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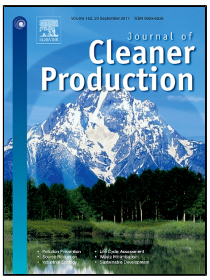

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Trade-off between remanufacturing and recycling of WEEE and the environmental implication under the Chinese Fund Policy

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Abstract:

China is the second largest producer of waste electrical and electronic equipment (WEEE) in the world. To manage WEEE, the Chinese government has enacted a series of laws and regulations, the most important one being the Chinese Fund Policy. In an industry regulated by disposal fees and subsidies included in the fund policy, companies facing higher manufacturing costs may consider engaging in WEEE collection and recovery. This study considers a manufacturer with a WEEE recycling qualification, which combines remanufacturing and recycling to treat WEEE and sells remanufactured products under its brand name. A stylized model is applied to characterize the optimal solutions for the manufacturer and analyze the effects of the fund policy on the manufacturer's collection and recovery decisions. Furthermore, this study investigates the environmental impact of the product using a life cycle analysis–based (LCA-based) approach and characterizes the conditions under which the recovery of WEEE increases the environmental impact of the fund policy. The results herein show that applying for recycling qualifications is always profitable for the manufacturer, and the profits increase as the subsidy increases and the disposal fee decreases. However, high disposal fees or subsidies may have adverse effects on the environment. Low remanufacturing costs and high remanufacturability are not always conducive to the environment, especially for the products with high environmental impact in usage.

Keywords: Remanufacturing, Recycling, Chinese fund policy, WEEE, LCA, Environmental impact

1. Introduction

Due to rapid technological development as well as more demanding customers, the life of electronic products is shorter than ever before, which results in higher amounts of waste electrical and electronic equipment (WEEE, also called e-waste). For example, the amount of global WEEE was up to 41.8million tons in 2014 (Wang et al., 2016) and was forecasted to be 50 million tons in 2018 (Baldé et al., 2015). If not properly treated, WEEE can pollute the soil and groundwater with hazardous substances, such as lead-based solder, arsenic, and selenium, which pose threats to human health and the environment. Meanwhile, some categories of WEEE (e.g., used computers, cell phones, LCD monitors) contain many precious metals, such as gold, silver, copper, and iron, and this metal content is worth much more than the raw ore. Recycling one ton of cell phones would recover 40 times as much gold as mining one ton of raw ore (Hunt, 2013). In order to reduce the influence of WEEE on the environment and improve the utilization of resources, many

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