



Optimal Power Generation Portfolios with Renewables: An Application to the UK

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Abstract

In recent years, geopolitical events have raised questions about the security of European energy supplies and which electricity generation technologies present an optimal fuel mix. Likewise, private investors need to allocate their capital efficiently by devising portfolios of generation assets. This paper applies the Modern Portfolio Theory to determine an optimal portfolio with four electricity generation technologies. Using UK electricity and fuel price data and European carbon allowance prices for the period 2009-2013, we find that coal assets increase portfolio risk and decrease overall returns, whilst a combination of gas, nuclear and wind assets allows an investor to maximise risk-adjusted return. In addition, we examine the role of power purchase agreements (PPAs) to assess whether predictable revenues create more appealing portfolio characteristics. We find that such contracts reduce portfolio returns, highlighting the importance of the set prices and their possible fluctuations over time. The findings support electricity market reform that discourages coal investment and supports investment in renewable technologies. The results also suggest that PPAs could make sense for independent renewable generators, although this would require modelling of the uncertainty of variable load factors and operating costs.

Keywords Electricity, portfolio theory, technology, risk

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