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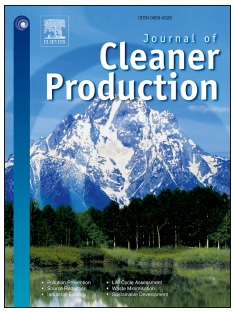

The choice of energy saving modes for an energy-intensive manufacturer considering non-energy benefits

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The choice of energy saving modes for an energy-intensive manufacturer considering non-energy benefits

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Abstract: In practice, energy-intensive manufacturers have two main options when improving their energy efficiency: design and implement energy efficiency projects on their own (we call this self-saving) or enter into an energy performance contracting (EPC), which mainly includes shared savings and guaranteed savings. In this paper, we will discuss an energy-intensive manufacturer facing self-saving and shared savings options and how this manufacturer chooses the optimal energy saving mode when non-energy benefits are considered. We only consider "costs and profit" as non-energy benefits and formulate an optimization model of self-saving and a Stackelberg game model of shared savings. From our model analysis, when considering only energy savings, we find that the optimal unit savings has a monotonic impact on the optimal profit of the manufacturer. Our results indicate that: the manufacturer will prefer the second option to the first when the investment cost factor ratio of the energy service company (ESCO) to the manufacturer is small; otherwise, the manufacturer will prefer the first to the second. Furthermore, when considering non-energy benefits, we find that the results change in some cases.

Key words: Energy efficiency management; Energy performance contracting; Non-energy benefits; Game model

1. Introduction

Improving energy efficiency is one of the most effective means by which energy-intensive manufacturers (hereafter abbreviated as manufacturers) can address the “three big mountains”, i.e., the rapid rise in energy prices, increasingly stringent environmental policies, and growing consumer awareness of environmental protection. China intends to achieve its peak CO_2 emissions in approximately 2030 (U.S.-China Joint Announcement on Climate Change, 2014). To cope with Toxic Haze, more than 2100 industrial enterprises in China’s capital of Beijing have ceased or limited their production of goods. For example, Xu Lejiang, the chairman of China’s iron and steel association and the Baosteel group, believes that environmental and resource limitations have become an important reason for the current low-profit plight and that scientific and technological innovations should be used to address the high consumption and the high emissions of production processes. Kim and Worrell (2002a) benchmarked the energy efficiency of steel production to the

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