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# 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 organizational 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 makes 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 organizational 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 behaviors 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 emphasize 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 provide 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].

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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 analyze 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 organizations 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 organizations, and the users of the technical services afforded by the regime, such as energy [16]. The behavior 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 recognizes that technology and society are not separate spheres of activity or policy, but are highly inter-dependent. Technology can determine behavior 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 socio-technical 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, behavioral 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 behaviors—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

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