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Comparison of Informal and Regulated WEEE Collection Methods in China

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Abstract. This paper explores Waste Electronic and Electrical Equipment (WEEE) collection in China based on an open-ended interview among 14 housholds, in an attempt to demonstrate the role of various informal and formal stakeholders can be managed during the innitial stage of recycling, WEEE collection. In relation to the complex e-waste recycling system based on informal collectors, a comparaison between formal and informal collection methods has been done in order to get a better understanding of e-waste collection and dismantling infrastructure. In the discussion section, informal collection and regulated trade-in with retailers is compared as the two representations of informal and formal collection means. Suggestions are proposed on how to improve WEEE collection methods through recognising and incorporating the roles of the formal and informal WEEE collection sector.

Keywords: WEEE; Formalizing, Informal collector, Recycling system, Management

1. Introduction

During the last decade, China has become the largest manufacturer of electrical and electronic products in the World. In parallel, local consumption of consumer electrical and electronic products has risen dramatically. From 1993 to 2003, the number of PC (Personal Computers) users in China increased 1052% whilst the average growth all over the world was much lower, at 181% (Streicher-Porte, 2005). Similarly, the number of mobile phone users in China has jumped to 740 million in 2010 (CCID, 2010). Consequently, enormous amounts of electrical and electronic equipment waste (hereinafter referred to WEEE or e-waste) has rapidly increased and far exceeds the capacity for environmental sound collection and processing (Streicher-Porte, 2005). Statistics estimated by environmental researchers indicated that the items of EOL (end of life) equipment comprises of five large appliances (TVs, Refrigerators, Air conditioners, Clothes Washing Machines, and PCs) in China were 885 354 units in 2005, double by 2010, and to reach 2 820 000 units by 2020 (Liu., et al., 2006). Massive e-waste was generated in China and it will keep going up in the coming decades.

In view of the large e-waste generation and negative impacts caused by informal recycling, the Chinese government authorities have to face the challenge and try to intervene with formal collection methods. However, the mature recycling management models, which are widely applied in advanced industrialized countries, cannot be fully duplicated in China and likely to be of limited successes because WEEE recycling in China is essentially based upon the illegal handling of e-waste by the informal sector (Martin and Geering, 2010). Although informal sectors have higher collection rates, the subsequent dismantling and processing methods have led to adverse impacts to the environment and human health (Xing, et al., 2009). In addition, since informal sectors are running their businesses spontaneously, without authorized licenses or accountability, official data about the significance of their practices cannot be recorded, nor their contribution to recycling rates cannot be accessed and quantified. This is an important barrier to establish a sound WEEE recycling system in China (Yang, et al., 2008). Therefore, in order to improve the WEEE recycling system in China, it is necessary to investigate different collection methods and in particular the role of informal sector.

2. WEEE Collection Methods

The chain of WEEE recycling system in China is described as three subsequent stages, which are WEEE collection, WEEE sorting/dismantling and end-processing (refining and disposal) (Schluep, et al., 2009). Generally, WEEE collection is the process of gathering obsolete e-products from end users. WEEE dismantling and WEEE processing is the process of sorting and dismantling e-waste into sub-assembly and raw materials. It worth mentioning that WEEE collection is the essential first stage of e-waste recycling chain and thus determines the amount of e-waste that is available for downstream processing.

According to a review of WEEE collection systems, there are three categories of collections worldwide: producer collection, municipal collection and independent collection (Kang and M.Schoenung, 2005) (Terazono, 2010;Yoshida and Yoshida, 2009). Each of them involves several specific collection methods (shown in table 1). Producer and municipality collection categories, which are formal collection methods are widely applied in developed countries such as Switzerland, Germany, US and Japan (Kang and M.Schoenung, 2005;Yoshida and Yoshida, 2009) while less developed countries such as China and India are mainly composed of collection by independent informal sectors (Streicher-Porte, 2005).

Informal sectors are normally unregulated and illegal private operations that avoid paying tax and being monitored by the Chinese authorities, whereas formal collections are organized and supervised by producers or authorities. In China, there are mainly two independent collection systems, which are based on the informal collector and the trade-in collection. These two significant collection methods will be analysed in the next section to better understand how to optimize WEEE collection methods in China.

2.1. Informal Collection

Informal collection is the fundamental infrastructure in China and accounted for the largest portion among all the WEEE collection methods. A case study conducted in Beijing, in 2006, revealed that nearly 94% of 428 respondents recycled their e-waste through informal collectors (Liu., et al., 2006). Another study investigated in Beijing in 2005 among 1100 respondents, also suggested a significant proportion of informal recycling, with a percentage of 57%. Many studies indicated informal collector is the most significant collection method in China (Martin and Geering, 2010;Yang, et al., 2008;Zeng, et al., 2010). Although the percentage of informal collector varies in different case studies, this dominated collection method is a pervasive means for consumer and provides large quantity of e-waste for downstream toxic contaminants.

In order to better understand the informal recycling, a pilot study at Tsingtao will be introduced comparing with the informal collection. The national WEEE pilot study was conducted in Tsingtao, which aimed to set up a collection network under supervision. State of art equipment and advance technologies for e-waste treatment had been settled in the national recycling plants and large financial investment inputted to maintain these equipment, However, insufficient WEEE could be collected by regulated means even though pilot project collection provided higher collection price to end users (Yang, et al., 2008). Additional costs incurred for the “payment to the owner” and “transport cost” in the pilot study, which cost are much higher than the informal collectors’ (Yang, et al., 2008). Informal collectors save a lot of expenses through individual collection, transportation and recycling, and therefore earn more benefits than regulated collection in this pilot study. It can be concluded that WEEE collection rate is hard to improve by simply raising the economic reward. It is necessary to understand why the informal sector is so successful in its collection rates from end-users and how to improve the mechanisms above the informal collection, with in an accountable and regulated environment.

An open-ended interview study was conducted among 14 households in four cities (Beijing, Shanghai, Tianjin, Xi’an) in China. The discussion topics included households’ attitudes and experiences towards informal collection and trade-in with retailers.

From the perspective of the households, informal collection means offer several advantages compared to formal collection systems. **I)** Accessibility. There is no accurate figure on the number of such collectors in China because collectors are not registered. A rough estimation is that there are about 5000 informal WEEE collectors in Beijing (European Communities, 2006). Therefore, it is easy to find a collector around local communities, commercial districts, or shopping centres. **II)** Door-to-door service. Collectors can collect e-

waste from home, which is a convenient choice for consumers especially with heavy household appliances. **III)** Time of transaction. Compared with the regulated collection, informal collection saves a great deal of time from the simple procedure and quick transaction. **IV)** Quick cash. Although trade-in with retailers may result in a better deal for consumers upon purchasing new e-products, many consumers are inclined to choose the immediacy and convenience of cash offered by informal collectors (Zeng, et al., 2010).

In spite of the higher collection and recycling rates achieved by the informal collection, there are also several disadvantages not only from the perspective of households, but also from social aspects. **I)** Uncertain security for the consumers' safety and belongings. Although door-to-door collection provides convenient service, home visitations by strangers without business licenses may be dangerous. **II)** Unregulated e-waste disposal and processing results in downstream adverse impacts to the environment and to human health. **III)** Since informal collectors do not record data about the quantity and categories collected, there is insufficient data for further research on WEEE recycling systems. **IV)** Informal collection operates as a black economy is outside of normal financial regularly systems.

2.2. Trade-in with Retailers

Trade-in is a new Chinese national policy for formally collecting e-waste that achieved certain success. In order to compete with informal collection and establish a regulated WEEE recycling system, the government launched a scheme that encouraged consumers to return their EOL e-products by means of retailers. Under this policy, consumers can get discounts when purchasing new products under the arrangement of trade-in. When the trade-in pilot scheme launched in Tianjin at 2009, 35.5% of 461 local respondents had trade-in experience in the first year (Yao, et al., 2009). Consequently, after the initial partial trail of project, the Chinese government has extended the "trade-in" policy to the whole country in 2010. Until February 2011, 134 million items of household appliances have been collected under the scheme (MOFCOM, 2011). Financial support from the Chinese government for the scheme is 32 billion Yuan subsidy (approximately 5 billion US dollars) (MOFCOM, 2011). Despite this trade-in scheme was suspended at the end of 2011, some features could be used for establishing regulated collection method.

There are two procedures (MOF, 2009) in the "trade-in" scheme in China (fig.1). Firstly, consumers need to make an appointment with a collection company. Then, the collection company will offer a door-to-door collection and a trade-in voucher. In addition to the voucher, there is also a collection compensation to the consumer. Secondly, consumers need to fill a subsidy application form combined with a Photo ID before purchasing new electrical products from designated retailers. Consumers can eventually get a maximum subsidy of 10% discounted of the new item.

Since China cannot fully duplicate the international models for WEEE management, Chinese trade-in policy varies from the ones in developed countries (EU, US, AU, and Japan) in the following aspects: **I)** It provides doo-to-door service by collection companies. This is a superior advantage to informal collection means in terms of the guarantee of safer service from licensed collection companies. **II)** As illustrated in fig.1, consumers can get double compensations (shown in dotted line), in the form of the discounts from retailers, and the cash reward from the collection companies. **III)** WEEE collection and financial reimbursement is organized and managed by the government authorities while in advanced countries, it is often organized by retailers and producers (PHA Consulting Associates, 2006). **IV)** The Chinese government sponsors the trade-in policy whereas in many other countries, trade-in is organized and financial supported by producer or retailers, rather than the government.

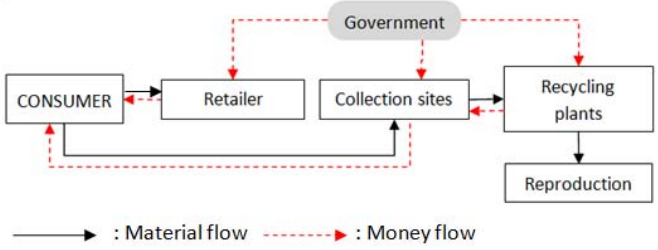

Fig. 1: Material and money flow of trade in with retailer in China

From the differences in retailer collection between China and advanced countries, it can be concluded

that the success of this pilot strategy contributes to the improvement of the original trade-in model based on Chinese informal collection. However, since trade-in scheme still in its first stage, there are some disadvantages could be improved. These are as follows: **I)** Complex procedures. From the procedures of trade-in policy, four documents (voucher from collection company, subsidy application form, receipt of new item and photo ID) are needed. Compared with informal collection, trade in is time consuming. **II)** The list of trade-in is short. Within the initial stage of trade-in, only five categories of large appliances (TV, Refrigerator, Air condition, Washing machine, and PC) are included in the trading list. Many other e-waste also with huge generation amount have not included in this trade-in scheme. **III)** Limited number of trading. Consumers cannot trade-in more than 5 times with the same identify card, which is a measure to avoid cheating to some extent. As well as being a limitation, it is also causing troubles for the consumers who want to replace more obsolete products. **IV)** Cheating exists among retailers. This happens in the form of stealing customers' information, done by unscrupulous retailers in order to promote their products to the consumer who are ineligible to get subsidy. **V)** Huge amount of subsidies for the Chinese Government. There are three subsidies (the transportation fee for collection companies, recycling fee for recycling companies, and subsidy to consumers' discount) (fig.1) released by the Chinese Government to different sectors during trade-in, which cause severe financial burdens [20].

3. Conclusion and Suggestions

From the comparative analyses of two different collection methods, it can be concluded that informal collectors have attractive advantages for the consumer, particularly concerning time saving. By contrast, the trade-in scheme has complex procedures, although they ultimately provide more compensation. Despite this, as living conditions are improving, many Chinese consumers do not regard financial rewards as the most important factor. Convenience of the transaction is often more important. Therefore, it seems necessary for the government to improve the trade-in strategy and shorten the steps of the transaction. At the same time, the Government could benefit by learning from well-advanced WEEE management models elsewhere and bearing in mind the unique conditions that exist in the Chinese WEEE market.

In addition, there is an obvious flaw in the WEEE management of electronic waste disposal in China. Many types of electronic products, such as mobile phones, computers and mp3s, etc., are not on the trade-in list but represent a significant proportion of product obsolescence. Many households have to resort to using informal collectors. Therefore, it is urgent to explore a formal collection method that not only include a longer list of e-waste categories, but also incorporate the services of the informal collection sector in a more accountable and regulated WEEE recovery and recycling system.

Bearing in mind the failure of the Tsingtao pilot projects mentioned earlier, competing directly with informal collection systems is unlikely to succeed. Additionally, the cheap labour and low-carbon transportation offered by informal collectors, which are among the main reasons that lead to the negative results in the national pilot project, could be better utilized by the Chinese Government. Hence, providing informal collectors with the means to minimize subsequent environmental damage will be easier than to compete directly with them. How to guide informal collectors towards the formal recycling plants is the research question that needs to be investigated further.

There is obviously a lot to learn from European (US, Germany, Switzerland, Netherland) and U.S. about WEEE management such as EPR (Extended Producer Responsibility) that provide financial support and the regulatory framework for WEEE collection and processing (Hischier and P. Wa¨ger, 2005). However, China is unique due to its massive manufacturing base, drastically growing consumer base and established on informal WEEE collection sector. Despite its many shortcomings, the informal sector offers WEEE regulators a model of high product recovery rates and convenience to consumers. The challenge for WEEE regulators is how to harness the strengths of the informal collection sector and incorporate it into a more accountable and regulated system of e-waste collection. As a result, the Chinese government has to explore more inclusive strategies such as trade-in pilot projects that combine the advantages offered by the informal sector. So rather than compete with the informal collection sector, the Chinese Government should preserve its advantages and seek solutions to improve the disadvantages inherent within the informal collection sector.

Furthermore, EPR mechanisms should be clearly defined through developing a hybrid system by recognizing and incorporating the informal sector.

4. References

[1] M. Streicher-Porte, R.Widmer, A. Jain, H-P. Bader, R. Scheidegger, S. Kytzia, "Key drivers of the e-waste recycling system: Assessing and modelling e-waste processing in the informal sector in Delhi," *Environmental Impact assessment Review,* vol. 25, pp. 472-491, 2005.

[2] CCID, Net,. (2010). *Mobile phones users in China in 2010*. Available: http://comm.ccidnet.com/art/1537/20090630/1812911_1.html

[3] X. Liu., M. Tanaka., and Y. Matsui., "Generation amount prediction and material flow analysis of electronic waste: case study in Beijing," *Waste management & research,* vol. 24, 2006.

[4] S.-p. Martin and A.-C. Geering, "Opportunities and threats of current E-waste collection system in China: A case study from taizhou with a focus on refrigerators, washing machines, and televisions," *ENVIRONMENTAL ENGINEERING SCIENCE,* vol. 27, 2010.

[5] G. H. Xing, J. K. Y. Chan, A. O. W. Leung, S. C. Wu, and M. H. Wong, "Environmental impact and human exposure to PCBs in Guiyu, an electronic waste recycling site in China," *Environment International,* vol. 35, pp. 76-82, 2009.

[6] J. Yang, B. Lu, and C. Xu, "WEEE flow and mitigating measures in China," *Waste Management,* vol. 28, pp. 1589-1597, 2008.

[7] M. Schluep, C. Hagelueken, R. Kueh, F. Magalini, C. Maurerc, C. Meskers, E. Mueller, and F. Wang, "Recycling from e-waste to resources- Sustainable innovation and technology transfer in dustrial sector studies," United Nations Environmental Programme, United Nations Univeersity2009.

[8] H. Kang and J. M.Schoenung, "Electronic waste recycling: A review of U.S. infrastructure and technology options," vol. Resource, Conservation and Recycling, pp. 368-400, 2005.

[9] A. Terazono, "Management of E-waste and mixed metal scrap: current issues and future tasks," *South Pacific Regional E-waste Workshop (ewaste2010) Sofitel Hotel, Brisbane, Australia,21 July 2010,* 2010.

[10] F. Yoshida and H. Yoshida, "Japan, the European Union, and waste electronic and electrical equipment recycling Key lessons learned," *ENVIRONMENTAL ENGINEERING SCIENCE,* vol. 27, 2009.

[11] Y. Zeng, J. a. Luo, and Y. Lai, "Dismantling Industrial Chain of Electronics Waste-Study report of industrial chain of electronics waste recycling and disposal and public survey in Guangzhou," Green E-waste Guangzhou, Guangzhou05 June, 2010 2010.

[12] European Communities, "Implementation of the Waste Electric and Electronic Equipment Directive in the EU," European Commission,Directorate-General Joint Research Centre,institute for prospective technological studies2006.

[13] C. Yao, Q. Tian, X. Chen, Y. Chen, Y. Huang, W. Liang, and T. Chen, "Current situation of e-waste recycling system in China- A case study in Tianjin, China," *Resource and Science,* vol. 5(20), 2009.

[14] MOFCOM, Ministry of Commerce of the People's Republic of China. (2011). *Collection from Retailer supported by Chinese Government*. Available: http://www.mofcom.gov.cn/

[15] MOF, Chinese Ministry of Finance, "Trade in measures for the implementation of Waste of household appliances " Chinese National Ministry of Finance, Commerce Departement of Chinese Government, National Development and Reform Commission,Ministry of Information Industry, Beijing2009.

[16] PHA Consulting Associates, "ELECTRONIC WASTE RECOVERY STUDY," Resource Recovery Fund Board2006.

[17] R. Hischier and J. G. P. Wa¨ger, "Does WEEE recycling make sense from an environmental perspective?The environmental impacts of the Swiss take-back and recycling systems for waste electrical and electronic equipment (WEEE)," *Environmental Impact Assessment Review,* vol. 25, pp. 525-539, 2005.