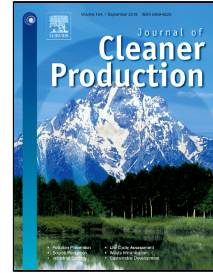


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# Game theoretical analysis of firms' operational low-carbon strategy under various cap-and-trade mechanisms

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**Abstract:** Governments commonly utilize various carbon emission regulations to ensure the sustainable energy consumption of firms and consequently improve the total social welfare. In this study, we apply a game theoretical model to analyze how a manufacturer's operational decisions on sustainable energy consumption and low-carbon production will be changed with the variation in official cap-and-trade policies. Results will provide the government with analytical supplements in making real-world decisions. Our findings show that the manufacturer can obtain increased incentives to upgrade its purification technology in a high low-carbon preference market compared with that in a low low-carbon preference market. Furthermore, the government should constrain the cap-and-trade policy and encourage the manufacturer to upgrade its purification technology when the consumers' low-carbon preference is relatively high. These research findings reveal that when consumers show a high low-carbon preference level, the manufacturer should make socially optimal decisions for its operations. When consumers show a moderate low-carbon preference level, a significant conflict occurs between social welfare optimization and purification technology upgrade. Thus, if a technology upgrade is necessary, then policy-based promotion to increase the consumers' low-carbon preference level is an essential factor to maximize the total social welfare.

**Keywords:** Social Welfare; Sustainable Energy Consumption; Game Theory; Cap-and-Trade

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