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A socio-technical perspective on low carbon investment challenges – Insights for UK energy policy

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ABSTRACT

The UK is moving into a new phase of energy governance which is characterised by significant demand for new investment to meet long term climate policy objectives and to address shorter term energy security challenges. This paper examines how contributions from the socio-technical systems approach can be operationalised to address the policy and societal challenge of large scale investments in low carbon energy infrastructure. Research on socio-technical transitions explores the dynamics of long term structural change in capital intensive systems such as energy, housing and water supply, seeking to redirect them towards more sustainable long term trajectories. Focusing on the UK electricity generation sector, the paper expands on three key low carbon investment challenges where socio-technical research can provide useful insights – (1) understanding long term uncertainty and investment risks; (2) avoiding technological lock-in; and (3) accelerating the diffusion of low carbon finance 'niches'.

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1. Introduction

In order for low carbon energy transitions to be realised large scale and long term capital investment will be required in a range of new infrastructure assets. Infrastructure, in a general sense, refers to the material basis of socio-technical systems – power stations, rail networks, ports, airports, pipes and wires etc. This has always been an important public policy issue because infrastructure supports the delivery of essential societal services, such as power for electrical devices and mobility. Governments have historically played a central role in infrastructure investment because of the wider social and economic benefits that it brings, but also because securing investment in these assets requires a long term and consistent governance framework. The balance between public and private investment has varied, though, between different types of infrastructure and according to the relative dominance of different political views of the role of markets in economic decision-making.

A strongly market-oriented framework for energy infrastructure investment has been followed in the UK since the early 1990s, with this model increasingly being followed in other countries. This reflects a view that markets for the delivery of societal services would bring about the incentives for private actors to invest in infrastructure assets, leading to greater economic efficiency and socially optimal outcomes. This model was strongly influenced by neo-classical economic thinking (Helm, 2003). However, this framework is increasingly challenged by the need for high levels of investment to meet other societal objectives of reducing carbon emissions and maintaining energy security, whilst maintaining affordability of energy services to consumers and businesses. In order to deal with these new complexities it is likely that a rebalancing of the relationship between governments and markets will be required (Pearson and Foxon, 2012). The energy policy framework which emerges will need to address a number of key questions: What kinds of policies can effectively mobilise finance and deliver low carbon forms of infrastructure investment? How is uncertainty and investment risk managed by public and private actors? And how are long and short term policy objectives reconciled?

The purpose of this paper is to explore the ways in which studies of socio-technical systems and their long term dynamics can provide useful insights which help to address these complex questions. The origins of the field can be traced back to the work of the historian of technology Thomas Hughes who charted the early emergence and expansion of 'large technical systems' (LTS) such as electricity supply (Hughes, 1983). Hughes and colleagues highlighted the role of pioneer 'system builders' such as Thomas Edison, and how, over time, these infrastructures develop a systemic character through a process of mutual shaping of the technical system and its wider social environment (Summerton, 1994; Coutard, 1999; Vleuten, 2004). More recent contributions have sought to account for the transformation of these now mature systems in the context of climate change, energy security and other drivers of change (Magnusson, 2012; Foxon, 2013).

Both the historically orientated LTS approach and the transitions perspective are grounded in the wider field of technology studies which seeks to account for the social character and implications of technical change (Williams and Edge, 1996; Bolton and Foxon, 2014; Mackenzie and Wacjman, 1999). Unlike neo-classical economics, which has formed the intellectual basis for energy policy in the UK since the 1980s, strands of technology studies such as this view technical change as a dynamic non-linear process, where outcomes are not determined by markets, but shaped by a wider set of social processes. A systems framing is adopted in which the market is embedded in socio-technical 'regimes' which are alignments of institutions, infrastructures and actors which provide stability to and underpin the delivery of essential societal services. Central to the analysis is how fundamental and long term changes to regimes occur, focusing on the de-stabling effects of radical innovations which emerge from typically dispersed 'niche' spaces, and changes in wider socio-technical 'landscapes', including macro level social, economic and technological trends (Rip and Kemp, 1998; Geels, 2002b). Our purpose is not to undertake a systematic review of the entire body of socio-technical systems literature (For overviews see: Markard et al., 2012; Smith et al., 2010; van den Bergh et al., 2011; Vleuten, 2004), rather we draw selectively from key concepts and contributions to the field to consider specific areas where we believe socio-technical thinking can help to contribute to the low carbon investment debate.

Although questions of finance and investment have not been an explicit focus of this field of research to date, though see (Geels, 2013), there has been some engagement with the issue, for example with a recent special issue of this journal focusing on the implications of the economic-financial crisis for the