Do Liberalized Electricity Markets Discourage Investment in Renewable Energy Technologies?

Government policies in the electricity sector in many nations include a focus on programs to support the development and deployment of low-carbon technologies in order to reduce their cost and thus reduce the long-term cost of decarbonizing the sector. However, the design of liberalized, energy-only electricity markets may actually make low-carbon investment riskier than continued investment in fossil fuel technologies.

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I. Introduction

Electricity markets in many countries have been undergoing substantial change over recent years, mainly associated with the (ongoing) shift from vertically integrated state monopolies to liberalized, privately owned, unbundled market participants operating in a carbon-constrained environment. As a result, traditional methods for determining the optimal portfolio of power generation assets have also radically changed, as the industry has moved from one of being largely driven by capacity to one relying predominantly on short-term wholesale market price signals, uncertain environmental regulations, and changeable renewables policies. A critical issue to consider,

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therefore, is whether such signals alone can act as a driver for long-term investment in generation capacity, or whether separate capacity payments are required to provide an additional incentive. There exists a significant body of publications on this topic (see, for example, those cited by Hakvoort and de Vries, 2004), with the prevailing view being that, in practice, energy-only markets are likely to lead to a shortfall of investment in generation capacity over time.[1] This article draws attention to the fact that such a situation is likely to be exacerbated by the entry of low-carbon renewable technologies into the market.

Current government policies in the electricity sector in most developed nations are primarily focused on programs to support the development and deployment of low-carbon technologies in order to reduce their costs and thus reduce the long-term cost of decarbonizing the sector. However, the design of liberalized electricity markets may actually make low-carbon investment riskier than continued investment in fossil fuel technologies. Thus, even with a carbon price, investment in low-carbon renewable technologies may be discouraged.

This article discusses how the above issues may impact on investment in high-capital-cost, low-carbon technologies in liberalized electricity markets. Whilst the fundamental analysis is relevant to all liberalized power markets, U.S. data are used to illustrate the principles involved.

Although energy-only markets for trading electricity vary in their design across jurisdictions, fundamentally they all possess a similar market structure. Scheduled and semi-scheduled generators offer price and associated quantity bids for fixed dispatch intervals, with prices averaged over a 30-min trading interval. The marginal generator (i.e. the highest accepted bid) sets the wholesale price, which then applies to all successful bids. The marginal generator is generally a fossil fuel generator. Thus, marginal bid pricing will include the carbon price, since this will be part of a fossil fuel generator's short-run costs. This should give a competitive benefit to low-carbon technologies. However, the risks attached to recovery of the fixed costs of new investment in low carbon generation assets will vary considerably depending on the capital intensity of the different technologies.

II. Power Generation Investment in Liberalized Electricity Markets

Table 1 shows the overnight capital cost (in $/kW) of a range of current and potential power generation technologies in the U.S.[2] What is particularly noticeable is the marked cost difference between gas and the other technologies, and the substantial increase in cost associated with CCS technology. The corresponding levelized costs of electricity (LCOE) are given in **Table 2**, where the differences between the technologies are far less pronounced. The LCOE is a convenient summary measure of the overall competitiveness of different generating technologies. It represents the real cost per kilowatt-hour of building and operating a generating plant over an assumed financial life and duty cycle. All LCOE estimates in Table 2 embody a carbon price of $15/tonne $CO_{2\text{-}e}$ and are based upon a real after tax weighted average cost of capital (WACC) of 6.5 percent.[3]

In general, nuclear and renewable technologies possess relatively low running costs of generation, but involve relatively high initial capital investments. Thus the appropriate discount

Table 1: Overnight Capital Costs (2012$): Power Generation Technologies, U.S.

Technology	$/kW	$/kW (with CCS)
Advanced PC	3,246	5,227
Coal IGCC	4,400	6,599
CCGT	917	2,095
OCGT	973	
Wind (on-shore)	2,213	
Wind (off-shore)	6,230	
Nuclear	5,530	
Solar thermal	5,067	

Source: U.S. EIA (2013).

Abbreviations: PC, pulverized coal; IGCC, integrated gasification combined cycle; CCGT, combined cycle gas turbine; OCGT, open cycle gas turbine; CCS, carbon capture and sequestration.

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