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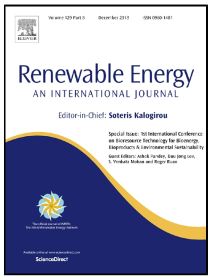

Analysis of Coal Conversion to Biomass as a Transitional Technology

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Analysis of Coal Conversion to Biomass as a Transitional Technology

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ABSTRACT

The dominant transitional path towards a low carbon electricity industry for systems which have been heavily dependent upon coal is through its replacement by large scale wind farms and the widespread emergence of distributed solar. In this pathway, maintaining resource adequacy in the context of increased intermittency in generation has become a major concern. This paper examines this requirement to maintain resource adequacy and compare the costs and carbon impacts for new gas turbines or biomass conversions to achieve this in an expedient transitional way. This is formulated as a policy optimization in which the imperative is to replace existing coal with a renewable alternative (in this case study, wind) and to maintain the system security at the existing level, and thereby find the optimal subsidies, either as energy credits ("green certificates" or "contracts-for-differences") or capital benefits ("capacity payments" or tax allowances). In a model of the GB system, the results show that that biomass-conversion outperforms investment in peaking gas turbines to deal with the transitional economic externality of extra reserve costs. In particular, the results suggest benefits of 10% lower costs of subsidies, 70% lower implied costs of carbon, and a reduction of 18% in wholesale power prices.

Keywords: Renewable Energy, Biomass, Investment, Security, Carbon Price

1. Introduction

Managing the transition of a carbon-intensive electricity industry towards low, or zero, carbon emissions has become a delicate balance of policy initiatives and long-term commitments. Whilst substantial subsidies have been provided to support the early stage innovations of renewable energy technologies, wind and solar in particular, a consequence of these subsidies has been a structural change in the wholesale market economics leading to lower revenues and asset impairments for incumbent fossil fuel generators [1, 2, 3]. As a consequence, further subsidies, usually in the form of capacity payments, have been required to ensure that sufficient generators remain operational and to incentivize the extra reserves that are needed to cope with the intermittency of wind and solar production [4, 5, 6, 7, 8]. The sum of these subsidies, both for stimulating the innovation in new, clean technologies and maintaining resource adequacy, together with the associated network infrastructure upgrading, are inevitably subject to government budgets and considerations of consumer impact (e.g. the Levy Control Framework in the UK [9], and the Energiewende in Germany [10]). Within a framework for medium or longer term decarbonisation of the sector, e.g. by 2030 or 2050, policy support for

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