

# Recycling of Waste Electric and Electronic Products in China



Keli Yu, Heran Zhang, and Yunong Liu

**Abstract** This chapter mainly focuses on the development of waste electrical appliances and electronic products/waste electric and electronic products (WEEP) management in China and its key effects to circular economy. China has experienced 5 stages since the 1990s when the collection and disposal of WEEP started. By trying different ways to deal with WEEP, China has found the possible route to manage it. The article discusses the progress, achievements, and the status of WEEP management in China (including the categories, dismantling capacity & technologies, operational mode, reuse, environmental, and social influences). We provide case studies on Aihuishou (China's largest electronic products collection platform) and Guiyu (transformation of a well-known e-waste recycling town). China now is the country with the world's largest WEEP dismantling and disposal capacity. The recycling of WEEP is also a microcosm of China's circular economy.

**Keywords** Waste electric and electronic products (WEEP) · Policy · Management · Collection · Dismantling technique · Reuse · Effects

## Learning Objectives

- National policies on WEEP.
- China has experienced 5 stages on WEEP management.
- The annual dismantling capacity of the qualified national WEEP dismantling enterprises is about 152 million units.

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- The total dismantling quantity of WEEP of 109 qualified enterprises from 2012 to 2018 was 441,735,909 units.
- China's standard collection rate of WEEP has reached the international leading level.
- New collection modes of WEEP are emerging.

## 1 Introduction

China is a major producer, exporter, and consumer of electrical and electronic products. With the rapid development of the economy, the pollution of the environment problem has become increasingly severe, therefore, the Chinese government places great importance to the recycling and disposal of WEEP.

### Definition

**Waste Electrical and Electronic Equipment (WEEE):** The Regulations on Administration of Collection and Disposal of Waste Electrical Appliances and Electronic Products provides that “the Regulation shall apply to the recovery, disposal, and other relevant activities of waste electrical and electronic products listed in the Catalogue”. This means that a wide range of electrical and electronic products will have to be recycled and disposed of in accordance with the Regulation. These products listed in the Catalogue are TV sets, refrigerators, washing machines, air conditioners, and microcomputers.

**“Home appliances old for new” Policy:** Refers to the Chinese government has used government funds to encourage consumers to trade in old ones.

**Urban Mining:** The recyclable iron and steel, non-ferrous metals, produced and stored in the process of industrialization and urbanization in waste electrical and mechanical equipment, wires and cables, communication tools, automobiles, home appliances, electronic products, metal and plastic packaging and waste. Resources of rare and precious metals, plastics, rubber, etc., are used in an amount equivalent to that of primary mineral resources.

## 2 Development Process of Waste Electric and Electronic Products in China

### (1) Primary Stage

Since the 1990s, informal recycling of WEEP started in China. It was collected by small vendors and shipped to domestic electronic waste distribution centers, mostly to Guangdong and Zhejiang Province. At that time, illegal importing of waste electrical and electronic products was rampant, which lead to serious negative social and environmental impact [1–3].

## (2) The emerging stage of formal dismantling enterprise

After 2005, formal recycling companies began to appear in China, however, in general, the development of formal recycling companies was very slow due to the lack of collection channel, and some big companies also tried to build physical collection channels spontaneously. Companies like TES-AMM started their operation and provide recycling service for some electrical and electronic producers.

## (3) “Home appliances old for new” policy

From June 2009 to December 2011, the Chinese government implemented a policy named “Home appliances old for new” nationwide, which not only promoted the consumption of home appliances, but also incentivized the formal recycling of WEEE. The successful implementation of the policy has also improved the energy efficiency of household appliances, reduced environmental pollution, and recycled resources such as steel, non-ferrous metals, plastics, rubber, and other resources available for recycling, which is very important to developing a circular economy. During the period of “home appliances old for new” (June 2009–November 2011), more than 40 formal enterprises were officially established, and the amount of recycled waste home appliances added up to 83.733 million.

At present, Guangxi Province has implemented the “Home appliances old for new” policy again since last year. At the same time, some e-commerce platform, such as Tmall, [JD.com](http://JD.com), Pinduoduo, also have launched many “Old for new” promotion to stimulate consumers to trade in their used electrical and electronic products and buy new ones.

## (4) Construction of urban mining industrial parks

In 2010, in order to implement the “Circular Economy Promotion Law”, and promote the development of recycling industry, China’s National Development and Reform Commission and the Ministry of Finance initiated the construction of “urban mining industrial parks”. Seven regional recycling parks were selected for the construction of “urban mining” as the first batch for demonstration.

In these parks, waste electrical appliance recycling enterprises carry out the treatment and disposal of waste household appliances, and have achieved good treatment results. Up to now, a total of 49 “urban mining” industrial parks have been established nationwide.

## (5) “Regulations on waste electrical and electronic equipment Recycling and Treatment” and the implementation of financial subsidy scheme

From January 1, 2011, the “Regulations on Administration of Collection and Disposal of Waste Electrical Appliances and Electronic Products” came into effect. After the promulgation of the regulation, China gradually established a waste electric and electronic products recycling system, including planning, a funding scheme (funds collected from electrical and electronic product manufacturers including both

domestic and foreign, and distributed to the dismantling plants) for the disposal of WEEP and an audit management. Since the implementation of the Regulation, a total of 16 complementary regulations, regulatory documents and standards have been issued to govern the various stages of collection, treatment, and disposal of waste electrical and electronic equipment.

Since 2012, China has implemented a financial subsidy scheme for the disposal of WEEP. Funds are collected by the government from the producers/importers of electric and electronic products. WEEP are collected by producer or collectors and are dismantled by qualified dismantling plants (5 batches of 109 waste electrical and electronic products dismantling and processing enterprises were selected and listed as the qualified WEEP recyclers that can receive financial subsidy). Dismantling plants have to report the dismantling amount of WEEP per quarter, and the provincial department of ecological environment audits the report to confirm the data of dismantling outcome. After that, the Ministry of Ecological and Environment (MEE) has to further review the data and submitted the result to the Ministry of Finance (MoF). Finally, the Ministry of Finance will approve and appropriate funds to the audited dismantling plants (Fig. 1).

The dismantling volume of WEEP of 109 qualified enterprises from 2012 to 2018 is shown in Table 1. The implementation of the financial subsidy scheme has effectively standardized the disposal of WEEP and reduced their potential environmental risks (Fig. 2).

Since the implementation of the financial subsidy policy for WEEE, from 2012 to 2018, the dismantling products generated by the formal dismantling facilities have reached 7,552,600 tons, including iron and steel, recycled copper, recycled aluminum, and recycled plastics.

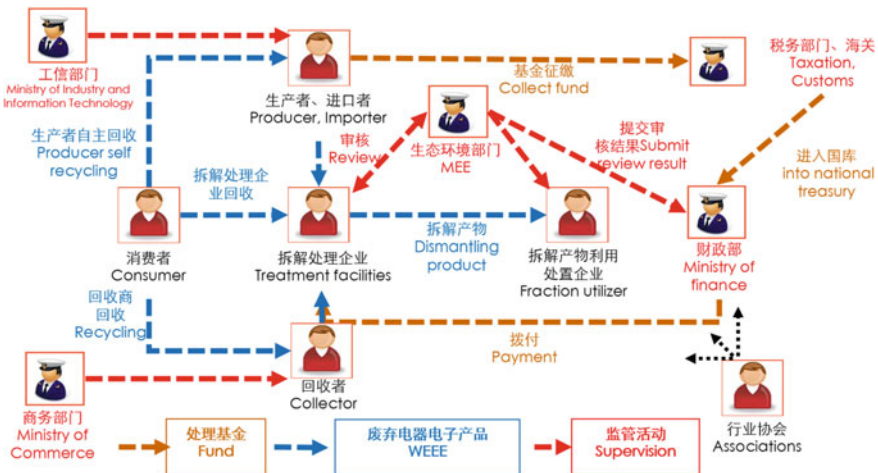
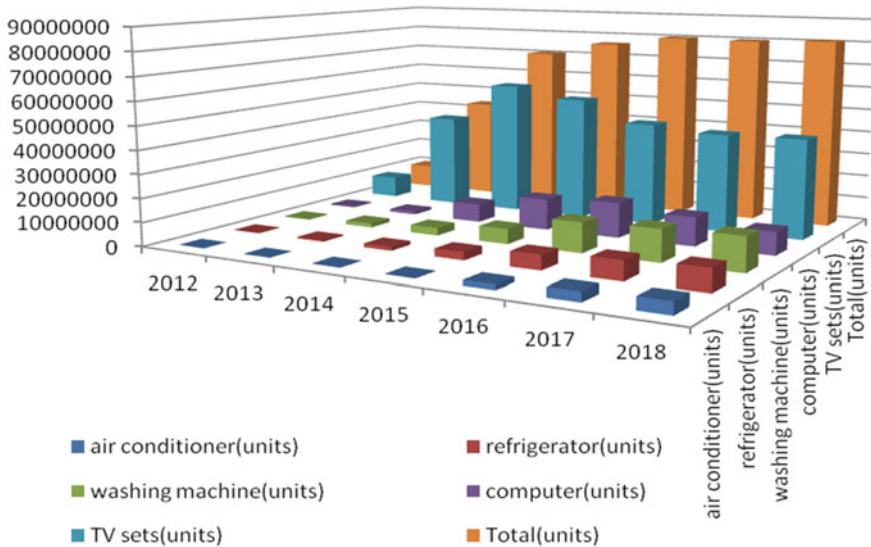


Fig. 1 Implementation of the financial subsidy scheme for WEEP disposal funds. MOC stands for Ministry of Commerce

**Table 1** The first batch of urban mining demonstration base

NO.	Name	Province/municipality
1	Tianjin Ziya Circular Economy Industrial Park	Tianjin
2	Ningbo Jintian Industrial Park	Jiangsu province
3	Hunan Miluo Circular Economy Industrial Park	Hunan province
4	Guangdong Qingyuan Huaqing Circular Economy Park	Guandong province
5	Anhui Shoutianying Circular Economy Industrial Park	Anhui province
6	Qingdao Xintiandi Vein Industry Park	Shandong province
7	Sichuan Southwestern Renewable Resources Industrial Park	Sichuan province



**Fig. 2** Dismantling volume of WEEE of 109 qualified enterprises from 2012 to 2018 (units)

Estimated by Xianlai Zeng [4], in 2018, the generation of WEEE (estimation only includes five kinds of WEEP including TV sets, refrigerators, washing machines, air conditioners, and computers) was about 9.981 million tons in theory, while the weight of WEEE treated by qualified facilities in China was nearly 2.006 million tons, the formal recycling rate of waste electrical appliances can be calculated as 20.1%.

The formal recycling rate = the weight of WEEE treated by qualified facilities/the weight of WEEE generation in theory \* 100%.

The implementation of the “Regulations on the Management of the Recycling and Disposal of Waste Electric and Electronic Products” and supporting policies have formulated detailed technical and management requirements for dismantling and disposing of waste electrical appliances, guiding them to carry out production



**Fig. 3** WEEP collection in community (Picture is from the following website. <https://new.qq.com/omn/20180619/20180619A1THLK.html>)

management in accordance with the relevant requirements for financial subsidies, and environmentally sound operations.

### Tip

Waste electrical and electronic products management in China has experienced 5 stages.

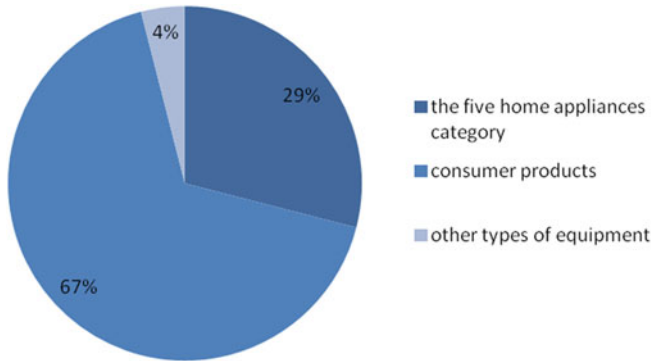
The total dismantling volume of WEEE in 109 qualified enterprises from 2012 to 2018 reached 441,735,909 units (Fig. 3).

### Case Study

#### The collection system of WEEE in Beijing

The construction of collection system is considered to be very important in promoting the recycling of WEEE in China. In 2017, Beijing has launched a pilot project of new WEEE collection system and several designated collection channels were selected as demonstration cases. In the first batch, there are five pilot types including.

1. sanitation enterprises rely on domestic waste separation and collection network recycling,
2. electrical and electronic product manufacturing enterprises rely on sales network recycling,
3. Electrical and electronic product sales enterprises “old for new” recycling,
4. recycling companies to expand the scope of services, and



**Fig. 4** Ratio of different kinds of WEEP in 1.09 million units

5. Internet companies “Internet + collection”.

13 companies were selected as demonstration cases by the government. According to preliminary statistics, in 2018, a total of 1.09 million units of various WEEP were collected by 13 pilot units, exceeding 16% of the planned volume.

Figure 4 shows the breakdown of different kinds of WEEP in the 1.09 million units. The five home appliances category include TV, air conditioner, washing machine, refrigerators, computers), consumer products include mobile phones, laptops, tablets, cameras, etc. and other types of equipment include printers, telephones, network equipment, etc.

In April 2018, these selected companies initiated the “Beijing Waste Electrical and Electronic Products Recycling Industry Alliance” to share information and resources, exchange experiences, and coordinate to solve common problems. With the active participation of industrial associations and pilot companies, the research and development work aimed at regulating WEEE recycling and forming relevant industrial standards has also started as planned.

**Key Points**

Beijing City, the first pilot city in China to launch the construction of formal WEEE collection system, conducted demonstration activities for the collection of waste electrical and electronic products and achieved good results.

**3 Status of Dismantling and Treatment of WEEE in China**

(1) Dismantling capacity

At present, the annual dismantling capacity of the major home appliances (TV sets, refrigerator, washing machine, air conditioner, computer) of the 109 qualified facilities is about 152 million units per year (Fig. 5).

The dismantling capacity by region is shown in Fig. 6, unit (million units).

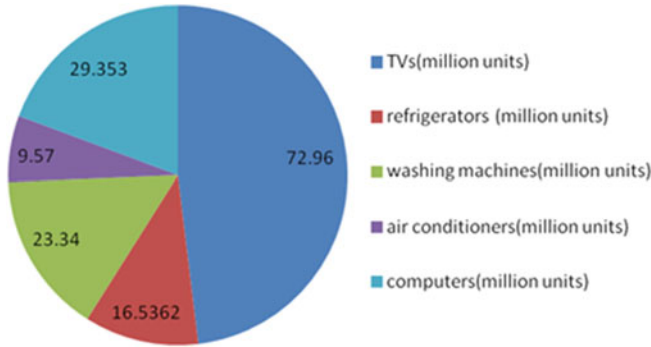


Fig. 5 The annual dismantling capacity of the 109 qualified facilities

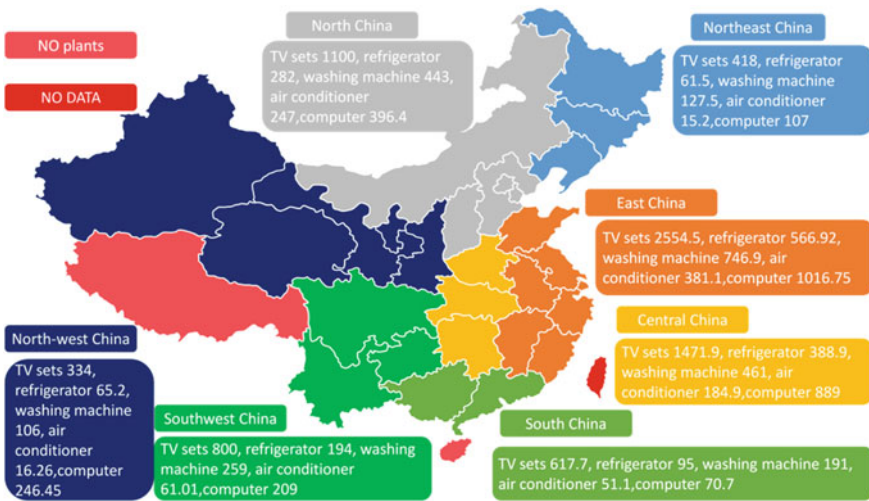
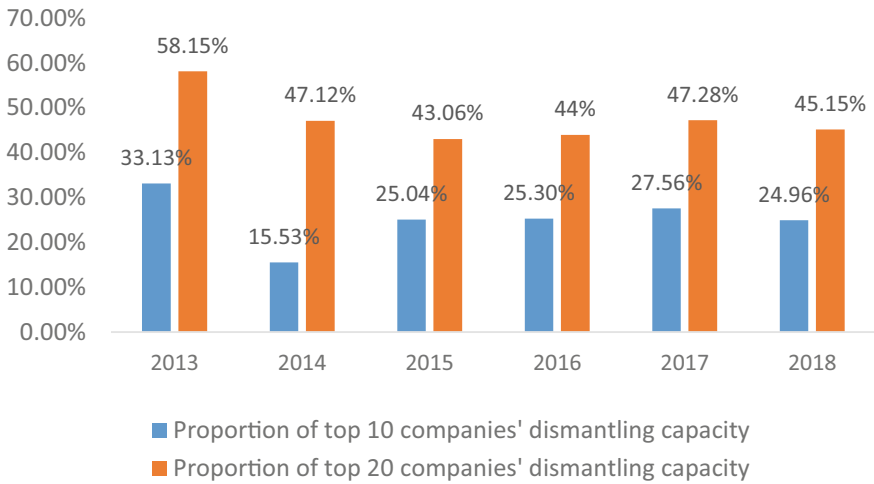


Fig. 6 The dismantling capacity by region in China

According to the annual dismantling volume of WEEP in the qualified facilities published by the Ministry of Ecology and Environment (MEE), relevant information on industrial development can be shown in Fig. 7.

In the past two years, WEEP dismantling enterprises show the phenomenon of polarization. The dismantling volume of large dismantling companies (mostly listed companies) with strong financial support and dismantling capabilities has continued to increase, while the dismantling volume of some small and medium-sized dismantling enterprises has dropped significantly.





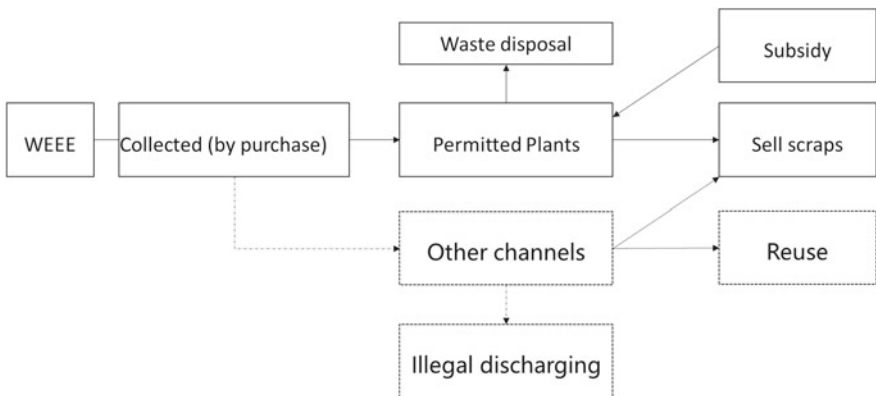
**Fig. 7** The proportion of the top 10/20 companies in total dismantling in 2013–2018

(2) Operational model

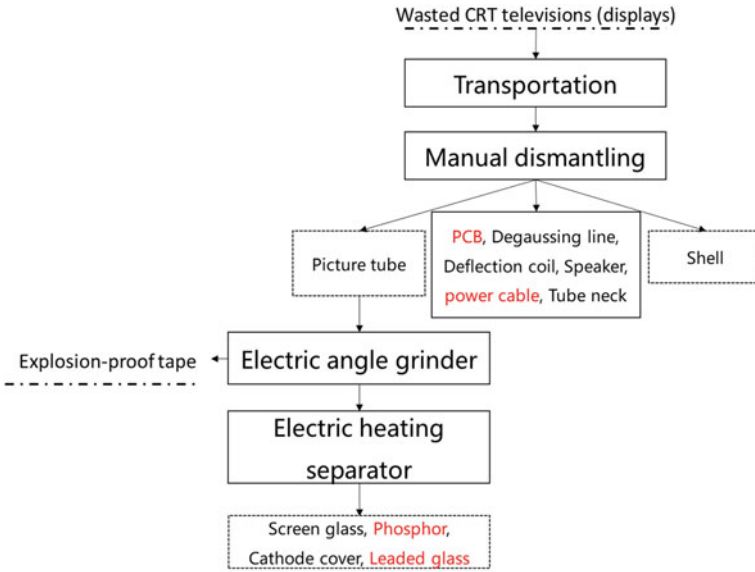
The basic model of China’s WEEE dismantling is shown as follows (Fig. 8):

(3) The categories and technologies of dismantling

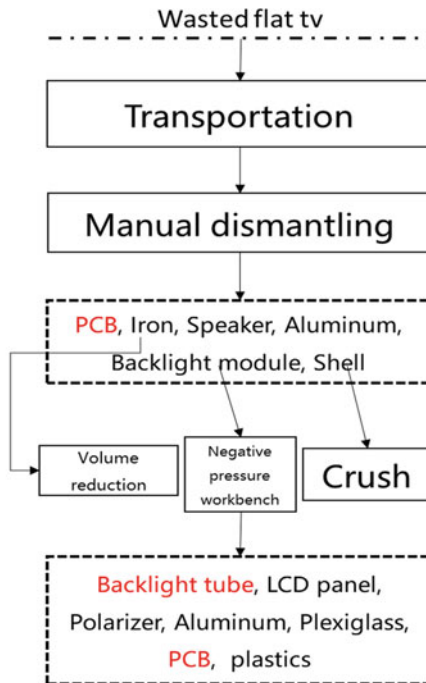
At present, the environmental-sound treatment and disposal of waste electrical and electronic products in China mainly aims at major home appliances. The dismantling process is shown as follows (Fig. 9):



**Fig. 8** Basic model of China’s WEEP dismantling

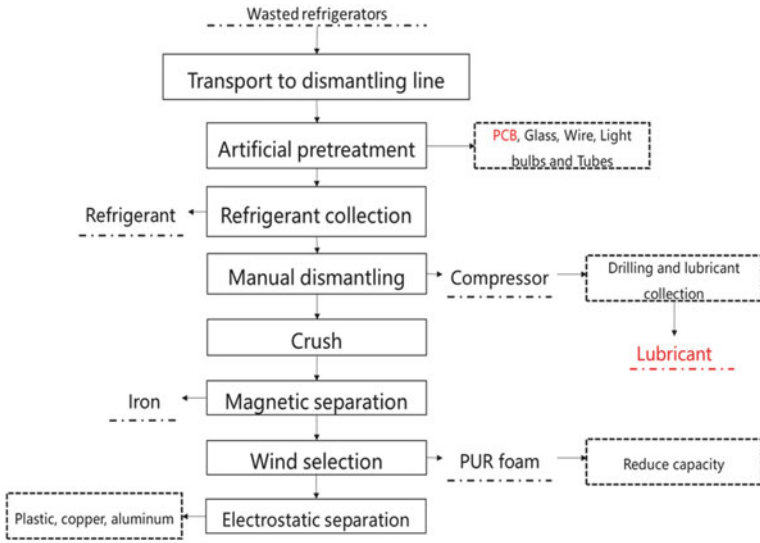


(a) Wasted CRT televisions (displays) dismantling

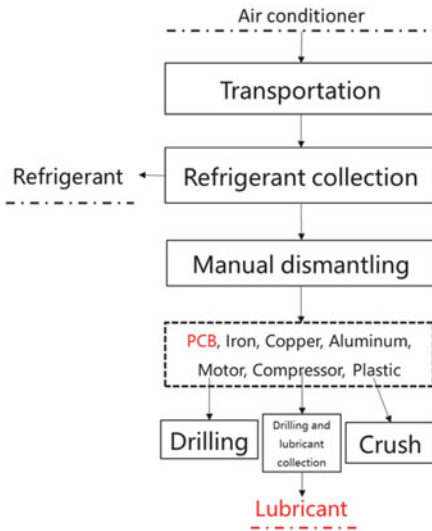


(b) Wasted flat TV dismantling

**Fig. 9** Dismantling process of wasted CRT televisions (displays), wasted flat TV, wasted refrigerators, wasted room air conditioners and wasted washing machines and dismantled products

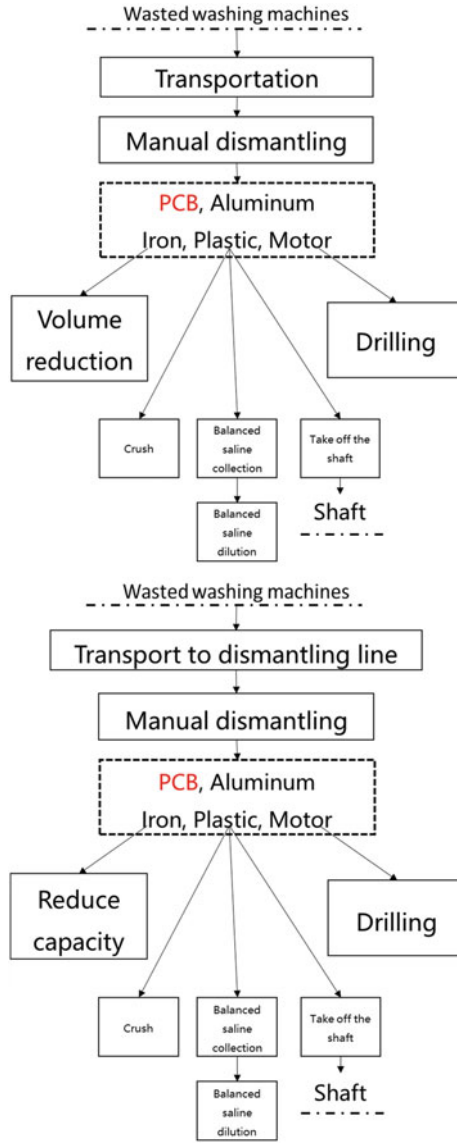


(c) Wasted refrigerators dismantling



(d) Wasted room air conditioners dismantling

Fig. 9 (continued)



(e) Wasted washing machines dismantling

Fig. 9 (continued)

Waste printed circuit boards (WPCB) are one of the key products in the dismantling process. The disposal of waste circuit boards is an important part of environmental protection. At present, the 109 qualified dismantling plants transport most of the WPCB and components to companies with qualifications for scrap circuit board disposal. The waste circuit board disposal technologies used by these qualified companies are mainly physical, thermal, and hydronic methods. In addition, some copper smelting companies are also developing WPCB disposal business.

In addition to the five categories of home appliances, according to the “Waste Electrical and Electronic Products Disposal Catalog (2014 Edition)”, there are nine new types of WEEP (printers, copiers, fax machines, monitors, range hoods, Electric water heaters, gas water heaters, mobile communication handsets, telephone) are also included in the treatment list, but there is no relevant policy to guild the disposal of nine new types of WEEP at present. In addition, for small household electrical appliances other than the 14 categories, some of WEEE dismantling facilities use the overall crushing and sorting process.

#### (4) Reuse of the used electric and electronic equipment (Table 2).

Regarding the reuse of electrical and electronic products, China has developed rapidly, in recent years, an active second-hand electronic product market. Some second-hand product trading Internet platforms have been in operation, such as Paipai, Xianyu, Aihuishou, etc. It mainly focuses on second-hand electronic product, especially mobile phone, due to the high update rate of mobile phone, the trading volume on the platform is huge. On the other side, because of the market for second-hand reuse of large appliances is relatively inactive, large household appliances (such as refrigerators, washing machines, etc.) are in low-trading volumes. For example, second-hand refrigerators may have obvious noise, vibration, and poor cooling effects, high risk in safe refrigeration of food; second-hand washing machines may have rust in the tub, aging of the transmission belt, and health risk. In addition, the power consumption of home appliances that have exceeded their working life may increase.

According to the survey conducted by China National Resources Recycling Association (CRRA), the reuse of used waste mobile phone screens is about 50%, and keyboards, shells and other components, is relatively low, about 10%.

Although the second-hand electronic product market has grown at a certain scale with sorting and classification and other preliminary operating specification and processing formulating, regulations and industry standards for refurbishment and reuse of components are yet to be developed.

#### (5) Environmental and social impact

The use of secondary materials generated from the dismantling of waste electrical and electronic products has obvious energy saving and emission reduction effects. According to the estimates of CRRA, recycling 1 ton of WEEP can save 1.97 tons of standard coal, and reduce wastewater, solid waste, carbon dioxide, and sulfur dioxide by 24.23, 13.61, 4.73, and 0.046 tons, respectively, according to the statistics from

**Table 2** List of main policies and regulations related to WEEE recycling in China

No.	Name	File document number
1	Catalogue of Waste Electrical and Electronic Products for Disposal (2014 Edition)	No. 5, 2015
2	Measures for the Administration of Licensing of Waste Electrical and Electronic Products	No. 13
3	Administrative Measures for the Restricted Use of Hazardous Substances in Electrical and Electronic Products	No. 32, 2016
4	Measures for the Administration of Collection and Use of Waste Electrical and Electronic Products Processing Fund	No. 34, 2012
5	Guidelines for Qualification Examination and Licensing of Waste Electrical and Electronic Product Disposal Enterprises	No. 90, 2010
6	Guidelines for the preparation of development plans for the disposal of waste electrical and electronic products	No. 82, 2010
7	Guidelines for establishing a data information management system and reporting information for waste electrical and electronic product processing enterprises	No. 84 of 2010
8	Guidelines for Dismantling and Disposing of Waste Electrical and Electronic Products and Production Management Guide (2015 Edition)	No. 82, 2014
9	Guidelines for Review of Disassembly and Disposal of Waste Electrical and Electronic Products (2015 Edition)	No. 33, 2015
10	Waste electrical and electronic product processing fund subsidy standards	No. 91, 2015
11	Notice on further clarifying the scope of products collected by the waste electrical and electronic products processing fund	No. 80, 2012
12	Notice on improving policies for disposal of waste electrical and electronic products	No. 110, 2013
13	Notice on adjusting matters related to the declaration and review of waste electrical and electronic products	No. 117, 2016
14	Technical policies for the prevention and control of pollution from waste household appliances and electronic products	No. 115, 2006
15	Technical specifications for pollution control of waste electrical and electronic products	No. 1, 2010
16	Guidelines for Dismantling and Disposing of Waste Electrical and Electronic Products and Production Management Guide (2019 Edition)	2019

MEE, as of 2018, China's WEEP recycling facilities have recycled 8.142 million tons of WEEP. Based on this estimate, as of 2018, China's WEEP facilities have accumulated energy saving and emission reductions as follows (Table 3).

According to this calculation,<sup>1</sup> as of 2018, the emission reduction benefit from the formal dismantling and disposal of WEEP was 6.549 billion yuan.

<sup>1</sup><http://www.dlyj.ac.cn/article/2014/1000-0585/14709>.

**Table 3** Energy saving and emission reduction effect of WEEP (million tons)

Type	Save standard coal	Reduce wastewater	Reduce solid waste	Reduce CO <sub>2</sub>	Reduce SO <sub>2</sub>
Effects of energy saving and emission reduction of WEEP	16.0397	197.2807	110.8126	38.5117	0.3745

The recycling of waste electrical and electronic products has significant social benefits. According to the survey conducted by CRRA, in 2018, the average number of employees in China’s waste electrical and electronic product processing enterprises was 191, it is estimated that 18,763 jobs were directly created by WEEP facilities nationwide. In addition, in the recycling process, there are also a large number of scattered WEEP collectors who are engaged in related work.

By the end of 2018, a total of 5 WEEE recycling companies were named as China’s national circular economy education demonstration bases. In addition, many enterprises have been rated as local circular economy education demonstration enterprises by different provinces and cities, which have strongly promoted the development of China’s circular economy publicity and education.

**Case Study**

**Case 1**

**Aihuishou**

Aihuishou is China’s largest electronic products collection platform, the first “Internet + environment” type company, which is mainly engaged in professional and safe collection of electronic products, sale of second-hand products, mobile phone rental. It focuses on recycling of mobile phones, laptops, digital cameras, and other 3C (Computers/Communications/Consumers) products, with the second-hand mobile phone trade accounting for 80–90% of its business. By the end of 2017, Aihuishou had opened more than 200 direct sales stores in China’s major cities and more than 30,000 cooperative stores in other cities with over 1500 employees. In 2016, Aihuishou processed 5.2 million mobile phones with a turnover of about RMB1.5 billion (Fig. 10).

It provides a three-step collection service, which is convenient and fast:

1. The customer fills in the equipment information according to the equipment list template. Agreed on-site survey time.
2. On-site survey and verification.
3. The two parties sign the contract; then collect the equipment, and pay the customer.

**Key Points**

Internet + collection have become a new form of WEEP collection.



**Fig. 10** offline collection of Aihuishou (Picture is from the following website. <http://dy.163.com/v2/article/detail/EGP575VB0514R9KM.html>)

## Case Study

### Case 2

#### Guiyu Town

Since the 1970s, Guiyu has gradually developed into a center for recycling and dismantling waste household appliances and waste plastics. The town is mainly engaged in collection, dismantling, processing, and utilization of waste electronic appliances and plastics. More than 5,500 farmers were engaged in the WEEE recycling business across 21 villages. There were more than 300 private enterprises/home workshops with more than 60,000 employees in 2005 [5]. The annual dismantling and processing of waste electronic appliances and plastics added up to 1.55 million tons. However, due to outdated recycling technology and the lack of proper management, the scattered WEEE recycling in Guiyu caused serious pollution to the environment, and Guiyu became one of the most notorious centers for e-waste illegal importing and informal recycling in the world.

On account of the serious environmental problems in Guiyu, under the guidance of relevant national ministries and commissions, as well as provincial, municipal, and district governments, Guiyu launched a comprehensive environmental pollution control project which was proposed to complete at the end of December 2015. At present, the overall restoration work and the construction of the circular economy





**Fig. 11** Water quality in Guiyu a few years ago (Picture is from the following website. <http://www.1.xcar.com.cn/bbs/viewthread.php?tid=21671949&extra=page=1&page=2> (2004 year))

industrial park are progressing smoothly, and heavy pollution and illegal dismantling in Guiyu has been significantly curbed (Figs. 11 and 12).

In order to promote Guiyu's comprehensive improvement of environmental pollution and the transformation and upgrading of the electronic waste dismantling and processing industry, the Guiyu Circular Economy Industrial Park started its construction in 2010. The planned construction period of the park is 10 years divided into two phases (2010–2015, and 2016–2020). The first phase of the park was completed in 2015.

A total of 411.84 acre of land is acquired in the park, and the current use area is 156.5 acre, which are 82.37 acre of actual land in Huamei District and 74.13 acre of Nanyang District. The park is divided into four areas, including the trading area, dismantling area, further treatment area, and environmental protection infrastructure. The trading area has two parts: a centralized trading center and a product trading market. The dismantling area has a general dismantling plant (a total of four phases), TCL Deqing Environmental Protection Company. Further treatment area is divided into three types: smelting project, hydronic project, and physical method treatment project. The environmental protection facilities include: industrial sewage treatment plant, domestic sewage treatment plant, hazardous waste transfer station, garbage compression transfer Stations, domestic waste landfills, and flue gas treatment facilities (Fig. 13).

Prior to 2012, Guiyu's annual electronic waste treatment capacity could reach the level of one million tons, and the current treatment capacity is around 400,000–500,000 tons per year, and the overall scale has dropped significantly. According to the statistics of the industrial park, the total volume of electronic waste transactions



**Fig. 12** Guiyu town water quality status (2015 year)

in the second, third, and fourth quarters of the park in 2015 was 110,000 tons, and the first quarter of 2016 was about 110,000 tons (excluding the TCL Deqing processing volume). At present, about 90% of the circuit boards processed in the park were domestic origin. Based on the information from all parties in the survey, it is estimated that the current PCB processing capacity in the park is about 45,000t/year, of which foreign sources should be less than 5000t/year. Since a large number of home workshops have entered the park, the informal recycling in Guiyu has changed



**Fig. 13** Park flue gas treatment equipment (The first picture is from the following website [https://www.sohu.com/a/164860752\\_99908715](https://www.sohu.com/a/164860752_99908715). The second picture is from the following website. <http://sn.people.com.cn/big5/n2/2016/0113/c340887-27533674.html>)

significantly. Most of the home workshops have moved into the park for operation. Guiyu e-waste dismantling has improved significantly in terms of pollution control.

Guiyu has been engaged in the dismantling and processing of electronic waste for decades. It has rich experience in fine manual disassembly, high recycling rate, and resource efficiency. Valuable materials are accurately and meticulously identified. Guiyu has created positive impact in efficient recycling of valuable materials and improved resource utilization (Fig. 14).

### Key Points

In Guiyu Town, a famous e-waste recycling center, great changes have taken place in pollution control, and the environment has been greatly improved. A centralized industrial park is already operating meanwhile, illegal and informal recycling is diminishing.

## 4 Conclusion

China advocates the development of circular economy. In terms of recycling WEEP, various attempts have been made since the 1990s. China now is the country with the world's largest WEEP dismantling and disposal capacity. At the same time, the management level and treatment technology are also improving. Although the



**Fig. 14** Components of waste electrical and electronic products (The picture is from the following website. <http://news.bjsyqw.com/2017/0208/96507.shtml>)

qualified facilities in China mainly recycle big home appliances, it provides valuable experience for the subsequent treatment and disposal of other kinds of WEEP.

### Questions

1. What stages did China go through in recycling of WEEP, and the characteristics of the Chinese model?
2. How many enterprises in China formally dispose waste electrical and electronic products, what is the dismantling capacity?
3. What's the new mode of collecting waste electrical and electronic products in China?
4. What is the status of Guiyu Town, a world-renowned e-waste disposal area?

### Answers

1. China has gone through 5 stages in management of waste electrical and electronic products since 1990s, they are primary stage, the budding stage of formal dismantling enterprise, home appliances "old for new", Urban Mining, the implementation of "Regulations on waste electrical and electronic equipment Recycling and Treatment" and financial subsidy scheme phase.  
China's success provides a new management mode of WEEP, it can be called the new extended producer responsibility system, which may make a lot of sense for developing countries.

2. In China, a total of 109 dismantling and processing electronics companies have been included in the fund subsidy. The annual dismantling of “four machines and one brain” is 152 million units.
3. Internet + collection has become a new way of collecting WEEP.
4. Guiyu Town has begun comprehensive environmental control, the dismantling of electronic waste and the transformation and upgrading of processing industry. Most demolished households have moved into the park for operations as required. The dismantling of e-waste in Guiyu has significantly improved pollution control, and the image of water, air, and roads has also improved markedly.

## Patient information and guidelines

### Suggested Reading

Keli Yu, Heran Zhang, Jinfeng Qiu, Yunong Liu. Waste Electrical and Electronic Products Recycling Industry Development Report (2019).

## References

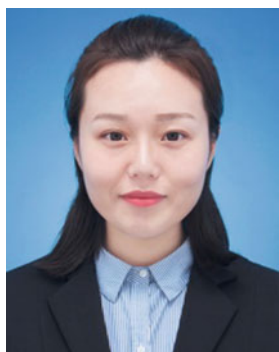
1. Bigum, M., Brogaard, L., & Christensen, T. H. (2012) Metal recovery from high-grade WEEE: A life cycle assessment. *Journal of Hazardous Materials*, 207–208(2012), 8–14.
2. Cui, Jirang, & Forssberg, Eric. (2003). Mechanical recycling of waste electric and electronic equipment: A review. *Journal of Hazardous Materials*, 99(3), 243–263.
3. Luo, Y., Luo, X. J., Lin, Z., et al. (2009). Polybrominated diphenyl ethers in road and farmland soils from an e-waste recycling region in Southern China: Concentrations, source profiles, and potential dispersion and deposition. *Science of the Total Environment*, 407(3), 1105–1113.
4. Zeng, X., Gong, R., Chen, W. Q., & Li, J. (2016) Uncovering the recycling potential of ‘new’ waste electrical and electronic products in China. *Environmental Science & Technology*, 50(3), 1347–1358.
5. <https://new.qq.com/omn/20180619/20180619A1THLK.html>.



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