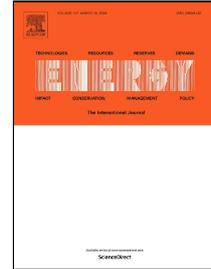


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Investment in the future electricity system - an agent-based modelling approach

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Keywords: investor behaviour, electricity markets, agent-based modelling, decarbonisation, electricity, scenarios

Highlights

- A model of investor decision making in the electricity sector is presented.
- An agent-based approach is used to model bounded rational behaviour of investors.
- Dynamics of electricity markets were replicated; carbon price scenarios were explored.
- Results show that average profits of investors increase with carbon prices.
- Results illustrate that outcome-based policy cannot be solely based on market instruments.

Abstract

Now that renewable technologies are both technically and commercially mature, the imperfect rational behaviour of investors becomes a critical factor in the future success of the energy transition. Here, we take an agent-based approach to model investor decision making in the electricity sector by modelling investors as actors with different (heterogeneous) anticipations of the future. With only a limited set of assumptions, this generic model replicates the dynamics of the liberalised electricity market of the last decades and points out dynamics that are to be expected as the energy transition progresses. Importantly, these dynamics are emergent properties of the evolving electricity system resulting from actor (investor) behaviour. We have experimented with varying carbon price scenarios and find that incorporating heterogeneous investor behaviour results in a large bandwidth of possible transition pathways, and that the depth of renewables penetration is correlated with the variability of their power generation pattern. Furthermore, a counter-intuitive trend was observed, namely that average profits of investors are seen to increase with carbon prices. These results are a vivid and generic illustration that outcome-based policy cannot be solely based on market instruments that rely on perfect rational and perfectly informed agents.

1. Introduction

The energy transition is gaining momentum in the last several years, due to rapidly falling prices of renewable energy technology and substantial institutional consensus on climate change created at the Conference of Parties in Paris in December 2015. The electricity sector is expected to take a leading role in the decarbonisation of the energy sector as it is crucial for a low-carbon energy system. The energy transition will therefore have a large influence on the electricity system, as it entails a transition from the centralised and homogeneous fossil fuel-based system to a much more distributed and heterogeneous system based on intermittent renewable sources. [1–4]

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