

Applying Institutional Theory to the Low-Carbon Energy Transition

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ABSTRACT

The low-carbon energy transition is a form of socio-technical transition and, as such, it involves profound changes in the institutions that govern society. Despite the acknowledged importance of institutions in shaping the pace and nature of transition, a relatively small proportion of the academic literature on the topic applies institutional theory to the analysis of this transition in a systematic and detailed manner, and these accounts draw mainly on organizational and sociological institutionalism. This paper aims to demonstrate the benefits of applying a wider set of institutional theories to the study of the low-carbon energy transition. It draws principally, but not solely, on rational choice and historical institutionalism with selective reference being made to key concepts within social and organisational institutionalism as well as discursive institutionalism. The paper demonstrates the high degree of parallelism that exists between the literatures on socio-technical regimes and institutions, and also shows how the systematic application of institutionalism can provide a deeper understanding of socio-technical transitions. It concludes by outlining the main elements of a research agenda relating to the low-carbon energy transition.

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1. Introduction

The growing social science literature relating to socio-technical and energy transitions make frequent reference to the importance of ‘institutions’, but there appears to be a relative dearth of published analyses which draw explicitly on the institutional literature to frame their arguments. Those accounts that do so have applied, with very few exceptions, ideas from organisational and sociological institutionalism rather than from rational choice and historical institutionalism. The importance of this deficiency lies in the essentially political nature of the low-carbon energy transition that arises from the widespread perception that energy is a national security issue, the powerful interests involved in energy, and the patterns of energy use that are deeply embedded in societies. Conversely, most studies of institutions fail to take technology into account, except in the field organizational institutionalism.

The aim of this paper is to respond to the calls to bring institutional theory further into the study of the low-carbon energy transition [1,2] by treating the energy sector as a socio-technical regime and examining how institutionalism can throw light on the processes involved in this transition. Institutions have been variously conceptualized as formal and informal rules [3,4] or as shared self-sustaining beliefs and expectations that may or may not be represented by rules [5,6]. Institutions allow actors to make decisions with little information and they become progressively reinforced by repetition of these decisions, provided the actors find that the validity of their decisions and actions is confirmed [7]. As well as constraining behaviours and change, institutions also enable change through their inherent ambiguity that can empower actors to experiment and learn [8]. Three parallel strands of neo-institutionalism have become established. Rational choice institutionalism emphasizes economic gains, historical institutionalism focuses on power asymmetries, whilst sociological institutionalism (also known as organizational institutionalism) highlights the importance of culture [9]. Schmidt [10] has proposed that discursive institutionalism be introduced as a fourth strand, to emphasise the role of ideas and discourse.

This account draws on a number of elements of institutionalism in order to deepen our understanding of different aspects of socio-technical regime transition and thus to identify an agenda for future research on the low-carbon energy transition. It draws on rational choice institutionalism as formulated by Douglass North and Oliver Williamson and elaborated by other scholars, as well as on historical institutionalism, as these approaches provides insights that are not revealed by a reliance on organizational institutionalism. These insights relate primarily to the importance of history and culture and to the general features of the prevailing political and economic systems. The paper builds on, consolidates and refines arguments I have elaborated in earlier analyses in the context of energy transitions in China and the United Kingdom [11-14].

Two warnings are in order. First, this account does not intend to provide a comprehensive overview of the literature on either socio-technical and energy transitions or institutionalism, as these tasks are beyond the scope of a single paper. Second, the intention is not to argue that institutionalism provides a superior lens through which to examine the challenges of the energy transition, but just that this framework is a useful complement to others. The aims are to demonstrate the strong degree of parallelism between the two strands of scholarship and to illustrate how institutional theory *can* be applied to deepen our understanding socio-technical and energy transitions, in hope of inspiring others to apply this approach in their particular case studies.

The paper begins by briefly reviewing key aspects of socio-technical regimes, regime transition, transition management and adaptive capacity (Section 2) before describing the different schools of institutionalism, and how they analyse institutional change and

adaptability (Section 3). Section 4 examines how previous studies have applied institutional theory to the study of socio-technical and energy transitions, and examines how such applications may be enhanced by applying a broader range of institutionalist ideas. The paper concludes with a research agenda for the study of the low-carbon energy transition.

2. Socio-technical and energy regimes and transitions

2.1 Socio-technical and energy regimes

The energy sector can be envisaged as a particular type of socio-technical regime comprising an assemblage of institutions which develop around a particular set of technologies and support the development and use of these technologies [15]. In most of the literature on socio-technical regimes, the term ‘institutions’ has been defined loosely as the formal and informal rules within a society as well as the relevant organisations which embody these rules. In addition to markets, policies, laws and regulations, a socio-technical regime encompasses the beliefs, values, expectations and cognitive routines of the various actors, including politicians, civil servants, company managers, engineers and scientists, civil society organisations, and the users of the technical services afforded by the regime, such as energy [16]. The behaviour of these actors will be conditioned by the regime and many actors will also build strong political and economic interests in the prevailing regime [17]. The concept of socio-technical regime recognises that technology and society are not separate spheres of activity or policy, but are highly inter-dependent. Technology can determine behaviour in society and societies can make choices concerning technology. Individual technologies have cultural symbolic value, as indeed does the whole notion of technological progress. Thus societies and technology co-evolve [18].

One key component of a socio-technical regime is the ‘policy paradigm’. The term ‘paradigm’ was originally elaborated by Thomas Kuhn to explain the nature of scientific research and discovery [19]. In the context of policy and politics, a paradigm can be seen as a set of shared beliefs, values, ideas and principles relating to the world or to a particular sector. The prevailing paradigm determines the intellectual, political and organizational framework within which policy challenges are identified and addressed. Policy solutions are formulated within the framework provided by the paradigm and such solutions are usually consistent with the paradigm [20]. Policy paradigms play a particularly strong role in the governance of energy on account of the political and economic importance of this sector [21-23].

The multi-level perspective provides an analytical framework that has become established in the transition literature, though not without its critics. This approach envisages the socio-technical regime lying between narrow niches of innovation and a broad sociotechnical landscape. Niches are protected spaces in which technological innovation takes place. This protection may arise from deliberate government policy or be an accident of institutional structure [24]. In either case, protection allows scientists and technologists to experiment, learn, develop new ideas and build networks in a framework of formal and informal rules that are different and less constraining than those governing the regime [16,17]. In contrast, the socio-technical landscape of a society provides the broad canvas on which multiple regimes lie, and includes the geographic, demographic, political, economic and industrial attributes of the society, as well the culture, values, behavioural norms and routines. In today’s globalized world, international markets, politics and conflict also form part of the landscape [16,18], and the energy sector is no exception.

2.2 Regime transition

A regime transition may be defined as a gradual process of societal change spanning the economy, technology, organizations, rules, systems, values and behaviours – essentially, a profound change in the way in which society operates [25]. Given the all-pervasive nature of socio-technical and energy regimes, it is not surprising that obstacles and constraints to change can be found across the physical, technological, economic, political and social spheres, especially in the energy sector [22,26,27]. Geels [28] argued that rules, commitments, interests, paradigms and infrastructure combine to support regime stability and create a high degree of path dependency. Smith et al. [29], among others, have drawn attention to the role played by a wide range of institutions and the relationships between them in determining the pace and direction of regime transition. Such institutions include the embedded culture, societal norms, professional networks, the educational system, and the environment for innovation. The process of transition is non-linear and unpredictable, whether or not it is directly supported by government policy. It is characterized by trial and error, by many disappointing technological and policy failures, and by unexpected success. As a consequence some socio-technical transitions can take as long as 100 years, though 50 years may be a more reasonable estimate for the current energy transition given the nature of modern communication and political collaboration [30-33].

In the multi-level perspective, change in the socio-technical regime arises from selection pressures coming from the landscape and technological niches, as well as from within the regime itself [15,17]. Pressures from the landscape may emerge at national, regional or global scales and arise from gradual changes in social structure, macro-economy, physical environment price or availability of resources, or the emergence of new beliefs or policy challenges. Demographic changes and the rising threat of climate change are two currently relevant examples of landscape changes). Change may be driven from within the regime, for example by the sudden emergence and adoption of a new technology such as combined cycle gas turbines (CCGT) in the electrical power sector.

The impact of these selection pressures on the regime depends on a variety of factors. For example, the uptake of a niche innovation will depend on the degree in which pressures from the landscape or from within the regime are creating a demand for the innovation at that time [17]. In a broader sense, regime transition will be promoted if the selection pressures from different sources are mutually reinforcing and if resources such as factor endowments, capabilities and knowledge are coordinated with these selection pressures. One additional requirement is for effective scientific and policy discourse [15].

In its simplest form, the structural approach embodied in the multi-level perspective ignores the key issues of agency, power and politics. Actors with different powers and interests within the regime play critical roles in setting the policy agenda, shaping the discourse and framing, supporting or suppressing niches, or just lobbying to obstruct or promote legislation [15,32,34,35].

2.3 Transition management

Much of the literature cited above takes an ‘outsiders’ perspective on socio-technical transitions, in the way that the authors analyse regimes as phenomena to be understood rather than to be managed. In contrast, the transition management literature is based on the assumption that there is scope for deliberate interventions by government to support and even steer the transition [34]. In contrast to the conventional governance with short-term objectives which most governments undertake, transition management involves both long time-scales and the need to change the way in which the government and society works. Indeed, given

our understanding of socio-technical regimes discussed above, the focus of transition management is on changing the system as a whole, rather than in using the system to achieve short-term goals, however worthy these goals may be [36].

Given that the transition to a new socio-technical or energy regime can take several decades, it is argued that governments need to develop a long-term vision or an imagined future 25 years or more ahead which can act as a guide for formulating policy options and setting interim objectives [25,30,36,37]. The long-term vision should combine not just specific quantifiable targets, such as the structure of the fuel mix or the total level of emissions, but also qualitative objectives relating to the future nature of governance. In this respect the long-term vision is likely to resemble a ‘paradigm’, discussed above, which articulates certain shared perceptions on the nature of the challenge and the manner in which preferred solutions will be identified.

Many of the core ideas relating to ‘transition management’ have also been captured within the literature on ‘reflexive government’ which emphasises the need for experimentation and learning to occur throughout society. The government is expected to adjust institutions and guide experimentation and learning by autonomous actors across society, and thus encourage long-term change in economic and social behaviours [37,38].

Transition management and reflexive government provide attractive intellectual frameworks for analysing the transition to a low-carbon economy, but these approaches have their weaknesses as guide to action. Even proponents of these narratives have under-scored such weaknesses as the under-estimation of the need for political legitimacy and the significance of political and economic power [25,30,38,39].

Transition management and reflexive governance also suffer from political tension between the preference for governments to guide, steer and coordinate and the realistic need for governments to decide and control [39]. In making unambiguous decisions, a government is taking risks which arise from its own bounded rationality and its vulnerability to influence from powerful actors, as well as from the uncertainty of the technological innovation process itself. Poor policies will result in rent-seeking by companies and a misallocation of resources through investment in failed projects [40-42].

Regardless of the risks that arise from inappropriate policy decisions, governments are often obliged to take some action to support a regime transition, most notably today in the case of the low-carbon transition. In doing so, they need to seek a balance between what Smith and Stirling [43] have termed ‘governance on the outside’, which implies a managerial approach to steering the transition, and ‘governing on the inside’, that involves more reflexive behaviours.

2.4 Adaptive capacity and transition

The transition to a low-carbon economy requires radical and rapid changes to take place in most industrial and industrialising societies if they are to undergo a in the sort of timescale envisaged by the IPCC. As a consequence, the concept of adaptive capacity, first developed in the life sciences, is now being applied in the social sciences, particularly in the context of socio-technical regime transition. The adaptive capacity of a society may be defined as its ability to respond to challenges posed by changes in its environment, either in anticipation of or in response to such changes [44]. The determinants of national adaptive capacity can be found throughout society and the economy and may include material resources and infrastructure, information technology and communication systems, human and social capital, and wealth and financial resources [15,45].

Although these factors are important, it has been argued that the over-riding determinants of adaptive capacity lie in the institutions of governance [44,46]. Consistent

with the transition management and reflexive government narratives, adaptive capacity is likely to be higher in societies with a greater variety of actors and institutions, with greater degree of autonomy for actors to innovate, with a greater capacity for social learning and with equitable systems of governance. This is because such societies provide greater scope for groups of actors to find solutions to emerging challenges without waiting for higher authorities to act; for socio-technical transitions require policy learning not just in the state but also across the whole of society [17,47].

Discourse plays a key role in learning and adaptation. The socio-technical transition literature recognises that the nature of the discourse and its role in policy change are heavily dependent on the character of the prevailing institutions, and not just the formal rules covering policy making and implementation. Just as important are the informal customs, values and norms of society, including the degree of trust between different sets of actors, especially citizens' trust in those giving advice or selling appliances [48-50].

Technological change clearly lies at the heart of a regime transition. Behind the more 'tangible' requirements for a technologically innovative society [51-52] lies a softer attribute known as 'absorptive capacity' [53]. Absorptive capacity is needed to turn new ideas and techniques into technological progress. Without it, no amount of transferred or indigenously produced technology can be diffused and deployed across a nation. The absorptive capacity of an organisation or a society is the ability to identify the value of new ideas or technologies, to introduce them into the organisation and to use them to produce new products or services.

In addition to the specialised knowledge and skills required for certain tasks or fields of work, the relevant sections of society require 'tacit' knowledge, which relates to wider experience and expertise. Such tacit knowledge is acquired through informal learning and is difficult to transfer through formal means [54]. Further, absorptive capacity can be enhanced by institutional structures that encourage the flow of ideas and information, between organisations and individuals within a nation and between nations [53]. In other words, the capacity of a nation for technological innovation depends to a great extent on the nature of education and learning, and on societal values and behaviours, that is to say on culture and social capital.

In his comparative study, Kash [54] identified three features of society, in addition to those already mentioned, which act to determine the capacity to innovate in complex technological fields. He argued that innovation is therefore favoured in non-hierarchical societies characterised by collective decision-making and by a high degree of inter-personal trust. In the absence of impersonal trust, a strong legal system is required.

3. Key elements of institutional theory

The literature on socio-technical and energy transitions reviewed in the previous section demonstrates that analysis of and policy making for the low-carbon energy transition requires an understanding of many attributes of a society. This provides the rationale for applying a broad range of institutional theories to the low-carbon energy transition. This section provides a brief overview of the main families of institutional theory before examining and assessing how these theories have been applied to socio-technical and energy transitions.

3.1 Different institutionalisms and integrative schemes

The three long-standing schools of institutionalism can be identified [9,10]. Rational choice institutionalism builds on the assumption that actors are rational. However, the rationality of the actors is bounded and institutions provide incentives or rules that fulfil a vital role in

lowering transaction costs and creating order [3,4]. Although rational choice institutionalism has its roots in economics, it has also been applied to political history [55].

Historical institutionalism developed within political science and focuses on how the wider structure of the polity or political economy shapes the distribution of power and the nature of power relations. This school takes a wider view on the nature of institutions, and includes both formal and informal rules, as well as norms, routines and ideas. It also shows how institutions not only constrain change but also themselves are resistant to change, a situation that results in most political change being incremental and path-dependent [56,57].

Sociological institutionalism grew from the field of sociology, as its name implies, and emphasizes the importance of culture in determining the nature of institutions and the way in which they shape actor behaviour. In this approach, institutions include symbols, frames and values that determine a set of practices that are specific to a particular culture and may have no relationship to economic efficiency. In other words, appropriateness trumps performance. These ideas have also been applied to organizational studies and thus the terms 'sociological institutionalism' and 'organizational institutionalism' can be used interchangeably [58,59].

Finally, Schmidt [10] has proposed that discursive institutionalism be recognized a distinct approach that directs greater attention than the other three institutionalisms to the role of ideas and discourse in shaping political outcomes and institutional change.

No sharp boundaries exist between the four schools of thought and a number of ideas can be found in two or more forms of institutionalism. Three integrative schemes are particularly useful to the current study. In the field of sociological or organizational institutionalism, Scott [58,60] built on the earlier work of DiMaggio and Powell [59] to draw attention to the usefulness of organizational fields to analysing economic and business activity. An organizational field comprises a set of organizations interacting in a system that spans the full length of the supply chain, as well as customers and regulators. It is characterized by a particular set of rules, networks, relations, habits, frames and meanings; in other words, the organizational field is governed by a set of institutional logics. This approach also incorporates 'artefacts' or technologies as important institutional carriers.

Williamson [61] drew up an integrative scheme that identifies three levels of institution (Fig. 1). At the highest level are informal 'embedded' institutions characteristic of the society in question. These include traditions, norms, customs, beliefs, mental models and expectations, or, in other words, the prevailing culture. At the second level lies the 'institutional environment' which has a preponderance of formal institutions consciously designed by humans. Most important in the study of economics are the political and economic systems, the bureaucratic structures and systems of government, and the nature of the judiciary. Also of great significance are the general features of the law relating to property rights, contract and dispute resolution, the systems for policy-making and implementation, and the role of civil society. At the third level are the structures and systems that govern individual transactions, for example firms, markets, government bureaus, networks, and various hybrid structures. Conventional transaction cost economics focuses on this level of institutions.

INSERT FIGURE 1 HERE

In their study of the long-term evolution of societies, Douglass North and colleagues [55] distinguished open access social orders from limited access social orders (or natural states). Open access social orders are characterised by relatively open access to economic wealth and political power, by the predominance of impersonal relationships in economy and polity, by the rule of law and equality before the law, and by secure formal property rights.

These features help to create a competitive environment which reduces economic rents and leads to innovation and creative destruction in the economic and political spheres. In contrast, in limited access social orders the governing elite is focused on creating and capturing rents. This activity is essential to the survival of the elite group by ensuring sustained cooperation within this group, because the rents which can be captured are greater at times of peace and stability than during war and turbulence. Personal relationships, patronage and clientilism predominate in political and economic transactions. The power of the state allows it to have a high degree of control over investment, trade and prices.

3.2 Institutional change

One of the most significant implications of the study of institutions, from both rational choice and historical institutionalism, has been to show how institutions constrain the pace and direction of economic and political development [6,62,63]. This path-dependency arises, not just from the constraints which institutions place on political and economic transactions, but also from the resilience or resistance to change of institutions themselves.

Institutions are resistant to change if they are self-reinforcing, producing positive feedback or increasing returns) [57]. These positive feedback mechanisms and the consequent institutional resilience result in a high degree of path-dependence for both political and economic institutions. The key characteristics of this path-dependence are three-fold. First, change in the system is not easily reversed. Second, the further down a development path a system has progressed, the more limited become the options for institutional change. As a result, earlier events or changes are more important than later ones. Finally, most institutional change is incremental [3,6,57].

The complex inter-locking and inter-dependence between institutions also provide a strong source of path-dependency, for change in one institution or the introduction of a new institution will generally require change in a number of other connected institutions. If the associated changes are not made, the new institution either may not be adopted by society or may result in unintended consequences [64,65].

Rational choice and sociological institutionalism identify another source of path dependency in the prevailing policy paradigm that can be seen as a social technology [62] or to the set of normative rules of Scott [60]. Policy paradigms be envisaged as belonging to the 'institutional environment' (Level 2 in Fig.1)¹. They are necessarily incomplete on account of the bounded rationality of human beings [62,64]. As a result, all institutions are imperfectly designed and many imperfect institutions persist despite their dysfunctionality or unsuitability.

It is easy to over-emphasise the resistance of institutions to change and their power to constrain change. Rather, it is vital to realise that institutions are always undergoing change and, at the same time, providing opportunities for change, either as a result of social or policy learning or through the deliberate actions of individuals or coalitions seeking advantage for themselves [65,66]. A key debate in institutionalism concerns the relative importance of endogenous and exogenous sources of institutional change.

Applying the terminology of historical institutionalism, an institution that fails to be self-reinforcing may become vulnerable to change [3,6,60]. Instability in the governance structures may also arise from incompatibility or 'friction' between institutions and this may

¹ In Andrews-Speed [11], I assigned various types of idea including policy paradigms to level 1. Given that many policy paradigms are not deeply embedded in societal culture, it seems more appropriate to place them in level 2, though such paradigms may have their roots in level 1 institutions.

provide the opportunity or the necessity for change [70]. In the terminology of rational choice institutionalism, a failure to align governance structures with transactions leads to a failure of governance, to subsequent conflict and to eventual crisis [61]. Such friction may exist at a single level of institution in the scheme shown in Figure 1, it may lie between different levels of institution, or it may lie at the interface between old and new institutions [3,5,67].

Those who argue that the ultimate causes of institutional change may be endogenous highlight the importance of long-term trends within a society and of how these trends may act to undermine or alter an institution [6,57,68]. Such trends may include changes in population structure, wealth, ideas, availability or prices of resources, technology, or structures of power. These gradual changes may be almost unnoticed in the society itself but they cause incremental changes in values and behaviour which in turn may undermine certain institutions.

An actual or perceived failure of a paradigm, or rather of the policies flowing from a paradigm, provides the opportunity for the introduction of a new idea or new paradigm. The appearance of new ideas, even without the failure of the old paradigm, may also provide an opportunity for change [20,65,67,69]. The reaction of government and society to paradigm failure or to the appearance of new ideas is highly variable. In principle, an opportunity for change may be provided by the failure of a policy or of a paradigm, or by incompatibility between prevailing ideas and institutions of governance [70,71]. Yet government and society are often willing to accept *ad hoc* adjustments which are made to policies rather than reject the paradigm. For example, a 'new' idea may be presented as being consistent with the 'old' paradigm, even though it is self-evidently in contradiction. This creates internal inconsistencies within the prevailing policy paradigm [20,67,72].

Historical, rational choice and sociological institutionalism all envisage actors, either individuals or organizations, as playing a key role in driving institutional change [9,56]. In simple terms, actors will seek to change institutions in order to favour their own interests. Their success will depend on their ability to address the collective action challenge intrinsic to such change and this will depend, in turn, on the distribution of power in the prevailing institutional framework [73]. The relative ability of a small number of powerful actors or of a large number of less powerful actors to bring about institutional change depends, in part, on the political culture of that society [74]. These 'institutional entrepreneurs' must find ways to frame arguments that successfully build support for their recognition of the need to adapt to new challenges by building new organisations and creating new institutions [60,65].

Most analyses of institutional change distinguish incremental or evolutionary change from radical or revolutionary change. Mahoney and Thelen [56] built on earlier work [70,75,76] to recognise three types of incremental institutional change: layering, which involves adding new elements to an existing institution; conversion, in which new goals or actors are added to an existing institution in order to change its function; and drift, when a changing environment combined with policy inaction results in a gradual change in an institution or in its neglect. In each case, a strong relationship exists between the new institutional arrangement and the pre-existing one. In a similar approach, Campbell [65] introduced an alternative approach to incremental institutional change which he named 'bricolage'. The essence of bricolage lies in the recombining of existing institutional elements into new institutions so that, as in the first approach, the new institutions bear strong resemblance to the pre-existing ones.

The full replacement of one institution by another, or of one set of institutions by another, can also occur, especially if a major crisis of confidence in existing institutions takes place. Such a crisis may last for several years as society experiments with new institutions before eventually settling on a new set of institutions and reaching a new equilibrium

[5,6,77,78]. These crises have also been called ‘critical junctures’ and they can create sharp deviations from the previous path of development of the society and its institutions [57].

3.3 Adaptive efficiency

The issue of openness to change has been addressed by institutional scholars who have argued that some cultures and institutional frameworks may be more adaptable than others. Societies that are more open to change tend to be characterised by comparatively loosely-linked, heterogeneous and discretionary institutions and to be open to new ideas [65,78,79]. North [3] captured the idea of openness to institutional change in his term ‘adaptive efficiency’ which refers to the willingness and ability of a society to acquire new knowledge, to innovate, to take risks through experimentation, and to eliminate unsuccessful political and economic organisations and institutions. In this respect, culture is seen as an important determinant of adaptive efficiency. For example, ideological conformity, whether rooted in history or imposed by dictatorship, may reduce a society’s adaptive efficiency [62, 80]. More recently, North et al. [55] have explored the manner in which adaptive efficiency is closely related to the nature of the prevailing political culture or social order. They argued that open-access social orders show a higher degree of adaptive efficiency than limited-access orders on account of their openness to political and economic competition which in turn provides opportunities for niche entrepreneurs to experiment and develop new solutions to pressing problems.

Key elements of a society’s adaptive efficiency are its ability to learn and its capacity for collective action. Both these attributes are shaped by the prevailing institutions. Social learning is perceived as being most effective in societies characterised by open, transparent and participatory policy-making processes, and by a wide range of social and professional networks [81-84]. Collective action requires trust or social capital to allow a society to come together to address certain collective action problems; or, in terms of transaction cost economics, trust lowers the transaction costs of solving collective action problems [85-89]. But the nature of trust and social capital in a society is, once again, highly dependent on the institutions of that society, especially the embedded institutions [90].

4. Application of institutional theory to socio-technical and energy transitions

4.1 Previous studies

A number of studies have drawn on institutionalism to interpret phenomena in the energy sector. The earliest ones applied rational choice institutionalism to the challenge of regulating newly liberalised public utilities, such as energy and telecommunications [e.g. 91-93]. Later research has sought to apply institutionalism to explain the varying nature of and consequences of energy sector reform in the former communist countries of Central and Eastern Europe and the Former Soviet Union [94-96]. Institutionalism also has been applied to many other aspects of the energy sector: for example, to electricity [97-99], the role of national oil companies [100], natural gas [101], urban transport [102], and technological innovation [103], as well as to individual industry governance challenges in specific countries [104]. Studies which go beyond the conventional analyses of governance and regulation to emphasise the need to change values, beliefs and behaviours in society include that of Polski [105] relating to energy security.

The term ‘institution’ appears in a number of analyses of sociotechnical regimes and regime transition. On many occasions the term is not defined at all; in others, there is general

mention of formal and informal beliefs, norms and routines with reference mainly to the work of Douglass North [3,62] and Richard Scott [58]. Only a small number of authors draw on institutionalism in a systematic manner to analyse socio-technical regimes and regime transition, and these almost exclusively apply Scott's approach.

Geels [28] drew explicitly on sociological and organisational institutionalism and applied Scott's 'institutional pillars' which embody three types of rule in society: regulative, normative and cultural cognitive rules [58]. Geels and Schot [17] emphasised that these rules both constrain and enable actors, and that their constraining power is greater in the regime than in the niche. They also applied DiMaggio and Powell's [59] concept of organizational field to embrace the full supply chain as well as regulators, researchers and civil society, and they distinguished the larger organizational field that forms the socio-technical regime from the smaller field that is the niche.

In their study of the urban water sector in Australia, Fuenfschilling and Truffer [106] also drew on organizational institutionalism to examine the role of organizational field logics. They showed argued that the more these institutional logics are aligned with each other the greater the field's resistance to change. An increase in the heterogeneity or incoherence in the field logics can provide the potential for innovative niches to make an impact.

Analyses of the low-carbon energy transition that explicitly draw on institutionalism are relatively few in number and they too mostly apply organizational institutionalism. Nilsson et al. [1] drew explicitly on Scott's [58] terminology to explain how regulatory, normative and cognitive rules can constrain the pace and path of the low-carbon energy transition in the case of Sweden. They concluded that low-carbon scenarios and road maps must take into account the institutional context to have any validity. In trying to explain incremental change in the development of bioenergy in the United Kingdom, Genus and Mafekheri [107] applied Scott's concepts of institutional carriers. These carriers are the elements which transmit an institution and can take one of four forms, namely routines, symbolic systems, relational systems, and artefacts. They argued that a high degree of variability in the strength of the different carriers can constrain the progress of institutional change.

These applications of sociological or organizational institutionalism to the study of socio-technical transitions and to the low-carbon energy transition have certainly provided useful insights, but their focus is limited. To address this deficiency, Kern [108] combined the organizational institutionalism of Scott [58] with Schmidt's [10] discursive institutionalism to show how ideas, discourses, institutions and interests combined to shape the contrasting low-carbon policy programmes in the Netherlands and the United Kingdom. This study identified the way in which institutional context shapes policy discourse and the relative power of actors, and concluded by highlighting that low-carbon transitions require different policy approaches in different countries. Geels [35] reinforced this observation of the importance of institutional context by drawing on the 'varieties of capitalism' literature that highlights the fundamental differences between liberal market economies such as the United Kingdom and the USA from coordinated market economies such as Germany [109].

Two accounts have drawn explicitly on the three-level scheme of Williamson (Fig. 1). Correlje and Groenewegen [110] questioned the value of neoclassical and transaction cost economics in understanding the low-carbon energy transition, and emphasised the need to apply institutionalist ideas to understand such issues as public values in order to identify ways to promote collective action. Lane and Montgomery [2] refer to Williamson's scheme and draw on the work of such scholars as North [3,55,62], Kuran [80] and Pierson [57] to critique the policy assumptions embodied in the IPCC's 'shared socio-economic pathways' (SSPs).

4.2 Enhancing the application of institutional theory to the energy transition

A more comprehensive approach to analysing the low-carbon energy transition would build on the strong parallelism that exists between the ideas developed in the literature on socio-technical regimes and regime transition (see above, section 2) and those that underpin institutionalism (section 3). For example, a socio-technical regime is seen as comprising formal and informal rules, as well as beliefs, values, expectations and cognitive routines, all of which can be seen as being institutions. The idea that the nature of the regime or the institutional environment shapes the relative power of different actors is common to both schools of thought. Policy paradigms are mental models. Multi-level perspective draws attention to the importance of the socio-technical landscape which comprises geographic, demographic, political, economic factors, as well culture, values, behavioural norms and routines. Many of these features could be identified as belonging to either the embedded institutions or the institutional environment.

Studies of socio-technical regime transitions, in general, and of the low-carbon energy transition, in particular, emphasize path dependency, incremental change and long time periods, as well as the role of pressures on the regime arising from slow changes in the socio-technical landscape. These are all similar to key elements in the historical institutionalist narrative on institutional change. The critics of transition management emphasize the bounded rationality of governments and the importance of politics and powerful actors which together render the task of steering transition extremely challenging. Finally, both the transition and institutional literatures imbue the concept of adaptive capacity or adaptive efficiency with issues such as human and social capital, trust, social learning and discourse.

The strong parallelism between these two schools of thought provides the opportunity to deepen and broaden studies of the low-carbon transition at national or societal levels. The existing literature may be effective at applying elements organizational or sociological institutionalism to the analysis of transitions, notably drawing on the concept of organizational fields and carriers to the examination of socio-technical regimes. However, few accounts systematically examine the wider socio-technical landscape. Whilst many attributes of this landscape do not take the form of institutions, for example physical, natural and demographic phenomena, many political, economic, legal, and cultural attributes of a society form important institutional components of the landscape. These primarily comprise the embedded institutions and the institutional environment of Williamson's scheme (Fig.1), in other words the deep rooted societal culture and the prevailing political, economic and legal systems. Using the terminology of North et al. [5], open access and limited access social orders provide quite different contexts for pursuing the low-carbon energy transition. Even within one type of social order there will be considerable variations; compare, for example the United Kingdom with Germany, or Russia with China.

In order to deepen our analysis of the low-carbon energy transition at national level it is necessary to draw on insights from all four institutionalisms in an integrative manner - in simple terms: rational choice institutionalism for property rights, transactions costs and contracts; historical institutionalism for power distribution; sociological institutionalism for culture, but not just within the organizational field; and discursive institutionalism for ideas and discourse. The advantages of looking deeper into national characteristics can be illustrated with a few examples drawn mainly from Europe and China, reflecting both open access and limited access social orders. These examples relate to adaptive capacity, policy paradigms, powerful actors, institutional or policy entrepreneurs, and behaviour at home.

China's adaptive capacity in the context the low-carbon energy transition might be expected to be less than that of many western nations, on account of the relative homogeneity of its institutions, the societal preference for conformity, the restricted nature of policy

discourse, and its clear character as a limited-access social order. Whilst such an interpretation has some credibility, it ignores the scope that exists for institutional experimentation [111], albeit within limits set by the state, and the way in which massive state funding and radical administrative measures can effectively side-step the need for subtle policy instruments in promoting renewable energy [112]. In addition, the energetic and entrepreneurial nature of Chinese society reflects a great depth of human capital [113]. A recent example relating to renewable energy has been the (quite unregulated) use of internet-based crowd funding to finance the deployment of distributed solar photovoltaics in the face of the state-owned banks' reluctance to lend [114].

In contrast, the open-access social order of the United Kingdom has led to plenty of institutional entrepreneurship and endless policy innovation, but rather less progress in successful policy implementation than had been hoped. Most institutional change relating to the low-carbon energy transition in the United Kingdom has been incremental and liable to sudden change. The Renewables Obligation introduced in 2000 was modified in 2010 through layering by the addition of banding in order to provide differential financial incentives for different types of renewable energy. Likewise, the law and guidance covering planning approvals have undergone frequent adjustments in order to balance the desire to promote renewable energy with the need to secure local participation in the planning process [115]. The more recent combination of feed-in-tariffs and contracts-for differences resembles bricolage, as it brings mechanisms designed independently for renewable energy and power markets respectively.

In contrast, Germany is one of the few countries that appear to be in the process of radically reforming its energy sector in order to promote the low-carbon transition, not least because of the widespread popular support for the strategy [116]. This support probably has its immediate origins in the environmental movement which sprung up in the 1970s as anti-nuclear protest, but may also have deeper roots in the romantic philosophy of nature that arose in the early nineteenth century, exemplified by individuals such as Schelling, Goethe and Hegel.

Quite different policy paradigms govern the energy sectors of the United Kingdom and China. A market-oriented, regulatory state paradigm has dominated policy thinking in the United Kingdom since the 1980s, and was quite in line with the country's historical preference for market mechanisms. This led to the deployment of market-based instruments to promote the low-carbon transition [21-23]. In contrast, China's government has continued to prefer state-centred paradigm that involves state ownership of major energy companies, state control of energy pricing, and administrative policy instruments to change actor behaviours [11]. The preference for state control over key sectors and resources dates back to imperial times, as do the general distrust of international markets and the quest for self-reliance [117,118].

One feature common to both China and the United Kingdom is the power of the incumbent actors in the electrical power sector to constrain the pace of deployment of renewable energy, in general, and of distributed energy in particular [13]. This resistance arises from their investment not just in physical assets but also in political assets. In the case of China, the state-owned energy companies, with their strong links to the political elite, have been able to ensure the government's continued adherence to the state-centred energy policy paradigm, despite steps being taken in the late 1990s to reform the sector [11]. The continuing dominance of this paradigm is likely to limit the effectiveness of the carbon emissions trading schemes currently being introduced.

The nature and role of institutional or policy entrepreneurs will be highly dependent on the prevailing political regime. In Europe, the number of institutional entrepreneurs engaged in promoting the energy transition and the wider climate change agenda continues to

grow. These entrepreneurs include academics, industry and professional associations, corporations, academics and NGOs, as well as individual politicians and government officials who are willing to promote change [119]. In the context of the European Union's carbon capture and storage policy, Boasson and Wettestad [120] argued that the institutional entrepreneurs were able to create and exploit a window of opportunity, frame the arguments persuasively and engineer the decision-making process in a favourable manner.

In contrast, the policy making process in China is more opaque, and policy discourse and decision-making remain less pluralistic than in Europe, despite substantial change since the time of Mao. In addition, the government continues to keep tight control over both domestic and international civil society organisations. In the fields of energy and the environment, Chinese NGOs may have acquired greater capacity and scope to raise policy challenges and report on implementation failures, but they are rarely able to engage in policy deliberation and design [121, 122]. International NGOs, notably those from the USA, are active in engaging the central government on environmental and energy issues, but their influence is constrained by a number of political, financial and administrative factors [123, 124].

Finally, the low-carbon energy transition requires a change of behaviour across society. Sociological institutionalism provides useful insights in this context by highlighting the importance of identity in determining human behaviour. Two types of identity are particularly relevant to the energy transition. The first is the identity as an "energy saver" which incentivises an individual to overtly curtail energy use through, for example, adjusting the space heating or cooling, and to buy appliances which are obviously green and efficient (Linden et al., 2006). The second relates to the role of the home in the life and identity of the household. At the most basic level, home ownership rather than rental appears to stimulate energy saving activities (Barr et al., 2005; Babooram and Hurst, 2010). But of greater significance is the perception of the home in the minds of the householders. The home plays a central role in the lives of many families and individuals, and this determines the nature of activities undertaken at home, the role of the home in the lives of the householders and the degree to which the home is seen as an expression of the identity of the household (Perkins, 2002; Mallett, 2004). These factors, in turn, will shape household energy use behaviours (Aune, 2007), as has been well illustrated in the contrasting cases of Norway and Japan (Wilhite et al., 1996).

5. Conclusions

History shows that technologies which provide improved or new services play a key role in driving a transition, even if they are relatively expensive in the early stages of implementation. Governments are often not central to such transitions. The energy transition will certainly need government intervention because it is costly and driven by the need to address the long-term public external cost of energy use rather than deliver a short-term private benefit. Markets by themselves will be unable to deliver the required behavioural changes in the time required [31]. The relatively short amount of time perceived to be available for the global low-carbon transition also distinguishes it from earlier regime transitions and renders this transition particularly challenging.

As a consequence, it is essential for governments to direct as much or more effort at changing energy use technologies and behaviours as they do at improving energy production technologies, for history shows that most energy transitions have been triggered by innovations in end-use technologies, such as the steam engine, light bulb and internal combustion engine. However, driving through changes in end-user behaviours in order to

realise the benefits of technological innovation requires substantial institutional change in most societies [33].

The study of institutions must therefore form a key component of analysis and policy formulation for the low-carbon energy transition, or indeed any socio-technical transition. The existing literature on socio-technical and energy transitions has relatively successfully explained, in general terms, the characteristics of a regime that determine its openness to change, the nature of regime transition and the importance of adaptive capacity. Some of these accounts draw explicitly on sociological or organizational institutionalism and provide useful insights at the level of the organizational field. However, such approaches fail to capture critical factors that either lie outside the organizational field or are implicit components of the field but are inadequately analysed.

This paper has sought to show that a broader institutional perspective provides useful insights into the wider context of the organizational field or socio-technical regime. In particular, it has drawn attention to how the general features of the political and economic system and of the national culture may shape the nature, pace and direction of the low-carbon energy transition. Following this logic, an effective analysis of the low-carbon energy transition at the level of a nation or sub-national region should seek to address the following non-exclusive list of questions:

What is the general nature of the embedded institutions such as societal values and norms, and how does this shape such attributes as preference for conformity, impersonal trust, willingness to change behaviour, and potential for collective action?

What is the general nature of the prevailing political, economic and legal systems (i.e. the institutional environment) and how does this shape policy discourse, policy making and policy implementation in general and in the energy sector in particular?

How does the nature of the institutional environment shape the distribution of agency and interest among actors, the openness to competition for ideas, and willingness to experiment?

What are the prevailing policy paradigms that shape the governance of energy, what are their origins, and how open are they to change?

Improved understanding of these and related institutional attributes of a nation will allow academics and policy analysts to draw up projections for future carbon emissions that are better grounded in political and societal reality than are many of the rather over-optimistic projections that have been developed in the past. Such analysis would also provide useful insights to those who design policy by guiding them to examine more closely the societies they govern before issuing policies based purely on technical and neo-classical economic considerations. This consideration is particularly relevant in the case of policy instruments that are transplanted from other countries with quite different institutional characteristics.

Finally, whilst a broad analysis of institutions can provide useful insights into the low-carbon energy transition, other factors also play an important role in determining the pace and path of the transition in a particular country and should not be ignored. In the case of China, for example, the availability of financial and human capital appears to compensate to some degree for apparent deficiencies of institutional adaptability.

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Figure 1. The three levels of institution which collectively govern actor behaviours (modified after Williamson, [61]).

