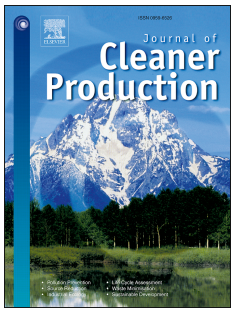
# Accepted Manuscript




Global Reverse Supply Chain Redesign for Household Plastic Waste under the Emission Trading Scheme

Xiaoyun Bing, Jacqueline Bloemhof-Ruwaard, Amin Chaabane, Jack van der Vorst

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# Global Reverse Supply Chain Redesign for Household Plastic Waste under the Emission Trading Scheme

**Abstract**

With increasing global resource scarcity, waste becomes a resource that can be managed globally. A reverse supply chain network for waste recycling needs to process all the waste with minimum costs and environmental impact. As re-processing of waste is one of the major sources of pollution in the recycling processes, a mechanism is needed to control and reduce the emission impact in the re-processing as a key to facilitate the globalized reverse supply chain and avoid spreading pollutants overseas. Emission Trading Schemes (ETS) can function as policy instruments for controlling emissions. The ETS introduces a trade-off between the economic efficiency and the environmental impacts. ETS has been implemented in Europe and is developing rapidly in China too. The aim of the research is to re-design a reverse supply chain from a global angle based on a case study conducted on household plastic waste distributed from Europe to China. Emission trading restrictions are set on the processing plants in both Europe and China. We modeled a network optimization problem using integer programing approach, allowing the re-allocation of intermediate processing plants under emission trading restrictions. Optimization results show that global relocation of re-processors leads to both a reduction of total costs and total transportation emission. ETS applied to re-processors further helps to reduce emissions from both re-processing and transportation sectors. Carbon cap should be carefully set in order to be effective. With a given carbon cap, the model also shows the effective carbon price range. These results give an insight into the feasibility of building a global reverse supply chain for household plastic waste recycling and demonstrate the impact of ETS on the network design.

**Keywords:** sustainability, reverse logistics, emission trading scheme, global supply chain, plastic recycling

## 1 Introduction

Recycled plastic can be used in industrial manufacturing to partly replace virgin plastics. The basic raw material for plastic is naphta, a distilled fraction from crude oil. Common 'second life' applications for recycled plastic packaging materials include fleece clothing, strapping, sewage