

Optimal Investment Decision under Tradable Permits and Carbon Tax Policies: A Real Options Approach

Yihsu Chen* Zhen Liu† Chung-Li Tseng‡

Abstract Submitted to UKERC Workshop in Oxford, UK, July 2008

Abstract

Tradable permits and carbon taxes are two market-based instruments commonly considered by policymakers to regulate CO₂ emissions. These two policies offer different incentives for electricity generators long-term capacity investments. Whereas the level of a tax is fixed and predetermined by authorities, the price of the tradable permits is uncertain and driven by market dynamics. Thus, permit price is expected to fluctuate commensurate with the prices of natural gas and electricity.

A real options approach is used to analyze a coal power plants investment decision in cleaner power plants, subject to these two types of CO₂ regulation. Under a tradable permit policy, the coal power plants investment problem is modeled as a continuous-time optimal stochastic control problem, subject to three correlated stochastic processes for the prices of electricity, natural gas, and carbon permits. The optimal timing for adding new capacity is determined and compared to that under a fixed carbon tax.

The results indicate that the coal power plant would advance its investment timing considerably under tradable permits. Such an advance in investment timing is positively associated with the level of correlation among the prices of electricity, natural gas, and carbon permits. Thus, if climate change policy aims to shift the electricity sector toward a less CO₂-intensive generation mix in the long-run, a tradable permit policy appears to be a more effective instrument than a carbon tax.

*University of California, Merced, School of Social Sciences, Humanities and Arts, School of Engineering, Sierra Nevada Research Institute, 5200 N. Lake Road, Merced, CA 95348, USA. E-mail: yihsu.chen@ucmerced.edu.

†University of Missouri-Rolla, Engineering Management & System Engineering, 1870 Miner Circle, Rolla, MO 65409, USA. E-mail: zliu@umr.edu.

‡University of New South Wales, The Australian School of Business, Sydney NSW 2052, Australia. E-mail: c.tsengz@unsw.edu.au.