

# The Exploring of Electronic Waste Recycling in Chongqing

Haojie Xu, Qiancheng Wei, Yuxin Liu

Chongqing University, Chongqing, China

Chongqing University, Chongqing, China

Chongqing University, Chongqing, China

1542416299@qq.com, 2609418767@qq.com, 714287765@qq.com

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**Abstract.** As a resource, electronic waste has considerable recycling value, while with the high requirements of recycling technical, if e-waste is not properly handled, the resource would become a hazard. As the largest developing country in the world, China will be one of the largest producers of electronic waste because of its extensive use of electronic products [1], but the recycling of electronic waste is still a problem that has not been completely solved. In order to solve the problem caused by electronic waste, Chinese government has promulgated relevant laws, and many scholars have given their insights to solve such a problem. By on-the-spot investigation, combined with the theoretical research of predecessors, this paper tries to find out the crux of the difficulty in recycling electronic waste in Chongqing, a fast developing city of China. At present, the recycling rate of electronic waste in Chongqing is lower than developed countries and the recycling procedure is not standardized, which are caused by many reasons. Therefore, it needs the participation of governments, enterprises and citizens to solve the problems of electronic waste recycling in Chongqing.

## 1. Introduction

Electronic waste, as its name implies, is a phased-out product of electronic products. The definition of electronic waste in *Measures for the Prevention and Control of Environmental Pollution by Electronic Waste* is: waste electronic and electrical products, electronic and electrical equipment and its waste spare parts, components, and articles and substances that are included in the management of electronic waste stipulated by the State Environmental Protection Administration in conjunction with relevant departments. From the point of view of resource recovery, most of the electronic waste contains numbers of precious metals, such as gold, silver, chromium, nickel, etc. [2], but if these heavy metals can not be properly treated, they will also do harm to the environment [3]. Therefore, it is necessary to effectively recycle electronic waste and properly dispose of electronic waste.

With the development of economy and the improvement of living standards, electronic products are becoming more and more popular in Chongqing. In recent years, the holdings of electronic equipment in Chongqing continue rising, as a result, the waste rate stays in a high position without going down. At present, the average annual growth rate of refrigerators and air conditioners in Chongqing is 55.04% and 20.55%, respectively. In the future, they will continue to grow at a higher or fluctuating speed. TV sets and washing machines will respectively reach their peak values in 2022 and 2023 [4]. In order to cope with the problems caused by the rapid growth of electronic waste, Chongqing implemented the qualification admission system for electronic waste treatment in accordance with the relevant provisions of *Regulations on the Recycling and Treatment of Waste Electrical and Electronic Products*. In addition, *the Chongqing Municipal Domestic Waste Recycling Management Measures* was promulgated to include electronic waste in recyclable garbage, so as to avoid citizens disposing of electronic waste at will. At present, the electronic waste treatment links in Chongqing include electronic waste recovery, disassembly, incineration and landfill. The recycling link is mainly the responsibility of mobile recyclers and individual recyclers; the dismantling link includes both small and medium-sized enterprises and large enterprises, and the

last two links are completed by enterprises qualified for electronic waste disposal. Although this link is complete, the recovery rate of electronic waste in Chongqing needs to be improved. In 2017, the discarded amount of electronic waste physics theory in Chongqing was 185400 tons [4], but according to *the environmental Bulletin of the Ministry of Ecological Environment of Chongqing in 2017*, only 571700 units were discarded [5]. The causes of this problem are various. There are not only imperfections in the system, but also problems in the implementation of the system, and the difficulties of each participant in the recovery link are also different.

## 2. Difficulties of participants in recycling

The recycling mode of electronic waste in Chongqing is relatively traditional and primitive, and it is not easy to be changed in a short time, which is also the common problem of most cities in China. Chongqing, as a rapidly developing city in recent years, has the characteristics of both old and new cities. Therefore, researching the recycling mode of electronic waste in Chongqing is equivalent to researching the recycling mode of electronic waste in most cities of China. This chapter analyses the dilemma of the recycling chain of electronic waste in Chongqing, including citizens (e-waste generation), recyclers (including individual recyclers and mobile recyclers, initial recycling) and enterprises (disassembly and disposal). Through field visits and investigations, the following questions are tried to answer:

1. The status of recycling and utilization of electronic waste.
2. Problems in the recycling and utilization of electronic waste.

### 2.1 Citizens

As a developed city, Chongqing has a fast growth rate, while its management of electronic waste remains to be improved. From the national point of view, the recovery rate of electronic waste in China reached 35% in 2014 [6], which was close to the level of developed countries and regions like Europe and the United States. In Chongqing, although there is no official recovery rate, according to the field survey of residents, many electronic waste has not been recovered in time and effectively.

First of all, the residents' awareness of recycling is not strong. Whether mobile phones that are easy to carry or refrigerators which are not easy to handle, most residents do not take the initiative to deal with them. The main reason is the imperfection of the recycling system. Traditional recycling is time-consuming and laborious, and the price of recycling is low. For some young people who pursue a fast pace, it is difficult to stimulate their enthusiasm for recycling. Although some large enterprises have the activity of replacing old ones with new ones from time to time, this activity has not been established in a fixed form. In this way, residents have limited options for recycling.

Another problem is that residents are worried about privacy leaks. At present, there is no data erasure standard in China's telecommunication electronic equipment [7], which makes it difficult for residents to trust recyclers of electronic waste, especially for mobile phones and computers, which store personal information. Once these information is illegally collected by others, it will pose a threat to residents' property, which makes residents very uneasy.

In *the Chongqing Municipal Solid Waste Classified Management Measures* implemented on January 1st, 2019, electronic waste equipment was included in the recyclable category, and residents who misplace domestic waste would be fined. This regulation is of great significance for the correct collection of small electronic waste, but in most residential areas of Chongqing, there is no standard garbage recycling equipment, which is still a traditional mixed recycling equipment. This situation of implementing the law without the conditions for its implementation has left many residents at a loss and made the law formalized. This also reflects the limited fulfillment of the responsibilities of Chongqing Municipal Government, which is not conducive to the relationship between the government and residents today when residents fully believe in the government.

## 2.2 Individual recyclers and mobile recyclers

Chongqing does not have a special recycling agency for electronic waste, which is similar to Zhengzhou and most other cities, and the recycling market is formed by spontaneous forces, so it is confused [8]. Generally speaking, individual recyclers engage in comprehensive recycling of recyclable garbage, including electronic waste. Individual recyclers are one of the main first-hand recyclers. Their shops are usually located in remote corners in old apartments. Most of the people who work in this field are over 40 years old and have a low educational background. Another first-hand recyclers of electronic waste are mobile recyclers, who operate in streets and alleys and engage in specialized e-waste recycling, unlike individual recyclers who have one fixed store. Every day, they look for vendors in every residential area of the city, and use loudspeakers to inform customers about their passing.

In the development of China in recent decades, the main recycling methods of recyclers have not changed greatly, but now, their development has encountered unprecedented difficulties, the main problem of which is low income. According to the data obtained from on-site visits, the monthly income of most recyclers ranges from 2000 to 5000 yuan. There are three main reasons for this problem.

First, the utilization rate of individual recyclers' resources is low. Because individual recyclers lack professional disassembly tools and skills, they only disassemble parts that are clearly accessible in value. For example, PCB contains 70% non-metals (including plastics, glass fibers, etc.), 16% copper, 4% solder, 3% iron, 2% nickel, 0.05% silver, 0.03% gold and 0.01% palladium, while less than 1% of the total weight of PCB concentrates more than 80% of its commercial value [9]. However, the way most recyclers use is very backward. Individual recyclers of electronic waste adopt a very primitive disassembly method for recycled electronic equipment: simple disassembly using hammers, pliers and other tools, and no further extraction of valuable raw materials, such as heavy metals. After disassembly, metals and nonmetals are simply screened and classified. Due to the backward working conditions, the loss and waste in the process of disassembly and classification are also very serious.

Secondly, because the garbage recycling industry relies heavily on the high recycling of waste, the inadequate amount of recycling makes the survival of the recycling station more difficult. At present, due to the large number of recyclers of electronic waste and the intensified competition, many individual recyclers choose to move to remote areas in order to reduce the pressure. However, the more remote the place, the less people know, the less waste be recycled, and eventually fall into the vicious circle of the quagmire. In addition, poor information and single recovery channel are also the reasons for the low recovery rate. Because most of the recyclers are middle-aged people and have limited knowledge of modern Internet technology, most of them rely on e-waste owners to sell into their stores to obtain e-waste. Most recyclers do not use online and on-site recycling at the same time. There are obvious shortcomings in information acquisition and recycling efficiency: the buyer is not clear about the seller's needs, and in most cases has to wait for the seller to come to the store. In the process of recycling, they are in a passive position, and information acquisition is obviously lagging behind.

Third, the competition in the industry is disorderly, and large-scale recycling enterprises try their best to monopolize recycling. In the recycling market of electronic waste, large enterprises occupy a dominant position in many fields, such as information access channels, recycling methods, technology, and so on, and take use of their own advantages to occupy a monopoly position. For example, Chongqing Xinzhongtian Environmental Protection Co., Ltd. has signed a franchise agreement with Chongqing Development and Reform Commission, so the enterprise can obtain a lot of electronic waste from the government. In addition, in some public bidding projects for electronic waste recycling, due to the government bidding is not standardized, or even lack of bidding links, some even qualified bidders are treated unfairly.

To sum up, the current situation of individual recyclers is very serious. Their incomes are generally low, their technological level is backward, and the competition pressure in the industry is high, which is squeezed by large enterprises.

### 2.3 Dilemma of enterprises

In Chongqing, the difficulty of dismantling and dealing with enterprises still lies in insufficient economic benefits. Enterprises mainly deal with electronic waste, such as household appliances, computers and other digital products. These electronic waste mainly come from upstream enterprises, the government and small electronic waste recycling stations. They sell unwrapped or preliminarily disassembled e-waste to downstream enterprises, which then carry out a series of disassembly and refining of valuable components. After the dismantling of electronic waste, it can be divided into two categories: one is the part that can be used continually. Enterprises sell these as raw materials to enterprises, the other part is the part that can not be reused, the part that can not be reused will be burned. Because the incinerator can meet the requirements of direct landfill, the enterprise will landfill it. But the land is limited and the price is high. Although the waste generated after combustion is not harmful, it can be used as asphalt raw material, but because of the fear of harmful substances and harmful to human health, enterprises have no alternative but to spend a very high cost on landfill every year.

It is also very difficult to obtain financial subsidies for E-waste treatment enterprises. According to China's laws and regulations, the government will subsidize enterprises engaged in electronic waste treatment. Financial subsidies will be distributed to enterprises in different categories and in different quantities. Each e-waste dismantling needs to be monitored and controlled. Every important part of electronic waste can not be spared, otherwise subsidies can not be obtained. In addition, subsidies need to be reported to the State Council layer by layer, with the consent of the Chongqing Municipal Government, and then to the State Council. The period is long and the audit is strict. As a result, government subsidies may take two to three years to distribute to enterprises, but the e-waste recycling and disassembly industry needs a lot of financial support. If the government subsidy is in place slowly and the capital chain is broken, even large enterprises can hardly survive. This is a major problem faced by many electronic waste disassembly and disposal industries. Enterprises are in urgent need of financial subsidies, but subsidies are always lagging behind, making the current survival situation of many enterprises not optimistic.

### 3. Suggestions

In order to solve the problem of difficult recycling of electronic waste, various countries and regions have introduced methods suitable for their own national conditions. Successful measures often regulate the recycling process and the cost bearers of electronic waste disposal. Following is an introduction to the successful recovery experience abroad and the analysis of the existing recovery methods in China, so as to summarize the suitable recycling and disposal methods for electronic waste in Chongqing.

#### 3.1 Foreign experience

In developed countries, after long-term economic development, people pay more and more attentions to their own environmental problems. Several states in the United States, as well as Japan and South Korea, have their own unique recycling system. These systems provide direction for residents to recycle electronic waste, and find the bearer for the cost of recycling and disposal of electronic waste. In view of this, China's electronic waste can also start from these two aspects. Table 1 lists specific recycling situations in some developed countries and regions.

Table 1 Recycling Approaches in Some Countries and Regions of the World

Time	2003	2006	2015	2001	End of 20th century
Country/region	California	Maine	New York	Japan	Korea

Regulation and policy	<i>Electronic Waste Regeneration Act</i>	<i>Regulations on Harmful Waste Control</i>	Policy of "Electronic Waste Not Landing"	<i>Law on Promotion of Resource Conservation and Recovery and Utilization</i>	<i>Electrical and Electronic Products and Automobile Resource Circulation Act</i>
Concrete measure	Waste from all video display equipment sold in California is charged by retailers to consumers for disposal fees, which are handed over to the "e-waste recycling and reuse special account", which is managed by the California government and is used to cover government-authorized collectors and processors' fees, publicity and management costs.	Mandatory recycling of home TV sets and computer monitors. When recycling, the recycler also provides the number of video display devices collected, and the processor provides records such as processing and reuse costs.	People should not throw discarded household electronic products such as TV sets, computers, fax machines, printers, scanners, tablets, electronic card readers, computer keyboards into garbage cans or put them on the roadside. They should log on relevant websites, inquire about the time when the Municipal Cleaning Bureau regularly recycles electronic products in various districts, and bring electronic products to designated recycling points. Residents who violate this rule will be fined.	Waste household appliances are recycled at special recycling points set up by sellers and municipal governments. Waste household appliances will be sent to the waste household appliances recovery and treatment center which is responsible for by the manufacturer or its entrusted enterprise. Consumers have to pay transportation and processing costs, which flow to the processing enterprises. If consumers discard electronic waste at will, they will face high penalties.	A total of 29 categories of electronic products are regulated in the regulations. When a consumer purchases a new product in the management catalogue and returns a similar waste product, the manufacturer is obliged to recover and dispose of it and bear the relevant expenses; the local government or municipal department is responsible for the recovery and disposal of the electronic waste discarded by the residents.
Recovery liability bearer	California Integrated Waste Management Board	Producer	New York Municipal Government and consumers	Consumer	Producer and government
Processing cost bearer	Consumer	Producer	Government	Consumer	Government and consumer

### 3.2 Analysis of existing recovery methods in China

Regarding the recycling methods of electronic waste, there is a producer responsibility system at the institutional level in our country at present. The specific connotation of producer responsibility system is similar, but it is believed that producers should take ecological responsibility for the products they produce. The producer is responsible for the recovery, disposal and recycling of its products [10]. At present, there are two main ways to take responsibility in our country. Firstly, the production enterprises pay fees to the government, and then the government, together with its own finance, subsidizes the fees paid by the enterprises to the qualified recyclers [11]. Second, the enterprise recycles independently. But the implementation of these two methods has their own disadvantages. Firstly, there is no clear legal basis for enterprises to choose the two methods. That is to say, enterprises can choose recycling methods according to their own conditions. Then there is a possibility for enterprises to choose the most advantageous method for economic benefit rather than the most environmentally friendly one. Moreover, the government has not publicized the direction of the electronic waste recycling and disposal fees paid by enterprises, so whether this fee is really used in electronic waste disposal is unknown. In addition, as China's e-waste management model focuses on recycling valuable materials under strict pollution control policies, no alternative solutions such as maintenance, reuse and remanufacturing have been implemented, and the treatment of non-recycled materials has been neglected [12]. Finally, the enterprises that choose to recycle independently do not recycle all the products they produce, only part of the products are recycled independently, while the rest are ignored.

For residents, at this stage, the recycling of electronic waste in our country is in a spontaneous stage. Whether to dispose of electronic waste correctly and timely is voluntary. So it is necessary to

provide a convenient and fast recovery channel for residents.

### **3.3 Suggestions on recycling electronic waste in Chongqing**

As mentioned at the beginning of this article, although the recycling chain in Chongqing is complete, the main bodies of this chain are faced with their own problems. This problem is caused not only by the imperfection of the system design, but also by the implementation of the system. By drawing lessons from foreign experience and summing up domestic recycling experience, combining with the specific situation of Chongqing, this paper puts forward such methods as the application and improvement of science and technology, the standardization of recycling system, the improvement of producer responsibility system, and the formulation of incentive measures.

#### *3.3.1 Application and improvement of science and technology*

In view of the primitive and backward recycling methods of electronic waste in Chongqing, and the phenomenon of individual recyclers' inadequate information leading to the recovery rate, the government can establish an online platform to build a communication platform for recyclers and consumers, and create a convenient recycling environment. Shanghai's online order collection method is a good example.

Due to the lack of reuse and reconstruction of waste electronic materials in Chongqing, only the dismantled residues can be landfilled, thus increasing the expenditure of recycling enterprises. Recycling enterprises can cooperate with scientific researchers in Colleges and universities to explore the transformation methods of electronic waste and increase the benefits of enterprises.

#### *3.3.2 Standard Recovery*

The industrial chain of waste electrical and electronic equipment recycling is long, and there are many participants. It needs the guidance of the government, coordinates with multi-participants, and divides labor and cooperation. Electronic waste has complex structure and diverse components. Therefore, the disassembly and disposal of complex electronic waste should be done by specialized enterprises, while individual recyclers with backward technology should engage in recycling work and simple mechanical structure disassembly. In this way, it can not only improve the professional level of disassembly, but also avoid some enterprises unable to apply for financial subsidies due to the lack of parts in electronic waste. Due to the phenomenon of non-standard bidding, some recyclers have lost the chance of fair competition. Therefore, in public bidding recovery projects, the same level of competitors should be guaranteed the same opportunity to participate in bidding, and improve the transparency of bidding work. Moreover, many residents are afraid that personal information in the electronic waste will be leaked, so they are unwilling to deal with the electronic waste in time. The government can set up a unified data erasure standard, and require recyclers to register the personal information of residents when they recycle the electronic equipment containing their personal privacy, so as to provide clues for investigating and dealing with the privacy leakage. In view of the relevant provisions of the "Measures for Classified Management of Domestic Waste in Chongqing" implemented in January this year in Chongqing, the government should build public facilities in accordance with the principles of unified management and rational distribution, create conditions for residents to comply with the regulations and avoid the law staying on paper.

#### *3.3.3 Improving the Producer Responsibility System*

The forms of producer's responsibility established by the producer responsibility system in our country are various, but in addition, we should set standards for enterprises to choose the way of responsibility according to the principle of unification of economic and environmental benefits. The government should also make public the situation of enterprises' fees for disposal of electronic waste, disclose the direction of the fees, and improve the transparency of the work. The government should also require enterprises that choose to recycle independently to report regularly on the recycling situation and supervise the performance of their responsibilities. Because of the rapid renewal and large quantity of electronic waste, it is difficult to investigate the status quo of electronic waste recycling[2]. The government may require producers to code electronic equipment during production, which will facilitate monitoring and understanding the status of recycling [13].

### 3.3.4 Developing and implementing incentive Policies

Companies qualified for dismantling waste electrical and electronic appliances and included in the subsidy list of the Disposal Fund for Waste Electrical and Electronic Products are eligible to apply for fund subsidy according to the amount of dismantling compliance, but the phenomenon of delayed financial subsidy issuance is very common [14]. At present, two enterprises qualified to apply for subsidy in Chongqing are facing this problem. At present, because of cost and technology limitation, environmental protection enterprises have little profit and need timely financial subsidies. Therefore, the government should issue subsidies in time. In addition, we should not only consider preferential policies for dealing with enterprises, but also give some financial support to individual recyclers [2]. On the one hand, individual recyclers play a huge role in recycling urban renewable resources, and residents are accustomed to selling them recyclable garbage, including electronic waste. In addition, the government can also carry out simple recycling technology training and improve their working environment in order to retain an important part of urban waste disposal.

## 4. Summary

Through on-the-spot investigation to obtain important information that hinders the recycling of electronic waste it is found that the recycling rate of electronic waste in Chongqing is not high, and the recycling process is also chaotic. To solve the problem of recycling electronic waste in Chongqing, it is necessary to consider the plight of the participants, and it is also an important work to improve and implement the existing system. After referring to the experience of foreign countries, four solutions are put forward. These measures are to solve the problems of difficult recovery and irregular recovery, as well as the management problems of recyclers. How to further solve these problems remains to be further studied.

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