Circular Economy-based Waste Management in Urban China

a Case Study of Shanghai

By

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Authorship Declaration

I, Saren Gaowa, hereby declare that I am the sole author of this thesis. To the best of my knowledge this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted as part of the requirements of any other academic degree or non-degree program, in English or in any other language.

This is a true copy of the thesis, including final revisions.

Date: June 10, 2020

Name: Saren Gaowa

Acknowledgements

This has been a strange year. In the age of early 20s, I often find myself stuck in a "foggy web of destiny", having no clue of where life is taking me. However, during this stumbled journey, I was accompanied by the warmest people who always give me a hug (sometimes a virtual one) when I feel down and low.

The one I am most grateful is my boyfriend Alex who is always a phone-call away when we were separated apart. Thank you for being you. I love you.

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Last but not least, I want to thank my parents for always believing in me and encouraging me to pursuit my dreams.

Abstract

China is one of the pioneer countries to adopt the concept of circular economy and prioritized it as a national-level policy. Recently, the Chinese policy-makers at the municipal level began to turn their focus to waste management *en masse*. In many Chinese cities, the informal waste recycling industry had already marketized during the years of development despite administrative constraints. However, a full-fledged market-based waste industry still failed to be established. This thesis sets out to discuss waste management policy in Chinese cities in the background of the circular economy and to provide empirical evidence gathered from the field using a case study of Shanghai. From government open data and qualitative interviews with a practitioner in the industry, this thesis finds that the Shanghai government's failure to recognize existing rules and systems of the recycling business and include the informal system into the new waste management chain are the reasons behind the lack of a market-based industry in Shanghai. Relevant policy implications are also discussed from the findings regarding Chinese cities' future toward zero waste.

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Acronyms

Acronym	Meaning
CE	Circular Economy
MSW	Municipal Solid Waste
MEE	Ministry of Ecology and Environment
NDRC	National Development and Reform Commission
SEPA	State Environmental Protection Administration
EIP	Eco-industrial Park
NIMBY	Not in My Back Yard

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1. Introduction

1.1. Circular Economy

The Circular Economy (CE) represents the idea of changing the current “take-make-waste” liner industrial mode, which largely threatens the global environmental and ecological system to a circular one (Ness 2008). The new industrial mode emphasis on both economic profit and environmental impact. It proposes a closed-loop material flow, in which the value of products and resources can be maintained after the being used (Su et al. 2006). Scholars also identify it as the “cradle to cradle” economy (McDonough and Braungart 2010).

Faced with economic growth pressure and resource and environmental difficulties, China’s decision makers have long been attracted by the concept of circular economy, and has formulated the world’s first national-level circular economy law (*Circular Economy Promotion Law*).

Recently, the Chinese government has emphasized on waste management under the concept of circular economy. Last year, the government proposed to establish zero waste cities, hoping to design out waste from a city planning perspective. This vision is in line with the *Foreign Garbage Ban* and the mandatory waste classification campaign in many cities, showed that the Chinese government’s determination on solving the "waste siege" problem while keeping the urban economy lively.

1.2. Municipal Solid Waste Management

Municipal solid waste (MSW) management has been the most relevant sub-sector of CE (Merli et al. 2018) because of a limited understanding of the concept (Ghisellini et al. 2016). In China, there are abundant studies discuss about the MSW management. Most of these studies are policy-oriented with engineering or environmental science backgrounds, putting forward the difficulties faced by the government in waste management and providing policy recommendations.

The implementation of waste management under circular economy concept can be divided into three levels, namely the micro, meso, and macro levels. Existing research generally believes that the micro level measures of the circular economy are taken within a single corporate through "clean production" to improve the efficiency of energy and resource utilization (Yuan et al. 2006; Fang et al. 2007; Liu and Bai 2014). At the meso-level, the initiatives are taken within the scope of enterprise clusters, EIPs, or industrial symbiosis experiences (Zhu et al. 2007; Wang et al. 2010; Geng et al. 2010a). At the macro level, CE is taken within a city or the whole municipal area (Mathews and Tan 2011), or even taken across the whole nation or society (Geng and

Doberstein 2008; Li and Zhao 2010; Merli et al. 2018).

According to the official definition used by the Chinese government (MEE 2019), waste is composite with four categories: general industrial solid waste, dangerous industrial waste, medical waste, and municipal solid waste (MSW). The MSW in the thesis refers to the everyday waste that generated in the urban area, including kitchen waste, electronic waste (e-waste), construction waste, and the emerging packaging waste etc.

According to the three stages of waste management, the research focuses on solving the problems of China's waste classification and reclamation (Peng et al. 2018, Du and Liu 2020), centralized collection and transportation (Zhu et al. 2009), and waste disposal (Chen et al. 2010; (Dorn et al. 2012), including landfill, incineration, and composting. According to the different classification of MSW, the research focuses on different fields such as kitchen waste (Liu et al. 2015), electronic waste (Yao et al. 2009), construction waste (Zhou et al. 2009; Li and Zhai 2015) etc. In addition, scholars (Geng et al. 2009; Du 2019) have conducted case studies on waste management evaluation in Chinese cities.

Studies also pay attention to the government's relation in waste management with the market (Feng 2009; Liu 2014; Liu et al. 2015; Lu et al. 2018), as well as with the civil society (Li and Hu 2013). Wang and Wang (2005) have studied the implementation approaches and regulatory policies of the market-oriented reform of China's urban waste industry. Tan (2008) believes that the existing problems in China's waste market can be solved by selecting appropriate environmental and economic means. Lu (2007) thinks that the franchise system can be introduced into the market-oriented reform of China's urban waste industry to better promote the development of the MSW industry. Scholars (Xue 2008; Liu 2014; Su et al. 2018) have also conducted empirical research on the performance of China's MSW management performance.

However, CE-based waste management from a city planning perspective have not received as much attention (Song et al. 2015). Globally, CE-based waste management solutions at a city level appear as zero waste cities (Song et al. 2015), innovative MSW management (Geng et al. 2010b), and zero waste index (Zaman and Lehmann 2013). None of them is based on the situation of Chinese cities. Therefore, there is a gap in the literature. This thesis will provide an empirical case study of Shanghai on its current waste industry's problem.

1.3. Research Overview

Chapter 2 provides a background of circular economy in China. It investigates how the concept of circular economy was adopted and implemented in the country. The chapter concludes that at the beginning of introducing the CE concept, the Chinese government mainly focus on the implementation at a micro and meso level, that is clean production

in firms and in EIPs. With the deepening understanding of the concept, the implementation focuses more on a macro level (cities). This laid a foundation for MSW management using circular economy idea in the cities.

Chapter 3 outlines the methodology of the thesis, addressing case selection, qualitative interview, and open data from the government. By using both qualitative and quantitative data, this thesis provides a more comprehensive picture regarding the overall status of MSW in Shanghai, as well as offers a more nuanced and humanistic touch of the interpretation of the numbers. Especially, this interview enabled us to probe into the informal yet routinized practices in Shanghai's recycling business and support the argument on why recognizing existing rules and systems is crucial to the sustainable management of waste.

Chapter 4 takes a closer look at the MSW problem and its management within the scoop of cities. It also discusses the waste management as a public good. This chapter finds that the problem of municipal solid waste needs to be solved urgently through waste disposal methods as well as source reduction. Waste classification is a way of source reduction and is to prepare for harmless treatment and recycling of resources at the later stage. For the government, it is still a great challenge to ensure that the market's involvement in waste management can not only help improve the performance of the industry but also balance the interests of the society.

Chapter 5 provides a case study of Shanghai's waste industry as well as its management policy. As one of the most commercialized cities in China, Shanghai has developed an informal waste recycling industry. However, as the Shanghai municipal government is doing its best to hope to build a comprehensive system for waste management, it faces challenges on incompetent management. This chapter seek to address the question of why Shanghai fail to establish a market-based waste recycling industry. Through qualitative data, it finds that, the Shanghai government failed to recognize existing rules and systems of the recycling business and exclude the informal system into the new waste management chain. The chapter also provides policy implication of the finds for the city's future toward zero waste.

Finally, Chapter 7 briefly presents the final conclusion and points out the limitation of the thesis.

2. Background

2.1. Circular Economy in China: Concept and Implementation

Since the Reform and Opening up in the late 1970s, China transited from a planned economy to a market-based economy, welcoming foreign investment and trade. After years of rapid economic growth, China has become the second largest economy in the world. However, the rapid and unsustainable economic growth model has exposed the problems of resource shortage and environmental pollution. To solve with this dilemma, Chinese scholars, inspired by the concepts of industrial ecology in Germany and Japan (Moriguchi 2007), have proposed the concept of circular economy (CE) since the late 1990s, hoping to help China explore a sustainable economic development path (Zhu 1998; Yuan et al. 2006).

Despite the inadequate theoretical backgrounds, the concept of CE was quickly noticed by China's environmental policy makers and was formally accepted by the central government in 2002 (Yuan et al. 2006) for the idea was in line with the newly proposed guiding thought of the Chinese Communist Party (CCP): "Scientific Outlook on Development".[1] In 2004, the State Council issued "Several Opinions on Accelerating the Development of Circular Economy", which marked the beginning of the introduction of the concept of circular economy in China and its comprehensive promotion at the national level (Me and Han 2019).

As the first country in the world to promote and implement the concept of CE nationwide, the early attempt had encountered huge challenges both in theory and practice. On the one hand, CE was implemented as a top-down policy objective in China, whereas, in countries such as Germany and Japan, CE initiative is mostly taken through a bottom-up approach (Ghisellini et al. 2016). Therefore, there were little experiences for the decision makers to make a guiding policy for the whole nation. On the other hand, the researchers working on CE during this stage mostly had backgrounds in environmental, chemical, and mineral process engineering, so they did not have the perspective of providing a comprehensive evaluation of the social and economic cost and feasibility for implementing a CE project (Huang 2004; Yuan et al. 2006).

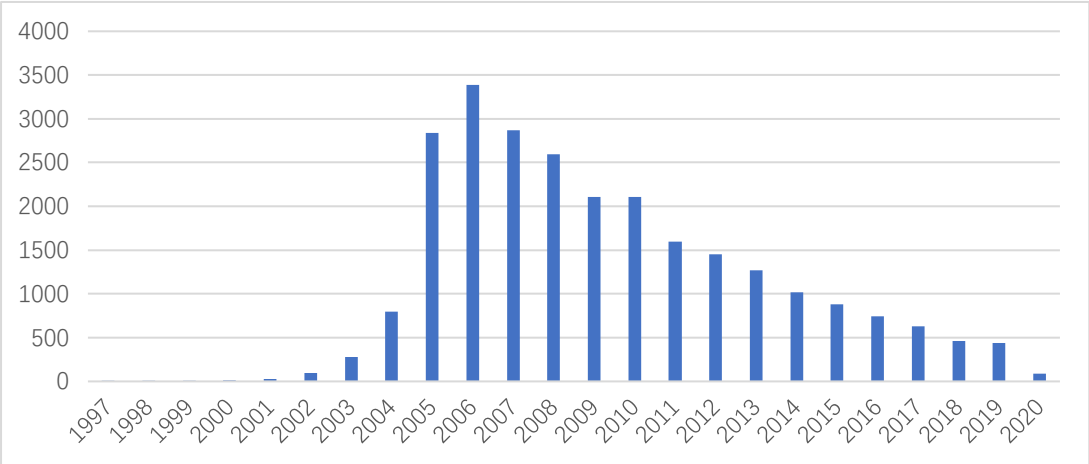
The understanding of the concept is divided into two different schools: the first is based on the approach of neoclassical economics, which is represented by environmental economics and resource economics that discuss the relationship between externalities and public goods. The second school was more prevail during that time, which is based on the perspective of ecological economics established in the 1980s, emphasizing that

[1] The Scientific Outlook on Development, also known as the Scientific Development Strategy, was proposed by the President Hu Jingtao in the 3rd plenary meeting of the 16th CCP conference in 2003 and was written in the Constitution as the guiding principle of the CCP.

the economic system is a subsystem of the natural system and the "3R" principle (Reduce, Reuse, and Recycle) in recourse reeducation and utilization (Zhu 2008).

During this period, China's top environmental policy agency- the State Environmental Protection Administration (SEPA)[2] was established and in charge of the promotion and implementation of the circular economy, especially the planning and carrying out of the eco-industrial parks (EIPs). The projects back then mostly focused on waste recycling in the EIPs. However, these early attempts had accumulated sufficient experience for CE development and prompted the further discussion and research in the field (Yuan et al. 2006). As fig. 1 indicates[3], there is a rapid increase number of research papers on circular economy from 2002 to 2006.

Figure 1: Numbers of Research Papers on Circular Economy



Source: CNKI

2.2. *Circular Economy Promotion Law*

With the rapid promotion of CE, this concept has been more discussed in academic circles and policy fields, and is widely regarded as a feasible economic strategy as well as an environmental strategy. Therefore, in 2004, the top macroeconomic agency of the country- National Development and Reform Commission (NDRC)[4] was appointed by

[2] SEPA was established in 1998. As a ministerial-level organization, SEPA is a direct agency in charge of environmental protection under the State Council. Its main task is to implement the national environmental protection laws, regulations and policies, supervise and manage the national environmental protection work in a unified way, prevent and control environmental pollution, protect natural ecology, improve environmental quality and promote sustainable economic and social development. In July 2008, SEPA was officially upgraded to the Ministry of Environmental Protection of the People's Republic of China (MEP) and became a constituent department of the State Council.

[3] The results of fig. 1 are obtained by the author searching for "circular economy (循环经济)" in the Chinese literature database CNKI.

[4] NDRC, formed in 2003, is a macroeconomic management agency and a constituent department of the State Council. The department of resource conservation and environmental protection of NDRC is responsible for the relevant policy planning of circular economy.

the State Council as the main government agency to develop and implement circular economy (Yuan et al. 2006). The change of the highest responsible organization also means that China's CE policy has begun to focus on the relationship between external and public goods.

The CE concept has been rapidly promoted and implemented under the guidance of NDRC. In January 2009, the Standing Committee of the National People's Congress issued the *Circular Economy Promotion La*w *(Xun Huan Jing Ji Cu Jin Fa)*, which is the first national law in the world on promoting the development of circular economy as well as the resource utilization efficiency, environmental protection and sustainable development.

CE Promotion Law legally established the planning system, statistical evaluation system, fiscal and taxation preferential system, and producer responsibility extension system needed to promote the development of circular economy. According to the law, the incentivizing instruments that are used to promote the development of circular economy include: special funds financial funds, tax incentives, preferential loans and other credit support, favorable price policies, government procurement, government recognition etc.

The law stipulates the key areas for promoting the development of circular economy, including source reduction (refers to activities to reduce the volume, quality or toxicity of products throughout their life cycle) and utilization. In particular, in terms of utilization, emphasis is placed on waste utilization, resource utilization, and system building.

Figure 2: Aspects of Utilization in the Circular Economy Promotion Law 2009

Waste Utilization	Industrial waste utilization
	Residual heat and pressure power generation
	Construction waste utilization
	Electronic waste reuse
	Urban and rural solid waste classification and reclamation
Resource Utilization	Water recycling
	Agricultural and sideline products utilization
	Wood utilization
System building	Industrial waste information exchange system
	Waste reclamation system

Source: Circular Economy Promotion Law 2009

According to these aspects, the government continued to formulate more detailed laws and regulations at different levels, such as the *Regulations on Recycling and Disposal of Waste Electrical and Electronic Products(Fei Qi Dian Qi Dian Zi Chan Pin Hui Shou*

Chu Li Tiao Li) for the e-waste, and the *Administrative Office Law on Pilot Remanufacturing of Auto Parts (Qi Che Ling Bu Jian Zai Zhi Zao Shi Dian Guan Li Ban Fa)* for the auto parts waste, etc.

In this stage of promoting circular economy, a set of mechanisms and systems were explored and established. First, at the national level the government has set up an inter-ministerial coordination mechanism for the development of circular economy, led by the NDRC, to coordinate policies on a regular basis with Ministry of Environmental Protection, Science and Technology, Commerce and other departments. Second, the government established a National Experts Advisory Committee on Circular Economy that would provide advice on major national policies concerning circular economy. Third, the government regularly publish the annual plan and five-year plan of circular economy, and to coordinate all the work of circular economy development (Me and Han 2019).

In 2017, NDRC released the *Evaluation System of Circular Economy Development Indicators (2017) Edition (Xun Huan Jing Ji Fa Zhan Zhi Biao Ti Xi)*. The latest version of the index system updates the previous system, improves the specific evaluation index, and specifies the specific statistics and calculation methods. It is divided into comprehensive index, special index and reference index. Comprehensive indicators include "main resource output rate" and "main waste recycling rate", which are mainly considered in terms of resource utilization level and resource recycling level. Special indicators include 11 specific indicators, mainly divided into resource output efficiency indicators, resource recycling (comprehensive utilization) indicators and resource recycling industry indicators.

It can be seen from this chapter that the CE concept was first introduced in China to solve the problem of sustainable development. However, at the initial stage, the Chinese government paid more attention to the implementation of CE at the micro and meso levels. With the in-depth understanding and research of CE, the Chinese government began to pay attention to the guiding role of CE at the macro level. This also provides a basis for urban solid waste management.

3. Methodology

3.1. Case Selection

This thesis seeks to explore the waste management in Chinese cities in recent years under the concept of circular economy. As a metropolis, Shanghai is still in the process of rapid urbanization. At the same time, its amount of MSW is also growing rapidly. In 2018, its total waste generation is ranked first across the country. In the same year, Shanghai became the first city in the country to establish a comprehensive mandatory waste classification policy in the form of local regulations.

In addition, the Shanghai municipal government has done a good job in publishing electronic government open data and reports. Especially during the Covid-19 pandemic, this is of great help to the completion of this paper.

3.2. Data Collection

The data and information that used in this thesis were derived from published government reports, governmental open data, as well as semi-structured interview with practitioner in the waste recycling business.

While the quantitative data give a more comprehensive picture regarding the overall status of MSW in Shanghai, the in-depth expert interview offers a more nuanced and humanistic touch of the interpretation of the numbers. Especially, this interview enabled us to probe into the informal yet routinized practices in Shanghai's recycling business and support my central argument on why recognizing existing rules and systems is crucial to the sustainable management of waste. Additionally, the perspective of a practitioner differs but also complements that of the government, underlining the necessity of hearing from "the people within". Fostering a healthy and communicative relationship between the local authority and the business sector has largely been neglected, especially on the policy-making branch of the government; this research hopes, then, by filling this blank, to contribute to better mutual understanding among all important stakeholders in the process, which arguably should already be completed by the decision makers.

According to Manzano (2016), there are mainly two qualitative interview methods, namely, traditional or conventional interview and realist interview. The difference between the two methods lies in the research purpose of the interviewer. For traditional interviews, the interviewer generally has a theoretical framework, and through open-end conversations to understand the details of the interviewee's personal experience, feelings, and understanding of specific concepts. For realist interviews, the interviewer uses a "teacher-learner cycle" to develop a theory through semi-structured interview

with the interviewee. This thesis conducted a conventional interview because the purpose is to understand the practitioner's view and knowledge in the field.

4. Municipal Solid Waste in Urban China

4.1. Waste Siege Problem

The miracle of China's economic growth is inseparable from the rapid urbanization process. However, rapid economic development has brought great pressure on China's resources and environment, especially in the cities. In 2018, 59% of China's population lives in the urban area (World Bank 2018), contributing more than 211.47 million tons of MSW (MEE 2019)[5], accounting for the majority of the total MSW in the country. The amount of waste generated in the urban area also shows an upward trend. According to the *2019 National Annual Report on Prevention and Control of Solid Waste Pollution in Large and Medium Cities (2019 Nian Quan Guo Da Zhong Cheng Shi Gu Ti Fei Wu Wu Ran Huan Jing Fang Zhi Nian Bao)* released by MEE (2019), the number of cities that have published data has decreased in the past five years, but the amount of waste has increased by 25%.

In 2018, more than 118.4 million tons of waste was still not being properly disposed in cities (MEE 2019). Xinhua Net (2020), China's official media, confirmed that two-thirds of China's more than 600 cities are surrounded by waste, and one-fourth of the cities have no suitable places to pile up waste. A large number of waste dumps have also caused waste of land resources and economic losses.

In addition, globalization has worsened the problem (Song et al. 2015). The process of globalization provides a reasonable solution to the waste disposal problem in developed countries. By exporting waste to developing countries, developed countries have avoided the problem of disposing of waste at home and effectively solved the problems of large-scale landfill, incineration, and environmental contamination that it may bring. China has been the biggest importer of global waste. Since 1992, China has imported 106 million metric tonnes of plastic waste only, which makes up to 45.1% of all imported plastic waste (Brooks et al. 2018).

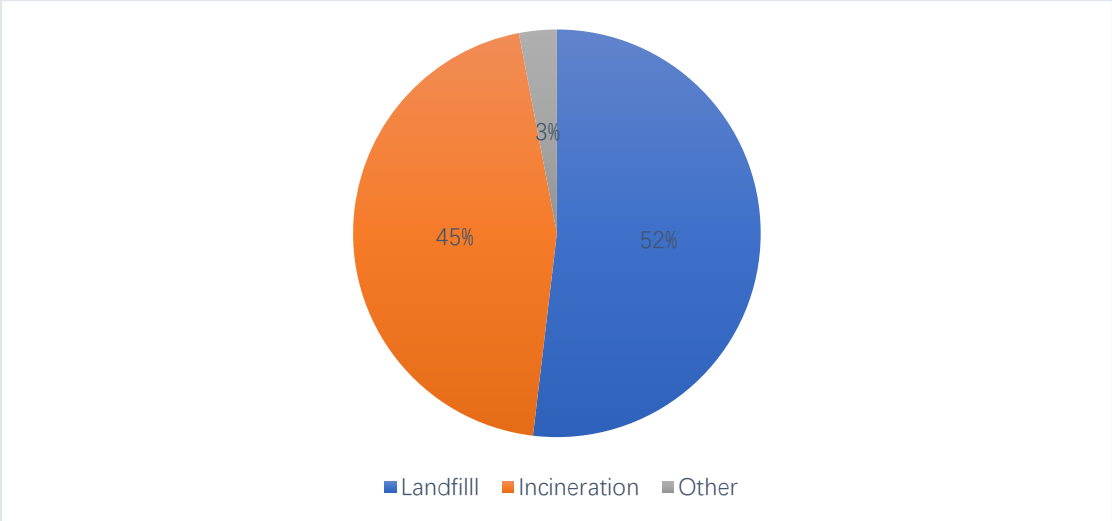
Unsustainable lifestyle and consumption mode lead to the continuing growth of MSW. Especially in recent years, under the influence of new consumption fields such as online shopping and take-out food, the consumption of express packaging bags, cartons with a large amount of adhesive tape, plastic lunch boxes, etc. has increased rapidly. Due to the problems of wide distribution, light weight, low added value and high utilization cost, it is impossible to effectively recycle such wastes solely by market mechanism. In addition, the recycling processing and utilization costs are high, which makes it difficult to form a complete industrial chain for recycling these wastes.

The massive growth of municipal solid waste, coupled with the shortage of waste

[5] This amount of waste was generated in 200 medium and large cities (one-third of total cities) in China. The country's total MSW in that year is 228.02 million tons according to the National Bureau of Statistics.

disposal capacity, has led to waste siege problem. Improving waste disposal capacity is a way to solve the problem. There are three main methods of waste disposal, including landfill, incineration, and composting. At present, landfill is the main waste disposal method in China, composing 52% of the total generated waste in 2018 (See: Figure 4).

Figure 3: China's Waste Disposal Methods in 2018



Source: National Bureau of Statistics

Landfill has arrays of negative impact on resource shortage, environmental pollution, and public health. The majority of waste generated in the urban area where the land resource is limited, especially in areas with high population density. Landfill also brings environmental pressure as the biodegradable organic matter from MSW decomposes and causes greenhouse gas emissions, namely the carbon dioxide and methane emissions. Landfill leachate may also contaminate the surface or groundwater, thus posing a threat to public health. (Danthurebandara et al. 2013). Statistics shows that in 2018, 236.4 million tons of garbage in China were still disposed of in violation of harmless standards (NBS 2020).

The Chinese government has gradually realized that relying on landfill is not a sustainable solution for the waste siege problem that China is currently facing. Incineration of waste is considered to be more advanced than landfill and has less impact on the environment. After incineration, the volume and weight of waste can be reduced, which can not only effectively reduce the occupation of land resources, but also control the secondary pollution caused by landfill. Therefore, NDRC (2016) issued *the 13th Five-Year Plan for the Construction of National Facilities for Harmless Treatment of Municipal Solid Waste,* promoting the method of incineration in the country.

In addition to reducing the landfill rate and increasing the power generation rate of waste incineration, the Chinese government also realizes that the fundamental problem of waste siege cannot be solved only from waste disposal at the endpoint. If the large

amount of waste in China does not decrease, it will not be able to truly solve the dilemma. Therefore, the Chinese government proposes that MSW management should be carried out from the source, that is, waste classification. Kitchen waste (mostly organic) and recyclable materials should be separated from general waste for incineration, composting or reuse. To this end, the Chinese government has launched a series of actions in recent years.

4.2. From *Foreign Garbage Ban* to Waste Classification Campaign

China's waste recycling and disposal industry has seen great benefits from the imported waste. Due to the high standard and quality of imported waste, the local industry has become dependent on it, building a formal industrial chain. However, domestic waste products with low quality and great difficulty in recycling were recycled by non-standard small factories. In order to further promote the development of circular economy in China, the policy makers decided to issue a *Foreign Garbage Ban* on the import of foreign garbage in 2018, hoping to force China's local waste classification and recycling industry to move towards a standardized and large-scale road.

The sudden promulgation of the Foreign Garbage Ban has caused the dilemma that there is no imported raw material in the renewable processing industry in a short period of time, and the raw materials produced by the domestic waste classification and recycling industry are difficult to keep up with the huge demand. In order to meet the demand, China has proposed a more radical urban waste sorting and recycling program.

"Waste classification is a new fashion," said by President Xi Jinping during a visiting in Hongkou District of Shanghai in early November 2018, making waste classification a hot topic of urban management in China (Wang 2019).

In the summer of 2019, Shanghai became the first city in China to start a mandatory waste classification campaign. On July 1, the local regulation "Shanghai Municipal Domestic Waste Management Regulations" came into effect. Waste that generated in the residences is required to be sorted into four categories: recyclable waste, harmful waste, wet waste (biomass waste) and dry waste (other waste)[6]. Its implementation requires all communities in the city set up centralized dropping points in certain locations. Residences can only drop their waste in those location and within a certain time. This waste classification campaign in Shanghai has aroused extensive discussion and criticism in the society. Some thinks that this is another top-down model of a *campaign governance*[7], which can mobilize the citizens but with a huge social cost (Li

[6] This classification standard has caused great confusion for residents. Among them, the classification of dry and wet waste is the focus of discussion. The purpose of separating wet waste from other waste (dry waste) is for increasing the efficiency of incineration power generation. Because the high humidity of waste will lead to great difficulty in combustion.

[7] Tang (2007) regards campaign governance as a "national governance method, based on and supported by the powerful political legitimacy gained by the ruling party in the revolutionary war era, through effective ideological propaganda and super-strong organizational network infiltration by the ruling party and the national bureaucratic organization, with mobilizing the masses as the main means, and concentrating and organizing social resources in

2019).

This mandatory waste classification campaign caught many people by surprise. However, the actual situation is that the policy of urban waste classification has been proposed and implemented in China for many years. In 2000, the former Ministry of Construction designated eight cities including Beijing, Shanghai, Hangzhou and Nanjing as the first batch of "pilot cities for classified collection of domestic waste". However, many of the early attempts to classify municipal solid waste were abandoned or difficult to continue. Therefore, the NDRC and the Ministry of Housing and Urban-Rural Development (MOHURD)[8] issued the *Mandatory Waste Classification System Plan* in 2017, Chinese cities began to vigorously implement waste classification again.

At present, mandatory waste classification campaign is more or less stuck in trouble. In an ideal situation, waste classification is used to prepare for harmless treatment and recycling of resources at the back end of waste disposal. However, at present, the lack of openness, the shortage of harmless facilities for waste treatment, and insufficient publicity and education on the benefits of waste classification have led to the low enthusiasm of residents. The government's coercive measures have made it more difficult for residents to keep this habit in their daily activities.

4.3. Waste Management as a Public Good

Shanghai's mandatory waste classification campaign has once again brought the Chinese government's way of providing public goods and services to the table. Municipal solid waste management has the attribute of public goods, because once a municipal solid waste management system is completed, it can bring benefits to every citizen in its service scope, and everyone can enjoy the utility it provides, that is, its utility has certain indivisibility; Moreover, anyone's utility of the waste management system will not exclude or hinder other people's utility at the same time, that is, its consumption has certain non-competitiveness. At the same time, even if someone else in the area does not bear the cost, one can still enjoy the benefits of the system, because he or she avoids the environmental damage caused by waste pollution, so its benefits are non-exclusive.

The theory of public goods holds that the higher the purity of public goods, the more important the role the government plays in providing public goods. As the degree of exclusiveness and competitiveness of public goods decreases, the government should provide the public goods. While the exclusiveness or competitiveness increases, the introduction of market mechanisms may improve efficiency in providing these public goods or service.

political mobilization to achieve various governance purposes of the country". Since the concept was put forward, it has attracted the attention of the Chinese literary circle and has been applied to the relevant research on China's national governance logic (See also: Feng 2009; Zhou 2012; Cai 2012; Ouyang 2014).

[8] MOHURD, formed in 2008, is mainly responsible for formulating housing and urban-rural planning policies in China.

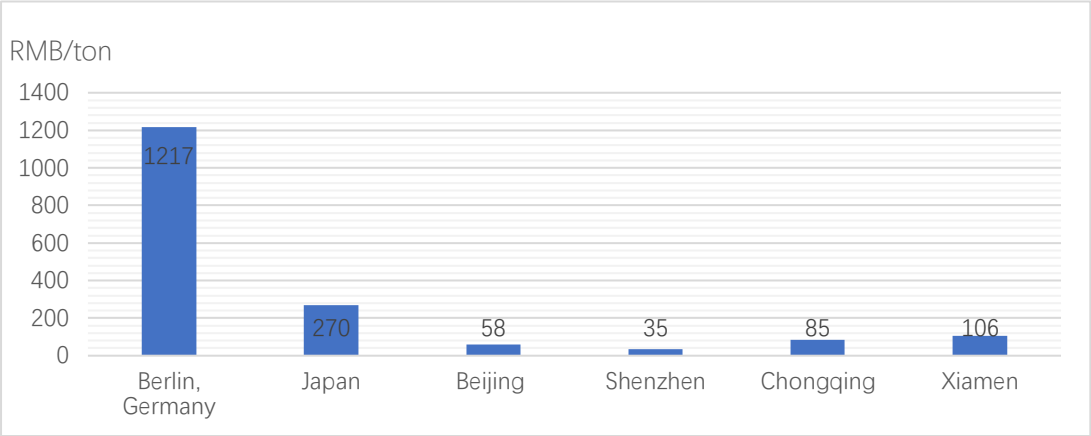
The exclusiveness and competitiveness are different among all stages of waste management system. Thus, waste classification and reclamation, transportation, and waste disposal are considered to be different public goods. Therefore, the government needs to implement differentiated strategies of providing the waste management services.

In China, waste management had always been a municipal utility and monopolized by the government for a long time and started the market-oriented reform relatively late. China's rapid economic development and urbanization in recent years have led to an increasing amount of waste. The government's financial capacity is not sufficient to support the growing waste industry. With the gradual establishment of the sewage charges principle and the deepening of the country's market-oriented reform (Liu 2014), in June 2002, the Chinese government issued the *Notice on Implementing the Municipal Waste Treatment Fee System to Promote the Industrialization of Waste Treatment (Guan Yu Shi Xing Cheng Shi Sheng Huo La Ji Chu Li Shou Fei Zhi Du Cu Jin La Ji Chu Li Chan Ye Hua De Tong Zhi)*. China began to implement the municipal waste treatment fee system in the whole country.

Waste treatment fee has the characteristic of special fund, which is invested in all aspects of waste treatment, including waste reclamation, transportation, and disposal. There is no uniform national standard for waste treatment fee. Generally, local governments designate standards within their own administrative regions. Judging from the pricing method, most cities impose a quota. The waste treatment fee made up for the shortage of financial funds, compensated the waste treatment cost.

Although the waste treatment fee helped to compensate the cost for municipal waste industry, the waste treatment fee in Chinese cities is generally kept at a lower level comparing to Japan and Germany (See: Figure 4). Most of the waste treatment funds in the cities still need financial funding from the central government. However, the waste treatment fees are often politicized and artificially limited to a lower level (Tan et al. 2008). Moreover, empirical research shows (Liu 2014) that the maintenance of municipal waste management's capital mainly comes from the single investment structure of government financial allocation, coupled with the limited financial capacity of the government, which has not significantly promoted the performance of the municipal waste treatment industry.

Figure 4: Comparison of Waste Treatment Fee



Source: Ling et al. 2019

In addition, the logic of collecting waste disposal fees is still that the government will be responsible for all services in waste management, which is not conducive to improving efficiency. The marketization of waste industry still lacks of competition mechanism. This has led to a long-term inefficient operation of the industry. Some enterprises in the business even have long-term losses and have to rely on government financial allocations to maintain their survival (Liu 2014).

The government should establish targeted and appropriate policies according to projects with different attributes. Liu (2014) based on the competitiveness and exclusiveness, and the economic attributes i.e. sedimentation cost and economies of scale, to the classification of different stages in the waste industry in his research. He concludes that the government should grant qualified waste terminal disposal enterprises franchise rights through public bidding, so as to ensure the economies of scale and improve efficiency. For other stages such as waste reclamation and transportation, the production efficiency can be improved through market competition mechanism.

4.4. Regulation by the Government

An important question for the government to introduce market provision in the waste industry is that how to regulate the private firms to make sure the outcomes of them seeking in maximizing profits in line with general social welfare (Steuer 2017; 2018). The Chinese government had already tasted the bad fruit of not dealing with this issue carefully. For example, the "Not in My Back Yard (NIMBY) Campaigns" on the issue of building waste disposal facility. NIMBY refers to a place's residents who wish to protect their living areas and avoid interference from public or industrial facilities that have negative effects on their living areas. In 2009, local residents of Panyu district of Guangzhou city gathered together on the street to protest a waste incineration power plant that was about to build in their neighborhood. The Guangzhou municipal government responded to the Campaign with an open-minded attitude and finally

abandoned the original site selection. Following this, the NIMBY Campaigns on incineration site selection protest happened in many parts of China (Liu et al. 2017).

Successive environmental mass incidents have made NIMBY an unavoidable social phenomenon and the biggest problem for selecting the site for waste incineration power plants. Especially the resulting social instability has forced the Chinese government to respond directly and solve the problems of construction and supervision of solid waste treatment plants.

Starting from 2017, China began to try to institutionalize public communication for waste incineration projects. The Ministry of Environmental Protection (now the Ministry of Ecological Environment) issued a notice that year, requiring the national waste incineration plants to install an automatic monitoring system for pollutant emissions, set up an electronic display screen at the gate of the plant to release pollutant data in real time, and connect the monitoring equipment with the environmental protection department.

However, this attempt is not optimistic. According to the observation report on environmental responsibility fulfillment for China's waste incineration plants released by an environment NGO in China (Wang 2020), only 49 of the 428 waste incineration plants in operation in China publish smoke automatic monitoring data on their websites, and 61 publish environmental quality information around enterprises. Only 99 of the dioxin emission information from waste incineration plants that are of most concern to the public have been made public. The report pointed out that it is difficult for the public to see the electronic screens installed in some waste incineration plants. Online information that is more accessible to the public is also very limited.

In addition to this, the effective supervision of waste incineration plants by the Chinese government also needs to overcome the influence of interest groups within the government. Taiwanese scholar Bian (2019) pointed out that since the market-oriented reform of China's municipal public infrastructure, many municipal infrastructures have formed an industry growth alliance between government and business. In the field of waste policy, since incineration has become China's main waste treatment model, waste policy has been controlled by incinerator interest groups[9].

This can also be seen from the appropriation of waste treatment fees. A large amount of subsidies have flowed into the back-end links of waste treatment such as waste incineration plants despite the high social cost (Song et al. 2017).

The vigorous promotion of the waste incineration plant in the past ten years and the

[9] A notable case is that in the legislative process of the "Renewable Energy Law" in 2005, the original incineration power generation was not included in the renewable energy law at the draft stage, and was finally included into the bill by Ye Rutang, deputy director of the National People's Congress Environmental Resources Committee. After Ye retired, he served as an independent trustee of a listed incineration power generation company. See also: Bian 2019.

failed long-lasting waste classification before Shanghai's classification campaign in 2019 confirmed Bian's statement to some extent. Because the waste policy has been controlled by interest groups for a long time, incineration power plants require a large amount of waste to enter to maintain profitable operation; while waste classification will reduce the amount of waste that eventually enters the incineration plant. A reasonable guess is that the waste sorting campaign led by Xi Jinping, which has strong characteristics of sporty governance, is likely to be an attempt to destroy the incineration plant interest group.

5. Design the Waste Out - the Case of Shanghai

5.1. MSW in Shanghai

China's new waste policy started with Shanghai as a testing ground and a pilot city. In 2019, Shanghai's Gross domestic product (GDP) reaches 381.55 billion RMB and its per capita disposable income reaches 69442 RMB, ranking first in the country. Related to this[10], in 2018, Shanghai produced a total of 9.84 million tons of municipal solid waste, also ranking the first in the country (MEE 2019). The amount of waste in Shanghai continues to grow. The average growth rate from 2005 to 2017 was 3.1%. Since 2015, due to the influence of new consumption fields such as online shopping and take-out food, the production of packaging waste has surged, and the growth rate of Shanghai's MSW is even close to 7%.

In order to solve the city's garbage problem and respond to the call of the central government[11], the Shanghai municipal government promulgated the *Shanghai Municipal Solid Waste Management Regulations* (*Shang Hai Shi Sheng Huo La Ji Guan Li Tiao Li*, hereafter referred to as MSW Regulation). It is a guiding local regulation for the new waste management policy in the city. The Regulation was investigated as a key project of the city in 2017 and become a formal legislative project in 2018. In 2019, the whole piece was promulgated officially, stating the city's beginning of a new area in waste management.

The MSW Regulation aims at all stages of waste management. It aims to achieve "reduction, recycling, and harmlessness of municipal solid waste, establish and improve a complete classification system for waste classification and reclamation, transportation, and disposal, and actively promote the reduction of domestic waste at the source and recycling of resources" (Shanghai Municipal Government 2019).

Quickly after its implementation, problems occur among different stages of the system. At the frond-end, waste classification is difficult to promote in the communities and heavily relies on volunteers to supervise residents' waste classification results. For the transportation and temporary storage, the recycling facilities and enterprises face objective difficulties such as finding the right locations (NIMBY effect can also happen in this stage), high employment cost, and difficulty in passing the environmental assessment and getting a land use permit from the government (Du 2019).

The problems encountered by implementing the MSW Regulations also include confusion in the management process, especially in the field of classification and

[10] Empirical evidence in OECD countries shows that there is a positive and linear relationship between income and MSW quantities (Johnstone and Labonne 2004).

[11] The introduction of this plan is a local regulation based on the *Implementation Plan of Municipal Solid Waste Classification System* issued by the State Council in 2017. President Xi Jinping's speech during his visit to Shanghai at the end of 2018 also urged the promulgation of this regulation.

recycling, where formal regulations and informal waste recycling industry have failed to form an effective connection. For MSW classification and reclamation on the one hand, it increases the social cost of classification for residents, on the other hand, it also increases the burden on the management cost for the government and local communities. At the same time, it squeezed the space for the informal waste recycling industry to develop and fail to organically integrate the informal waste recycling industry into the new waste management system.

5.2. The Informal Waste Recycling Industry in Shanghai

In China, an informal waste recycling industry (Steuer 2017) for low value-added waste has existed for decades. This industry is made up of waste pickers in the city. It is a huge and efficient informal waste recycling system. Experts who have long studied China's waste recycling system estimate that the low value-added recyclable waste accounts for about 30% of China's MSW, of which nearly 90% is recycled by the informal sector (Jiang and Feng 2018). The new classification and reclamation chain managed by the government had a disconnection with the preexisting industry. The vast majority of low-value recyclable materials mixed with solid waste flow to the terminal treatment facilities for landfill or incineration, which not only wastes a lot of resources, but also increases the burden of disposal facilities and urban environmental risks.

This informal industry has saved a lot of financial resources for China (Steuer 2017). However, the Chinese government rarely systematically studies this industry. The lack of understanding of the industry by the competent authorities has led to the departure of policy from reality. In recent years, attention has been paid to the informal recycling industry in Beijing particularly (Tong and Tao 2016; Steuer 2017; 2018). However, there is no relevant empirical data for the development of this industry in Shanghai. The informal recycling industry in different regions will have different problems and characteristics, so it is necessary to study the informal recycling industry in Shanghai.

Therefore, to provide an empirical data on Shanghai’s informal waste industry, the author conducted an interview with a practitioner in the business. From the interview, the author got the following conclusion:

First of all, for the current informal waste recycling industry, the standardized market access standards are too high. The procedures for applying license are complex, and the standards are not open and transparent. The interviewee suggested that to obtain qualification license, “five seals from different government agencies” are required (see appendix). And to a large extent, it depends on the “government connection” to obtain the official license.

Secondly, practitioners in the informal waste recycling business have difficulty renting sites. First, it is affected by the NIMBY effect, which may bring about the risk of complaints from nearby residents. Second, due to the lack of qualification certificates,

the land owners dare not rent the place to them. Lack of direct, accessible government funds also poses the problem of not being able to find suitable sites to operate the business.

Last but not least, the existing waste recycling industry cannot cover all areas of solid waste, and low-value-added or almost no-value-added waste is excluded from the recycling system.

These points pointed out through the interview data are a useful supplement to Du's review article (Du 2019) on Shanghai's waste management problems. Especially, this interview enabled us to probe into the informal yet routinized practices in Shanghai's recycling business and explained why Shanghai failed to establish a market-based recycling industry. The failure of the government is not recognizing the existing informal system of waste recycling.

In addition, the three conclusions have important implications for urban waste management policy makers. For the first issue, in order to promote the formalization and standardization of the informal recycling industry in the city, the government should consider reducing the issuance process of operating permits, and disclose the evaluation standards and results, so that unsuccessful evaluation business have a principle to follow for future.

As for the second issue, the NIMBY effect stems from the nearby residents' distrust of the waste collection site, and because of the lack of long-term stable sites, practitioners cannot invest in infrastructure that can make the site look neat, so it will make residents resist the waste collect site to be located in the neighborhood. To crack this vicious circle, the government should consider how to provide waste recycling sites in cities, or lease the government's existing sites to the recycling business, and provide subsidies from the waste treatment fees and government finances.

In response to the third issue, for low-value-added and non-value-added waste to enter the industrial cycle, someone must pay for the missing part of the value chain. Either a producer, a consumer, or a government. This is the key to the establishment of a low value recyclables industry circular recycling chain.

For the producers' side, the government can implement the extended producer's responsibility system, requiring producers to extend from the responsibility of resources and environment in the production link to the full life cycle from product design, consumption, recycling, and waste disposal. At present, the Chinese government has begun to expand the producer responsibility system in the fields of electrical and electronic products, automotive products, lead-acid batteries, beverage paper-based composite packaging and other fields.

At the consumer level, the government can solve the construction of the industrial recycling chain by raising the standard of garbage disposal fees. However, the government should be more transparent in how to reasonably collect, allocate, and use garbage disposal fees. At present, most of the waste disposal fees charged by the government flow into the back-end waste disposal process, that is, subsidies for incineration power plants, which is not the most cost-effective way (Song et al. 2017). This thesis suggest that the informal recycling industry should be considered for the city's newly established solid waste management chain.

5.3. Design the Waste Out

The Chinese government took a step further on waste management and set a vision of establishing zero waste pilot cities before 2020. The term “zero waste” was first used by Dr. Paul Palmer in 1973 for recovering resources from chemicals (Palmer, 2004). In a zero-waste system, material flow is circular, with materials wasted or underused. This concept is different way to put up the idea of circular economy. A government interpretation document (Gao 2019) also likened the zero waste city vision to the circular economy action plan of the European Union. Although putting forward differently, the core idea is to build a new economic system and social development model to fundamentally solve the problem of natural resource shortages and the occupation of scarce land resources by waste disposal.

According to the Office of State Council (2019), zero waste city is an advanced concept of urban management. It does not mean that there is no solid waste generated, nor does it mean that solid waste can be fully utilized as resources. Zero waste idea refers to the urban development mode that promotes the formation of a green lifestyle, the reduction and resource utilization of MSW, and minimization of landfill volume and the environmental impact of municipal solid waste.

In order to achieve the vision of building a zero-waste city, city policymakers need to design the system design from the city level and ensure the construction of infrastructure that promotes MSW management. Especially, according to the conclusions drawn by this study, the Shanghai government should fully investigate on the existing informal system and conclude the voice of the unheard.

6. Conclusion

This thesis discusses the background of how the concept of circular economy was adopted and implemented in China and laid a foundation for CE-based MSW solution. As the thesis taking a closer look at the MSW problem and its management within the scoop of cities, it finds that the problem of municipal solid waste needs to be solved urgently through source reduction. Classification of the waste is an effective way of source reduction for it separates different categories of waste and utilize waste resource accordingly. As a public good, the waste management can be introduced a market mechanism for efficiency improvement. However, the government should impose regulation on the market's involvement in waste management, in order to improve the performance of the industry, at the meantime, balance their interests with the society's.

The thesis also takes a glimpse at Shanghai's waste industry under the newly implemented policy. As one of the most commercialized cities in China, Shanghai has developed an informal waste recycling industry. However, as the Shanghai municipal government tries to build a comprehensive system for waste management at all stages. As the system was put into practice, it faces challenges on the incompetent management. From government open data and qualitative interviews with a practitioner in the industry, this thesis finds that the Shanghai government's failure to recognize existing rules and systems of the recycling business and include the informal system into the new waste management system are the reasons behind the lack of a market-based industry in Shanghai. In order to address the deficiency in policy, the government should (1) Reduce the procedures of license issuing authorities for informal recycler, provide formal channels, and integrate them into the new urban waste management system; (2) In the urban planning, design a dedicated site for the waste collection station, and lease it to practitioners of the waste industry with low-cost subsidies; (3) The government bears the main responsibility to establish a low value-added waste recycling chain, and to ensure that different links such as producers and consumers share part of the responsibility.

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Appendix

Selected Interview Transcript

Interviewer: Saren Gaowa
Interviewee: Miss. Gao
Project Manager of a Circular Economy Start-up in Shanghai

Location: WeChat Video Call
Time: 2020/06/09

S: What is circular economy from your understanding as a practitioner?

G: Circular economy, from my perspective, is an economic model to make us rethink about the value of trash. It is a solution to the increasing waste problem the world is facing today. Circular economy is pretty new concept in China. Most of the people have never heard of it. In recent years, because of the waste classification campaign in Shanghai, people are getting the sense of the idea. But many people just think that we are just waste recycler. This is partially true. But actually, circular economy has more aspects than recycling.

S: So you do recycle waste? What kind of waste do you recycle?

G: It depends on our clients need. For example, last year, we cooperated with a bubble tea company to collect the remaining plastic cups that customers had drunk in the store, and made these wasted cups into new products for secondary sales on the online store.

S: You don't have a competitive relation with the waste pickers in the street.

G: No. We are different markets. But we do share more or less some common difficulties.

S: What kind of difficulties? Could you elaborate on this?

G: Like the plastic tea cup we recycled last year. We need to collect all the cups from different stores in Shanghai. The first problem is classification of the cups. How to divide the remaining liquids from the cups. The waste pickers in the city can do it manually. But we don't have that many people could work on that.

G: Then after transportation, where to keep the cups that we collect. It is difficult to find an empty place or factory to store them. This is the same difficulty we face with the pickers. Their situation may be worse. Because the plastic cups are not too much and we only kept them in one place for a short time. The pickers need to find a stable

place for their business. And in the interview, we conducted with a recycler, he told us that most difficult thing for them is to find the sites, then permits and licenses.

S: Why is it so difficult to find a place?

G: Shanghai's land resources are very precious, and private people cannot afford their own land. It is almost impossible to rent it. Others will think that the waste disposal is dirty and smelly, and neighbors will complain. Secondly, according to government regulations, you need to have a site and a license. The land price in Shanghai is very high, how can this average person afford to buy this? So the best case scenario is to rent a place, but what about the license? If you want to have a license, you have to get at least 5 stamps from different bureaus. You have to have connections from inside.

S: But isn't there many recycle sites in Shanghai? How did they operate?

G: At present, a district in Shanghai may only have one or several waste dumps, and all of them have connections with the government, so they can obtain the qualification. Some of the biggest companies are owned by the SOEs. You cannot compete with them. Even if you have more resources, it is useless for the license issuing authority not to issue the license.

S: Have you ever understood why they still insist in this industry since there are so many difficulties?

G: Of course, it is because there are still considerable profits in this industry. They are not stupid either. If the profit in this industry is low, they will do something else. In fact, they only recycle waste according to the type and quality. They do not want the lowest value-added waste products or wasted products with low quality. They have to pick carefully in order to sell them. As far as I know, it is not a problem for medium-scale recycling site to earn hundreds of thousands of RMB a year. And even the most ordinary collector can earn 200 RMB in a day.