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The progressive inefficiency of replacing renewable obligation certificates with contracts-for-differences in the UK electricity market

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HIGHLIGHTS

- The asset performance risk of wind investments deteriorates with greater wind penetration.
- Green certificates may offer lower investment risk than feed-in tariffs.
- Detailed fundamental modelling reveals subtle asset performance risks for wind.
- Recent UK policy changes may be ill-founded.

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ABSTRACT

This paper looks at the emerging risk/return profile for new renewable assets as a conventional wholesale electricity market progressively decarbonises. Using a detailed fundamental model of price formation risks, under increasing replacement of fossil fuel facilities with onshore and offshore wind, we show that the risk return profile becomes less attractive over time, and may therefore need sustained and possibly increasing policy support. Furthermore, we show that green certificate trading may become progressively more attractive as a supplementary support to wholesale prices, compared to fixed feed-in-tariffs. This is because the increasingly negative correlation between renewable output and wholesale prices reduces its revenue risk compared to fixed feed-in tariffs, if other factors remain constant, and thereby improves conventional financial performance risk metrics. In particular, this suggests that the recent energy policy change in Britain to move away from green certificates and into contracts-for-differences may have been ill-founded.

1. Introduction

In the post-liberalised electricity markets, the political motivation to force through rapid technological change aimed at low carbon power generation and greater sustainability has inevitably led to awkward compromises and expedient interventions in market design. Creating a market price for the externality of carbon emissions was a theoretically attractive and practical solution, as the EU Emission Trading Scheme (EU-ETS) demonstrated since 2005, but not as complete a solution as anticipated. Even before the EU-ETS price decay, following an over-supply of allowances in the economic recession post 2008, separate initiatives to encourage the development of renewable technologies were instigated in the EU (and elsewhere) for reasons of sustainability and economic stimulus. Together with further subsidies for energy efficiency and additional carbon taxes, the multiplicity of policies tended to crowd out the singular role of a carbon market and further contributed to its depressed price levels (Blyth et al., 2009). As for the renewables themselves, again, a market based solution through mandated quantity targets and green certificate trading had the appeal of allocative efficiency with the market participants deciding how best to meet quotas and at what price. But, compared to alternative methods such as fixed feed-in tariffs (FiTs), green certificate trading apparently created higher transaction costs (Mitchell et al., 2006).

Thus, an extensive amount of research has looked empirically at the relative successes of green certificates, FiTs, and other incentives for renewable energy, and this accumulated research generally concluded, by 2012, that FiTs had been more effective in promoting renewable innovation (Butler and Neuhoff, 2008; Hass et al., 2011; Verbruggen and Lauber, 2012). The relative simplicity for new entrants of a fixed price was generally identified as the key factor, with Woodman and Mitchell (2011) suggesting that the absence of price risk may lead to a lower cost of capital for FiTs compared to green certificates. But, as so much of this evidence

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had been taken from retrospective observations on the early stages of renewable energy penetration in various countries, it is an open question whether indeed FiTs offer lower investment risks as low carbon penetration approaches the deeper decarbonisation targets that the policies envisage achieving by 2030 and beyond. This question requires a model-based analysis and in this paper, our results surprisingly suggest that in the case of wind, at least, green certificates would progressively offer investors a risk/return investment profile preferable to FiTs, after the early innovation stages and as decarbonisation deepens.

Deep decarbonisation targets for the power sector are becoming widespread. The EU envisages the power sector to be decarbonised by 2050, with some countries, e.g. Britain, seeking to substantially achieve it by 2030, and creating legislation with that in mind (Climate Change Act, 2008). Decarbonisation pathways for transforming the generation mix (EC, 2011; Eurelectric, 2009; HMG, 2010; National Grid, 2011) provide a technologically feasible basis for the setting of policies and incentives, but in Britain, as well as elsewhere, raise the question (Ofgem, 2009; DECC, 2010) of whether the established liberalised energy market design is "fit for purpose" (i.e., whether it will produce efficient prices and investment signals for a low carbon transformation). Indeed, by 2012, the UK Government (DECC, 2012) was persuaded that the market needed substantial reforms and in particular that in order to foster the development of renewables, the existing green certificate system needed to be replaced by FiTs for specific technologies. This was a departure of economic ideology and one whose analytical basis rested upon suggestions that the absence of price risk in FiTs would reduce the costs of capital and thereby stimulate more investment. In the analysis developed here, we show that prospective investment risk requires a much more detailed and computationally intensive modelling approach. A crucial aspect is how price and output risk interact within the usual financial investment risk metrics that need to be satisfied for investors to commit funds. Britain is therefore a topical case study in which to model the prospective investment performance of the various technologies envisaged in the low carbon pathways, and in those contexts to test a counter-proposition that as renewable penetration increases, the relative investment risks may favour green certificates over FiTs.

Britain introduced its green certificate mechanism, the Renewable Obligation Certificates (ROCs), in 2002, the market prices of which were determined by the demand and supply of renewable energy in the wholesale market on an annual basis. Demand was created by an obligation on retail suppliers to cover a specified fraction, increasing yearly, of their sales with certified green energy; supply was provided by metered renewable generation (with an administered buy-out supply to meet any shortfalls). In the UK, the ROCs were initially technology neutral, thereby tending to foster the less innovative solutions, but the Government soon rectified this through a more discriminatory procedure of awarding different amounts of ROCs to different technologies. Also, in order to ensure that ROC prices did not collapse, annual targets were systematically set to ensure that buy-outs at the administered price would be required. By 2012, ROCs had become successful in supporting the development of onshore and offshore wind, so much so that the UK had become the largest developer of offshore in the world, and that over 2012/13 a record 40% increase in wind capacity[1] and a 56% increase in renewable generation had occurred,[2] placing the UK fourth amongst G20 countries in 2013 for total renewable investment (PEW, 2014). So, at a time, in 2013, when the pace of investment in wind was gathering momentum, and the regulatory risk of FiTs was becoming a concern elsewhere in Europe (Spain[3] and other EU counties had retrospectively reduced feed-in tariffs, and recommendations in Germany were to move away from FiTs towards more market based approaches[4]), it was remarkably controversial to see the British Government suggesting that ROCs needed to convert into FiTs in order to achieve the required levels of investment.

The proposition advanced in this paper is that a significant component of risk for wind investors is intermittency and its complex interaction with price risk leads to an investment risk metric that may favour ROCs over FiTs, as decarbonisation progresses. Lenders and ratings agencies use various risk metrics to evaluate financial investment plans (CPI, 2011; Moody's, 2009), and as a proxy for these in this analysis we refer to capital coverage risk (the probability that annual net earnings do not cover financing costs). Thus, how price risk interacts with output risk to provide an annual coverage metric is a crucial concern. As decarbonisation progresses, we show that there is an increasingly stronger negative correlation between market clearing prices and output. This is the well-known merit order effect, as in Sensfuß et al. (2008), Obersteiner and Saguan (2010), Gowrisankaran et al. (2011), Hirth (2012), which may, furthermore, be amplified in a market with strategic players as their market power is greater at times of scarcity (Twomey and Neuhoff, 2010). In many regions around the world with high levels of wind generation, low prices commonly occur during very windy periods (e.g. Australia, North America, Germany, Denmark, Spain) and even negative prices are sporadic events. With ROCs, therefore, exposure to the market price of electricity means that, if this negative correlation between price and output is sufficiently large, the total revenue distribution may be less risky (in terms of the conventional measure of variance) than that implied by price risk and output risk independently. Indeed, depending upon the negative correlation, and the relative contribution of price and output risk, ROCs can become an effective hedge in revenue risk compared to FiTs. Evidently this presumes that in the comparison, *ceteris paribus*, ROCs and FiTs are both set administratively to provide the same average level of remuneration per MWh produced. We discuss this further and the implications of our analysis for hybrid schemes such as Premium FiTs in the concluding section.

In the next section we therefore create a detailed market simulation model to analyse the emergence of the above proposition in a realistic setting. Furthermore, we do this in a context that tests the various pathway assumptions, as proposed by the UK government for decarbonisation to 2030, against a conventional financial performance risk metric as well as the usual risk neutral expected rate of return. We describe the simulation set-up and the computational learning algorithm that allows us to models the emergence of prices above marginal cost. The results demonstrate that the various low carbon investment trajectories, if they are subjected to the plausible financial performance risk criteria that lenders and credit ratings agencies usually impose, may not be feasible without steadily increasing public support. Furthermore we show that for low levels of wind investment, the fixed feed-in tariffs are less risky, but after a moderate amount of wind in the technology mix, the green certificates (ROCs) become less risky than the fixed FiTs. We finally discuss the implications of this for the evolution of renewable support policies.

[1] http://www.renewableuk.com/en/news/press-releases.cfm/record-breaking-year-of-growth-for-uk-wind-energy.

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244726/renewables.pdf.

[3] http://www.the-european.eu/story-2536/spain-in-energy-policy-reversal-back-to-coal-gas.html.

[4] http://www.oxera.com/getmedia/97a39b7c-e751-4e5c-b53f-701ead6131af/Energy-market-reform-in-Germany.pdf.aspx?ext=.pdf.

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