Design of Electronic Waste Recycling System in China

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Summary. After years of rapid economic development, China is calling for development of a circular economy and resource recycling, to solve both the resource shortage problem and the environmental problems. Based on the analysis of the current status and the challenges of the electronic waste (e-waste) recycling in China, this paper seeks to design a financially feasible and environmentally safe e-waste recycling system. An integrated assessment model is proposed, in which the environmental, social and economic impact of recycling scenarios can be assessed simultaneously. The economic impact can be derived from an optimization model for the reverse logistics network.

1 Introduction

As a resource-poor country, China's rapid economic development has caused resource depletion and environmental problems. The conventional linear economic growth model, relying on large scale of resource consumption, has to be changed to resource-saving growth model, which focuses on resource recycling and recovery.

E-waste, comprising 8% of municipal waste, is one of the fast growing waste fractions [8]. The total volume of e-waste generated domestically in China is huge. More severe threat comes from the rapidly increasing amount of imported e-waste. More than 70 % of the e-waste of the United States goes to China [4].

E-waste refers to discarded appliances, such as TVs, PCs, air conditioners, washing machines, and refrigerators, as well as a variety of associated waste products, such as electrical wiring, printed wiring boards (PWBs), and batteries. E-waste contains five categories of materials: ferrous metals, non-ferrous metals, glass, plastics and others. Over 60 % of e-waste is composed of metals such as iron, copper, aluminium, gold and other metals.

The e-waste recycling is becoming a profitable business opportunity, in which valuable materials can be recovered and reused as a favorable resource for the economic development. 2.7% of the e-waste are pollutants including hazardous materials such as cadmium, mercury and lead. In the current e-waste recycling system, the

valuable components and materials of the appliances are extracted by manual disassembly and open incineration, while the remainder is dumped. Such unregulated and risky processing of e-waste has resulted in health problems and deterioration of air, water and land quality [7].

The objective of this paper is to design an e-waste recycling system based on EPR[1]. An integrated evaluation model and an optimization model for the e-waste recycling network are proposed.

2 The Status and Problem of the Chinese E-Waste Recycling

2.1 Characteristics of China's E-Waste Recycling Practice

E-waste is considered as a resource and income generating. Many urban and rural poor make their living by recycling e-waste. E-waste recycling in the unregulated profit-driven informal sector has caused human and environmental risks. The fast increasing volume of e-waste, chiefly due to illegal import, has been beyond the existing processing capacity.

2.2 Challenges Facing China's E-Waste Recycling Industry

To solve the problems, one well-regulated and environmentally sound recycling system has to be established. Three major obstacles are:

1. How to get sufficient e-waste to recycle?
   The formal recycling enterprises are competing for the e-waste stream with the extensive informal recyclers, which adapt well to the e-waste market. Buying e-wastes from the consumers means a financial burden on them.
2. How to finance the e-waste recycling system?
   According to the WEEE ordinance, producers will be responsible for the take-back, recycling and disposal of e-waste. But the Chinese producers will be concerned about their competitiveness and profit.
3. Pressure from legal regulations
   The products exported to EU have to meet the environmental requirements according to EU WEEE and RoHS Directives [4]. The Chinese regulations are far from elaborate and their enforcement is lax.

All these challenges are related to the informal recycling practice, which continues to prosper. The key issue is to incorporate it into the regulated system.

[1] EPR is defined as an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of the product's life cycle, including its final disposal [5].