

Incorporating oligopoly, CO₂ emissions trading and green certificates into a power generation expansion model

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Abstract— This paper presents a generation expansion model for the power sector which incorporates several features that make it very interesting for application to current electricity markets: it considers the possible oligopolistic behavior of firms, and incorporates relevant policy instruments, carbon emissions trading and tradable green certificates. It combines powerful traditional tools related to the detailed system operation with techniques for modeling the economic market equilibrium and a formulation for the resolution of the emissions permit and tradable green certificates market equilibrium. The model is formulated as a Linear Complementarity Problem (LCP) which allows the optimization problem for each firm considering the power, carbon and green certificate markets to be solved simultaneously. The model has been implemented in GAMS. An application to the Spanish power system is also presented.

Index Terms— Generation-expansion modeling; Carbon emissions trading; Green certificates; Oligopoly

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Citation:

Linares, P.; Santos, F.J.; Ventosa, M.; Lapiedra, L.; "Incorporating oligopoly, CO₂ emissions trading and green certificates into a power generation expansion model", Automatica, vol.44, no.6, pp.1608-1620. June, 2008.