideological reasons.

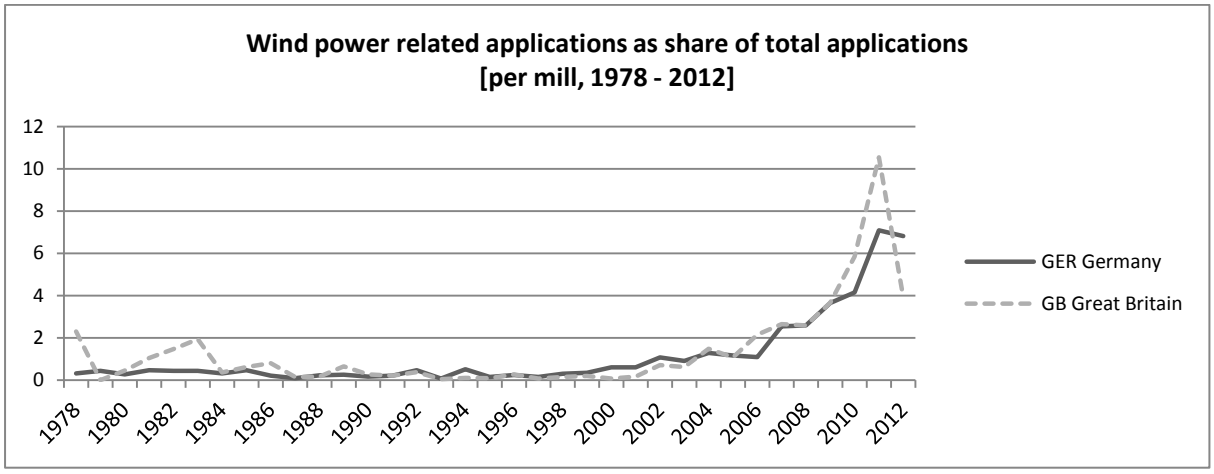


Figure 6: Share of wind power applications of total applications [per mill, 1978 - 2012] (OECD, 2013, own arrangement)

"The governments have deliberately promoted and supported innovation through [tax. A]s an inventor I only have to pay 10% capital gains tax, rather than 40% when I sell my shares. That's a fantastic incentive." (interviewee B2)

The case of this inventor does not seem to be an isolated one but rather it is indicative of a British pattern. Figure 7 shows data from the European Patent Office on British domestic patents in foreign ownership across all sectors. It shows that a high rate in foreign ownership of domestic inventions has always been a tendency in Britain but that since about 1986 there has been a steep rise in British patents in foreign ownership. This is not data that is specific to wind energy related patents but it does illustrate a wider tendency. It raises the question whether as part of a coherent industrial strategy it might be important to encourage keeping the 'knowledge' in the country and financially incentivise investment in production and further development in order to build home industries.

"[…] actually the main manufacturers [in Germany] and the main employment is not in the manufacturer's site. They're mainly assembly houses. […] But they have the design, they never let go of the design. They control the innovation. And that's a really important part of the environment." (interviewee B6)

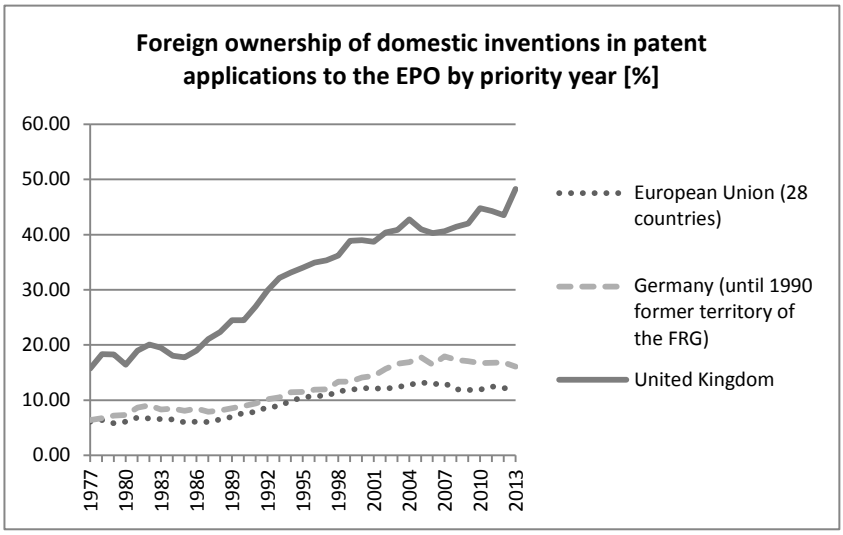


Figure 7: Foreign ownership of domestic inventions in patent applications to the EPO by priority year [%] (eurostat, 2016a)

This section has provided evidence on how the lack of a consistent industrial strategy in Britain has hindered the development of the wind energy industry and has raised the question of whether the prime driver for British inventors may have been a business interest whilst German inventors were mostly ideologically driven. This aspect is discussed further in the following section.

Influence of Key Informal Institutions

Whilst the section above discussed the role of the formal institutions in the form of an industrial strategy by central government the following section focuses on the role of informal institutions primarily in the form of the negative attitude towards nuclear power but also the role of elitism.

The table below compares the amount of discussion on the matters of 'Wind as Business' (individuals identifying wind energy as business opportunity), 'anti-nuclear' and 'energy affordability' in relation to different time periods across both countries. In relation to the above question it becomes clear that wind as business opportunity has become much more relevant since 2000 in Germany (after the introduction of the Renewable Energy Law) whilst it is often mentioned for Britain from the 1980s. Similarly the matter of opposition against nuclear power is of consistent importance for Germany across the time periods whilst it only becomes more relevant recently for Britain.[3] Also interesting are discussions on the matter of 'affordability' which has been shown to have been a much talked about concept above. The table below shows it has been a relevant issue much earlier for Britain whilst it is of importance only more recently for Germany.

	Wind as Business		Anti Nuclear		Affordability	
	BRI	GER	BRI	GER	BRI	GER
1 : 1945 - 1980	0%	0%	0%	23.75%	2.34%	3.04%
2 : 1981 - 1990	49.32%	20.58%	42.50%	36.75%	39.91%	13.59%
3 : 1991 - 2000	33.42%	5.05%	0%	12.93%	22.24%	1.50%
4 : 2001 - 2010	4.48%	74.37%	16.08%	13.91%	14.04%	24.65%
5 : 2011 - now	12.77%	0%	41.41%	12.66%	21.46%	57.21%

Table 1: Comparison of 'wind as business', 'anti nuclear' and 'affordability' concepts over time periods in Britain vs Germany [word count, percentage coverage], own analysis

It is apparent that the prevalence of different attitudes affects the setting of political priorities. What is seen as crucially important in the case for renewable energy is what is often referred to as the energy 'trilemma', a balance between the concerns that arise from climate change, securing the supply of electricity and the affordability for bill payers (National Audit Office, 2016). It is among these different priorities that policy makers have to choose, putting more weight on one or two of the concepts over the other. The author argues that the prevalence of different informal institutions affects this process. What is highly evident in Germany's case is that because politicians themselves are citizens and reflective individuals a wide

[3] The 42.50% for the 1980s result from an automatic coding procedure whereby whole paragraphs are coded to either country which may sometimes result in double coding. This is why these apparently exact numerical results must only be understood as indicative, not as absolute.

reaching strength of sentiment and a fundamental shift in such a sentiment is likely to have an impact on their personal attitudes and may be a catalyst for a politician to become an institutional entrepreneur by shifting political priorities or making even more substantial changes.

The passionate feelings about the environment and nuclear energy have been the most important drivers for German inventors according to interviewees. Similarly influential politicians like Hermann Scheer who is considered by all interviewees to have been instrumental in formulating the Renewable Energies Law of 2000 are known to have acted because of their strong personal convictions. Scheer and his colleagues bear the characteristics of 'institutional entrepreneurs' who see a need to change the institutional arrangements and initiate and carry forward the process, in other words make it 'co-evolve' with technological development and changing circumstances. Even among the incumbent companies business strategies are known to have changed direction when management changed and new attitudes entered.

In contrast this lack of strength of sentiment meant that in Britain an elite could pursue the existing 'power system' unchallenged for a long period of time, making sure to maintain the structures that benefit existing incumbents, i.e. the institutional arrangements were hindered in their 'co-evolution' with changing circumstances by the absence of a comparable strength of feeling amongst British policymakers and the wider civil society. The timely action of a small number of civil servants brought about the small element of support as part of the NFFO. They, too, were driven by strong personal conviction but they were up against powerful, vested interests and a constant flow of more or less sympathetic ministers seeking to maintain the existing, entrenched power structures both in the literal and the figurative sense (interviewee B8).

This study attributes the key role in the development of the wind energy industry to the attitude towards nuclear power and the consistently high rates of opposition in Germany. The early 1980s saw the rise of a number of environmental and anti-nuclear movements in Europe and the US. These social movements have been influential in shaping energy politics and played a pivotal role in galvanising the civil society into action (Sine & Lee, 2009; Vasi, 2011).

„And I guess there is something within German society, a deep desire to manage without nuclear energy. Because this is apparent in all these surveys that three quarters of Germans oppose nuclear energy. This has been like that for a long, long time. When there weren't even such strong alternatives." (interviewee G2)

A sceptical attitude to some extent is evident in both countries but survey data shows a more intensive strength of sentiment in Germany than in Britain (Figure 8). Whilst there has been

a ‘Campaign for nuclear disarmament’ throughout the years in Britain this never entered the main stream in the same way it did in Germany. Reasons for this difference may lie in the history of the countries. Britain was the first country to develop nuclear power for civil purposes, albeit as an almost accidental side product when producing plutonium for the creation of a nuclear bomb just after World War II (Taylor, 2016). Nuclear energy in Germany was associated with the National Socialists global quest for power and after World War II the country had agreed not to work on the development of nuclear weapons (Childs, 2001).

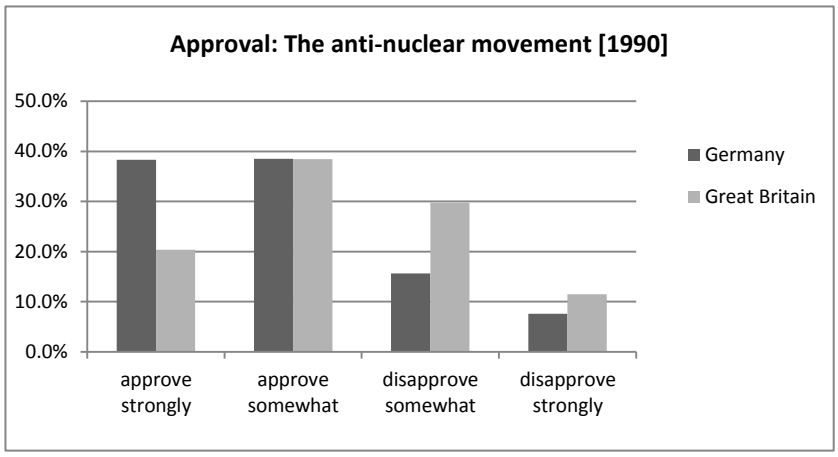


Figure 8: Approval rates of the 'anti-nuclear movement' (EVS, 2015)

Figure 9 below shows the most coded other informal institutions with ‘positive attitude towards nuclear’. A remarkable third of all conversation on this matter was associated with ‘elitism’. In Britain in those years the nuclear industry had become a popular industry for young graduates to go into as it offered high status and well-paid jobs. One interviewee described the recruiting practice of the brightest (Oxbridge) graduates into the industry. 20 years later these would have been powerful individuals with strong ties to those in government. His account confirms the association of positive attitudes towards nuclear power with elitism further (interviewee B11). Childs (2001) also describes that elitism was a strong characteristic of British industry as well as civil service and that management was not necessarily legally or technologically trained. Again, established recruitment practices drawing students mainly from elite universities together with a revolving door between the private sector, ministries and the civil service made sure that the status quo was upheld (Childs, 2001). This is an aspect which was also brought up by some of the interviewees to this study where they bewailed a lack of professional expertise amongst British industry management as well as the higher echelons of politics.

“[…] most of our politicians come from Oxbridge […] and most of the chairmen of our big organisations and our financial institutions are of the same class of people.” (interviewee B3)

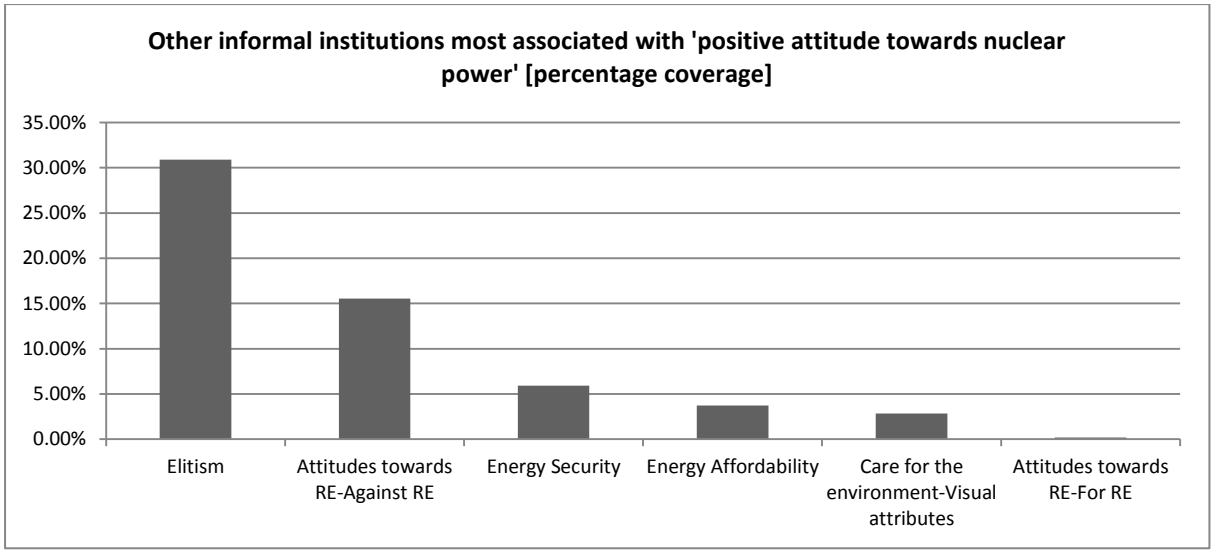


Figure 9: Association of informal institutions with positive attitude towards nuclear power, own analysis

Attitudes and values affect the engagement and investment by the general public with and into new technologies. As shown above they may also constitute the motivation for inventors, innovators, and entrepreneurs to act. Historical events and experiences of a region are seen as the most important influence on the evolution of certain informal institutions over others.

The shared sentiment against nuclear power seemed to have been a very important emotional catalyst for the capacity of German agents to challenge vested interests and entrenched power structures. It is missing in comparable strength in Britain. These German agents are an example of the room that agents have to evaluate and amend institutions following their reflections. A change in attitudes (or other informal institutions) can trigger such a process of evaluation and potential amendment whereas where there is no such change agents will be more likely to just accept and pursue the already existing institutions.

Conclusions

This paper offered evidence of the immediate role that informal institutions and in particular the attitude towards nuclear power and associated elitist attitudes had on the ability of the formal institutional arrangements to co-evolve with the technological development in wind energy and the changing circumstances where the devastating consequences of climate change were increasingly recognised. The German aversion against nuclear power has not been the only reason for Germany's successful building of the wind energy industry but it did trigger the actions of many individuals to directly create technologies, invest in the development of technology, demand changes to the institutional framework, implement changes to the institutional framework, and (less so) accept the new market players or even

change business practices and directly invest in renewable energy plants. It thus enabled an energy transition that was carried from the ‘bottom up’ and benefitted a great number of citizens be it through returns on their investment, through solid employment opportunities or through the economic regeneration of their region. In contrast the lack of a comparable popular shift in attitudes meant that there were no genuine champions for renewable energy neither amongst citizens nor amongst politicians. The co-evolution of the institutional arrangements was thus not triggered in the same way. In Britain the energy transition although progressing has mainly occurred from the ‘top down’ through the EU directive on renewable energy and used as political strategy to appease ‘green views’ rather than being embraced wholeheartedly. As a consequence policies were created that deliberately avoided challenging current power structures by encouraging new entrants and therefore the energy transition is driven by a small number of large and often foreign directed companies. Although investments are being made key decisions are ultimately made elsewhere and the socio-economic benefits do not reach citizens to the same extent.

The paper has provided evidence for some of the inter-institutional dynamics that fundamentally shape the creation and development of new pathways and has made a case for a more explicit recognition of the role of informal institutions and their impact on the capacity of the institutional framework to co-evolve with technological development.

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List of Interviewees

Pilot Study			
A1	Volkmar Lauber	A3	Matthias Heymann
A2	Peter Musgrove	A4	Florian Kern
Main Fieldwork			
Germany		Britain	
G1	Johannes Lackmann	A5	William Leithead
G2	Dieter Harrsen	B1	Martin Alder
G3	Martin Kopp	B2	John Armstrong
G4	Ruth Brand-Schock	B3	Pat Geraets
G5	Wolfram Axthelm	B4	Mark Hancock
G6	Prof Klaus Rave	B5	Andrew Garrad
G7	Johann Martin Rogg	B6	Jeremy Sainsbury
G8	Dieter Schaarschmidt	B7	David Still
G9	Christian Nath	B8	Godfrey Bevan
G10	Stefan Gsaenger	B9	Gaynor Hartnell
G11	Udo Paschedag	B10	Ian Mays
G12	Gerd Rosenkranz	B11	Don Swift-Hook
G13	Rainer Hinrichs-Rahlwes	B12	Alan Mortimer
G14	Uwe Nestle	B13	Peter Jamieson
G15	Norbert Giese	B14	Maf Smith
G16	Doerte Fouquet	B15	Robert Rawlinson-Smith