Transition pathways for a low carbon energy system in the UK: co-evolution of governance processes and technologies

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Abstract submitted for 8th International Conference of the European Society for Ecological Economics (ESEE), University of Ljubljana, Slovenia, 29 June – 2 July 2009

Summary

This paper describes the formulation of transition pathways for a low carbon (electrical) energy system in the UK. It uses an approach based on earlier work on understanding transitions, using a multi-level perspective with landscape, regime and niche levels, and its application to the development of 'socio-technical scenarios'. The paper describes four outline transition pathways for UK energy systems, based on the co-evolution of governance systems and technologies.

Introduction

This paper describes the formulation of transition pathways for a low carbon energy system in the UK. These are being developed in a new collaborative research project, involving leading UK engineers, social scientists and policy analysts, supported by the UK Engineering and Physical Sciences Research Council and the energy company E.ON UK. The project aims to (a) to learn from past transitions to help explore future transitions and what might enable or avoid them; (b) to design and evaluate transition pathways towards alternative socio-technical energy systems for a low carbon future; and (c) to understand and model the changing roles, influences and opportunities of actors in the dynamics of transitions. This paper describes four outline transition pathways for UK energy systems, based on the co-evolution of governance systems and technologies. These pathways involve different patterns of actions by central government, large and small energy firms, and end-users, and different mixes of centralized and distributed electricity generation technologies.

Analysis and Discussion

The theoretical approach to developing transition pathways has been described in earlier papers (Foxon et al., 2008a,b). The approach is based on earlier work on understanding transitions, using a multi-level perspective with landscape, regime and niche levels (Geels, 2002) and its application to the development of 'socio-technical scenarios' (Hofman et al., 2004). We follow three main steps in identifying and exploring transition pathways:

(1) *Characterise the existing energy regime, its internal tensions and landscape pressures on it*;

(2) *Identify dynamic processes at the niche level*; and

(3) *Specify interactions giving rise to or strongly influencing transition pathways*.

Most existing scenario approaches focus on technological and economic issues and developments, usually led by the assumptions in the particular modeling approach being used. There is a danger that such approaches neglect wider social and political issues and relationships that are equally important, such as public acceptability of different technologies and institutional changes, the mixture of short-term and long-term drivers and influences affecting policy-making, and the strategies of large and small firms involved in the industries concerned. These issues concern what is referred to as the 'governance' of energy systems (Smith, 2009), i.e. how the interactions between choices made by different actors within the system, including national and local policy-makers, large firms and new entrants, financial investors and end-users give rise to changes to the system. These actors have a range of individual and social goals, including the supply, provision and use of energy services at reasonable costs, maintaining security of supply, and contributing to wider social and environmental aims, which may often be conflicting – but are sometimes harmonious - in any particular decision process. Particular institutional arrangements frame the way that these conflicts are resolved, or synergies reinforced, and so strongly influence the governance of energy systems. Furthermore, they interact or 'co-evolve' with present and expected future changes in technologies, as technological changes create new opportunities and challenge existing arrangements, and new institutional arrangements and governance processes create incentives for development of, and investment in, particular technologies.

In specifying the transition pathways for future development of UK energy systems, we focus on different pathways for the governance of these systems and the implications of these for the rates of innovation and technological developments and arrangements needed. These pathways draw on earlier work on scenarios under the SUPERGEN highly distributed power systems and future network technologies consortia, a wider review of UK and international energy scenarios, initial interviews with 'gatekeepers' from the UK energy policy and industry communities, and useful insights from a workshop with invited stakeholders.

The first pathway, *Market Rules*, envisions the broad continuation of the current governance pattern, albeit influenced by fairly stringent targets for greenhouse gas reductions by 2050. The government specifies the high level goals of the system and sets up the broad institutional structures, but these are based around minimal possible regulatory interference in market arrangements, which are held to be the most effective and efficient mechanism for delivering energy services with the desired characteristics. This leads to a continuation of the present centralized generation system with energy services mainly supplied by large, vertically integrated firms exploiting technologies, including low-carbon technologies, at a relatively large scale.

The second pathway, *Action/Reaction*, envisions the continuation of the current governance pattern in the short to medium term, but then an increasingly evident failure of the centralized system to deliver on energy security and climate change goals leads to renewed interest in decentralized and hybrid systems, together with a greater focus on energy saving and the development of energy service companies.

The third pathway, *Central Control*, envisions greater direct governmental involvement in the governance of energy systems, in response to urgently perceived needs to re-orient the energy system towards key policy goals in the face of heightened concerns about key energy and environmental policy goals. This could involve the setting up of a ‘Strategic Energy Authority’ and/or the use of central contracts for delivering new low carbon generation, including nuclear power, offshore wind and coal with CCS. The initial focus would be on overcoming blockages in the current system, by addressing transmission constraints, planning issues, supply chains and skills, and introducing non-behavioural measures on the demand side, including increasing energy efficiency standards on products and new build housing.

The fourth pathway, *Thousand Flowers*, envisions a greater focus on more local, bottom-up diversity of solutions (‘let a thousand flowers bloom’), many of which are at least initially relatively small scale. This is driven by innovative local authorities and citizens groups, such as the Transition Towns movement, working to develop local micro-grids and energy service companies. A variety of more locally based technological and institutional solutions then begin to spring up, challenging the dominance of the existing large energy companies.

Conclusion

This paper demonstrates the value of the transition pathways approach to integrate issues relating to governance of energy systems with those influencing the innovation and deployment of existing and new technologies. This approach has been applied through ongoing interactions with stakeholders, which has enabled issues of current concern to policy-makers, existing energy firms and end-users to be identified and applied to the development of the outline pathways. The technical feasibility and social and environmental acceptability of these pathways will now be analysed in the project using detailed electricity network models, and further analysis of end-user requirements and preferences. These analyses will be brought together using a toolbox of multicriteria assessment tools. The findings of these analyses will feed back into the further development of the transition pathways, leading to a qualitative and quantitative specification of the pathways. This should inform decision-making by policy makers, energy firms and other stakeholders for the steps and choices needed for a transition to a low carbon energy system.

References

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