Robust Policies for a Low Carbon Future

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Aims
There is a strong need to design robust policy packages for emission reductions against a background of significant uncertainties on energy scenarios (including fuel prices), technology costs and availability and regulatory framework (especially the nature and ambition of any new international agreement on climate change). The inherent features of power generation investments and the electricity market like interdependencies, lack of efficient electricity storage and transmission monopoly add to the complexity of the problem. In a situation like this modelling and simulation has proven very useful. Models not only allow to explore the effects of different scenarios but also to assess the sustainable development of possible pathways towards an aimed end state in this case, a low carbon future.

We propose to develop an agent based model of the UK electricity system to analyse and explore how policy interventions interact with the behaviour of organisations in the total supply chain of the electricity sector. Our interdisciplinary team combines expertise in policy analysis, electricity and financial markets and agent based modelling.

Policy Context and Rationale
Long-term targets for the reduction of carbon emissions have been central to the UK policy debate on climate change for a number of years. Following RCEP’s (2000) recommendations, the UK government adopted 86% CO2 reduction target by 2030 from 1990 levels in the Energy White Paper (EWP 2003). The EWP 2003 also outlined the need for an energy strategy that recognises that climate change has implications for the global economy and that the economic implications of transition to a low carbon economy The Climate Change Bill, which was introduced to Parliament on November 4, 2009 with the aim of receiving Royal Assent by spring of early summer 2008, the UK will strengthen the institutional framework to deliver its carbon reduction commitments via a system of legally binding carbon budgets and clear and regular accountability to the UK, Parliament and devolved legislators.

Methodology
Agent-based modelling is the preferred methodology for two reasons.
1. Agent-based modelling allows for explicit consideration of strategic behaviour of individual organisations and customers and the subsequent effects on the performance and evolution of the electricity sector in the UK.
2. The explicit consideration of organisational and customer behaviour within the model allows for assessing the nonlinear and complex interrelationship between policy interventions, market forces and customer preferences in the electricity sector.

Only recently, agent-based models have received attention as a potential tool for use in the electricity sector. In general, these models have specifically focused on wholesale power markets exploring the consequences of strategic behaviour of electricity generators to the quantity and price of electricity in the context of specific market rules and network infrastructures.

The role of uncertainty and innovation are two key aspects within this agent-based model. High-stake investment decisions are irreversible and involve high levels of uncertainty. By means of the Agent-Based Modelling (ABM) approach, we will be able to model adaptive investment behaviours in a realistic way, to account for the heterogeneity among agents, and to explore the systemic effects of different strategies toward uncertainty in different scenarios. Secondly, the focus on long-term transitions requires explicit analysis of the role of innovation, both in terms of incremental learning as well as the introduction of disruptive technologies. In the electricity market, explicit consideration will be given to the role of innovation in the transition towards a low carbon future.

Expected Outputs
The methodology developed within this highly interdisciplinary research project will make several unique contributions to the development of policy instruments for the UK electricity sector:
1. An explicit platform to explore and develop robust policy interventions for a low carbon future in the UK.
2. Explicit consideration of the role of uncertainty and innovation in the long-term planning of the electricity sector.