

Measuring the CO₂ shadow price for wastewater treatment: a directional distance function approach

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Abstract

The estimation of the value of carbon emissions has become a major research and policy topic since the establishment of the Kyoto Protocol. The shadow price of CO₂ provides information about the marginal abatement cost of this pollutant. It is an essential element in guiding environmental policy issues, since the CO₂ shadow price can be used when fixing carbon tax rates, in environmental cost-benefit analysis and in ascertaining an initial market price for a trading system. The water industry could play an important role in the reduction of greenhouse gas (GHG) emissions. This paper estimates the shadow price of CO₂ for a sample of wastewater treatment plants (WWTPs), using a parametric quadratic directional distance function. Following this, in a sensitivity analysis, the paper evaluates the impact of different settings of directional vectors on the shadow prices. Applying the Mann–Whitney and Kruskal–Wallis non-parametric tests, factors affecting CO₂ prices are investigated. The variation of CO₂ shadow prices across the WWTPs evaluated argues in favour of a market-based approach to CO₂ mitigation as opposed to command-and-control regulation. The paper argues that the estimation of the shadow price of CO₂ for non-power enterprises can provide incentives for reducing GHG emissions.