

# THE FUTURE OF GREEN INVESTMENT IN WASTED ELECTRICAL AND ELECTRONIC EQUIPMENT RECYCLING SECTOR IN CHINA

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Abstract <p>The thesis is written with the purpose of growing Green Investment attention from both foreign and Chinese domestic market by introducing China's current development status of WEEE (Wasted Electrical and Electronic Equipment) collecting and recycling industry sector in various aspects. For achieving to answer the research questions about possibilities of future investment from both domestic and abroad, the author has used qualitative method to analyse and explain with collected data and information from a project and three interviews with both Chinese and Foreign enterprises in WEEE collecting and recycling field. The interviewing group including two Chinese executive managers from Marketing and Public Relations department, one Finnish Accounting Manager from Customer Services Department. Majority of data applied in this thesis mainly from WEEE articles, political statements and policies in mainland China.</p> <p>The results from a case project and interviews are relative with similarities among companies' executives and manager. There are foreseeable future about WEEE sector in China, the situation of current development in WEEE industrial sector is growing attention from both domestic and overseas, as the biggest market of EEE (Electrical and Electronic Equipment) manufacture nation, the market share of WEEE is going to remain as the largest market of WEEE sector around the world. The future for Green Investment in WEEE Recycling is going to gain more attention in all prospective, including political and legislation improvement, economic and industrial system upgrade, government support growth in finance, etc. Therefore, the future, however, depends all stakeholders in WEEE industrial sector to interact with each other through more transparent communication channels.</p>		
Keywords/tags: WEEE, Urban Mine, Circular Economy, WEEE Directive, WEEE Collecting and Recycling, EEE, EPR.		
Miscellaneous		

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## **ABBREVIATIONS**

3R	Reduce, Reuse, and Recycle
EEE	Electrical and Electronic Equipment
EPR	Extended Producer Responsibility
EU	European Union
FDI	Foreign Direct Investment
MEP	Ministry of Environmental Protection
MOF	Ministry of Finance
MOFCOM	Ministry of Commerce
MSEs	Middle Sized Enterprises
ODI	Overseas Direct Investment
RMB	Renminbi
SOEs	State-Owned Enterprises
U.S.A	United States of America
UM	Urban Mines
UN	United Nations
UNEP	United Nations Environment Programme
WEEE	Waste Electrical and Electronic Equipment

## 1. INTRODUCTION

A United Nations Environment Programme (UNEP) report: RECYCLING – FROM E-WASTE TO RESOURCES, published on July in 2009, estimated that the amount of Global Wasted Electronics and Electronic Equipment (WEEE) will increase by 40 million tons each year, in 2020, it is estimated to increase two to four times the amount of 2007 whereas the Wasted Mobile Phones and Televisions will be seven and one and half to two times. (UNEP, 2009) An industry report of E-Waste Management published in 2012 also revealed that the global scale of Electrical and Electronic Products market has sped up, the prices for raw materials have increased, and the amount of WEEE has lead to the rise of production value in the WEEE Recycling industry (not including material collecting), it estimated to reach 20.25 billion Us dollars compared to the 9.15 billion Us dollars in 2011. The Compound annual growth rate is 17.22%. (UNEP, 2012) The above reports claim that the estimated total amount of WEEE is about 48.9 million tons. China alone has a share of 11.10 million tons, about 22.7% of the total WEEE, and the second largest shareholder is United States, with about 10 million tons.

China has not only become the biggest manufacturer of WEEE in the world but is also growing to the biggest consumer of resources in the world. The annual consumption of resources has reached about 10 billion tons, four times which of the United States, becoming top number one and a Super Nation in consuming resources, said Doctor Chen Yong, a Director of Research Centre Academic Committee in Chinese Academy of Engineering.

The challenges China is facing while becoming the world's fastest growing economy, the worst threat is that more and more resources used in manufacturing and then sold in both the domestic market and exported to overseas are causing a huge loss in natural resources. Therefore, how to reclaim back those recourses once used, sold and exported, has Become a concern of the Chinese Government, relevant departments and other related authorities, and more importantly, how to efficiently and selectively extract raw material, valuable recourses from WEEE without causing environmental pollution.

There is a Japanese metaphor by scholars who say that today's cities are as the 'Urban of Mines' (UM), and Japanese scholars from the mineral refining process, the Institute of Tohoku University in 1988 first published this new concept. In 2001, scholars introduced the 'UM' concept to China from Tsinghua University. In brief, 'UM' is describing that, in metropolises, there are enormous new electronics being produced and used, then disposed by households, different organizations and companies to the waste landfills or recycling manufacturers' manufactories, the most precious and excellent mineral resources and raw materials, are becoming premier resources, can be selectively collected, recycled and re-used again for re-production purposes. These treasured metals, such as lithium, titanium, gold, indium, silver, antimony, cobalt, palladium etc., contained in Waste Electrical and Electronic Equipment (WEEE), are far more valuable, efficient and cost-effective than these metal minerals discovered in natural mines in remote areas or in the sea, High Ground Mountains or remote deserts. WEEE is also called E-waste in European Union (EU) Legislation (European Parliament and of the Council, 4.7.2012, 38). Under the circumstances of, Today China is the biggest exporter and supplier of manufactured electronics in the world, although the exporting quantity of Electronics to the United States of America (U.S.A) and EU has been inevitably declining during the global economic crisis. However, the market demands from emerging markets, such as from developing countries like Russia, Thailand and Indonesia, are still increasing on a yearly basis (China Daily, 2012). Therefore, the urge for collecting the required raw materials to meet China's full annual production capacity is critical and far from sufficient.

In order to keep up its competitive economic records, China has been enthusiastic about collecting and recycling WEEE resources from both domestic and international markets. In 2010, the estimated generation of WEEE from the domestic market was about 230 million tons per year, and was about 200 million tons WEEE imported from international markets (Caijing Network, 2012). The outcomes of collecting reusable, recyclable waste from foreign counties, mainly from the EU, Asia Pacific, North America. Crude dismantling and recycling methods applied on WEEE mostly by small-scale businesses through informal operations to remove only

valuable components, which are supplied by hawkers, peddlers and vendors, and the inappropriate methods have caused massive pollution to the environment, and human safety, and threaten human health awakening social critics worldwide. China has established a legislation framework and an infrastructure system concerning WEEE management to protect her society and environment from jeopardizing the overall wealth, as well as updating and adjusting its effectiveness while its implementation. However, due to the low cost of labour and lack of support from appropriate technology, China has been criticized for its ambitions in winning the economy world by sacrificing her environment and people's well being at a huge cost and causing irreparable damages.

On the other hand, for authorized WEEE recycling manufacturers, the legislation framework and its infrastructure system have not been completely and strictly applied in cities and provinces, especially regarding middle-sized and large operating enterprises in the WEEE recycling industry chain. Due to the informal collection and recycling system in the hands of small-scale businesses, the authorized WEEE recycling businesses are mainly relying on imported reusable and recyclable materials to meet their production capacity. For SMEs, without a supporting WEEE legislation system, a financial insurance or government support to assist their business to legally and regularly obtain sufficient WEEE from both the mainland and overseas markets, these concerns will be very critical factors to their future survival in the competitive market. However, under the pressure of survival, the public and private corporations in the recycling industry are the most ones, calling for the support from the Chinese facilitating platform to standardize the eco-industrial chain. To cope with the complexity of the situations that the WEEE businesses are facing, and to enforce the WEEE directive and other related regulations, and Chinese Government has set a strategic development plan and implementations in Solid Waste including WEEE recourse and toxic waste collecting, reuse and recycling, its including a function legislation framework, monitoring and observation parties, infrastructure system, funding and incentive policies, they will be the key role for changing the circular economic industry chain from informal to a standard and beneficial sector for social and environmental wealth. (Minister of



Environment Protection of Republic of China, 2013.01) (Minister of Environmental Protection of Republic of China, 2012.01) (China association of household appliances, 2011.05) To the Chinese government, the question is how to support companies effectively by developing a green, scientific and sustainable way to explore the 'Urban Mine', in order to reach the sufficient capacity, satisfy the industrial demand, maintain the economic growth, this mainly lies on the shoulders of Chinese enterprises and the cooperation with the foreign environmental forces as well (Hudong Wiki, 2010).

## **2.1 Motivation of the Research Study**

As an International Business student studying at JAMK University of Applied Science, The author has experienced and witnessed how Environmental Technologies have contributed to both the eco-system and the modern society in Finland, and how they have build and sustained an environmental friendly living environment for people, more importantly, how people appreciate the support from the government adjusting the Finnish Environmental Law to protect the society. On the other hand, the author has deeply influenced by the current environmental pollution occurred in her home country - China. China is ranked at top 2 in economic growth around the world (THE WORLD BANK, 2014), but close to the bottom at 118 in Environment Performance ( Yale University, 2014). Nowadays, China has gradually realized and emphasized its goals on improving environment qualities in all aspects by implementing strategic development plans in industry sectors. It is a difficult on-going task, and the solution requires the assistance and support from countries that has great experience, expertise, and with successful practices in solving environmental issues. The goal of the thesis is to first of all achieve an understanding sense about China's current development phase in WEEE recycling sector, include highlighting China's environmental issues, political changes and economic development, particularly, business activities and implementations of government reform strategies in WEEE sector, with evidences from public opinions and comments of enterprise entities. Due to the data of the study on WEEE sector in China is based on gathered information from both public and private entities, interviews with expertise from organizations and business enterprises, therefore,

the second goal is to present practical cases and knowledge to potential shareholders in both domestic and foreign markets, in order to emphasize key issues, leading investors to focus on critical business environment.

Companies, who are interested in entering Chinese market are recommended to re-evaluate the targeting markets, including the legislation, infrastructure, financial supports and incentives, local and national resources. These key issues are the most critical objectives, by reading and reviewing this document, companies will be able to take a close sight inside China's current changes the above mentioned areas, find out the differentiation between investors' research findings, results, and evidences in according of China's national short-term and long-term development plan and implementations, therefore, policy, decision makers are able to prepare plans for coping with unknown risks.

From 2009 to 2011, the author was recruited as Public Relations (PR) and Marketing Manager to TCL-AOBO Environmental Protection and Development CO., LTD., while the company was planning to establish a new project for recycling household appliances in the city's economic zone in Tianjin in the north of China. During the serving years in TCL-AOBO, the most frequent challenges the corporation and the author have been driven to experience, while planning business and market expansion after the final completion of construction and installation of production line in 2010, which holds a 100,000 tons (3 million units) of used household appliance processing capacity (TCL Corporation, 2011). The author had also been assigned to taken tasks of expanding supply chain, procuring WEEE from local EEE retailing merchandise chain during a nationwide pilot project, promoted by three government departments, they are Ministry of Commerce (MOFCOM), R.P.C, financed by Ministry of Finance (MOF), P.R.C, and inspected by and China's Ministry of Environmental Protection (MEP), R.P.C. However, the constraint is remained in recruiting sufficient WEEE resources for maximizing production capacity, in order to efficiently operate its business with profitable outcomes, on the other hand, without sufficient production inputs in a timely manner, the corporation will not be able to bear long period of constant investment injection, until those obstacles are able to

be removed by increasing collecting volumes and production capacity, political changes and supports from central and local government departments.

Therefore, the author is dedicated to conduct the research to assist WEEE recyclers with formulated solutions and recommendations, based on the studies received from Jyväskylä University of applied Science in various subjects in the areas of Marketing research, Business Statistics, Economics, Project Management, Supply Chain Management, and Business Process etc. By conducting the research, tackling research questions and tasks concerning MSE's struggles of fulfilling production capacity and correlating issues. In the following chapters, the author is going to present the audience with a comprehensive image of WEEE collecting and recycling sector in China to audiences who are interested to know WEEE issues, enterprises and potential investors in WEEE collecting and recycling sector.

## **2.2 Introduction of Case Companies in China and Finland**

The thesis has set the foot in a growing market in the WEEE collecting and recycling industrial sector in China, the participants from both collecting and recycling side are going to be the focus group, as their business activities, strategic plan, investment and market development plans about the Chinese market have significantly impact to not only their business decision, performances, but also draws attention from foreign potential investors. Therefore, it is important to present these three companies about their background, their struggle, success, and how they react to a growing and changing market, environment, and policies, to provide the evidence of how Chinese WEEE recycling enterprises are changing to adapt the environment, to also become a real practical reference for foreign investors to evaluate their business plan.

### **2.2.1 About Case Company TCL-AOBO**

TCL-AOBO Environmental Protection and Development Co., Ltd. (Tianjin) is a company jointly invested by TCL Huizhou Environmental Protection Co., Tianjin

Boqi Metal Products Co., Ltd., and Tianjin Ziya Environmental Protection Industry Park Co., Ltd. TCL-AOBO is a high-tech environmental protection venture. As the biggest shareholders with a 200 million Chinese dollars investment, TCL Corporation will follow the EU and China's WEEE Directives, in the manufacturing site, the factory is constructed and installed with high tech recycling production equipment and technologies.

TCL-AOBO is a multipurpose environmental protection corporation. From planning, design, to construction, TCL-AOBO is able to meet the requirement from pilot programs of waste imported appliances. The company is expected to process up to 100,000 tons of electronics and electrical appliances per year.

After the pre-test operation given permit from MEP, TCL-AOBO joined a national pilot project for promoting Old-for-New policy introduced by State Council of Central Government, meanwhile, TCL-AOBO has received official certification for recycling WEEE, Trade License for importing recyclable and non-hazardous parts, and other business operating permits as well. Like any other WEEE recyclers, the only challenge for TCL-AOBO to overcome is to obtain relatively adequate resources to begin its production for generating eco materials and supplying them to its shareholders in manufacturing industrial sector.

### **2.2.2 About Case Company SELOT Environment and Recycling Co., LTD**

SELOT Environment and Recycling Co., LTD was a High Technology enterprise established in 2008, located in Pudong new area of the Shanghai old port industrial park, covers an area of 36522.5 square meters, with registered capital of 6000 million yuan. The main business activities are including collecting, disassembling, sorting and recycling WEEE/E-Waste and Industrial Waste. The recycling capacity of copper, metal and rare metals from wasted circuits is over 50,000 tons and capacity of plastics is over 20,000 tons. SELOT has approved through ISO14001, ISO9001, and OHSAS18001 Certificate, with authorized certificates by both Central and Shanghai Environmental Protection Bureau, including Waste Electrical Electronic Products Processing Qualification Certificate, the Acquisition of producing waste

Metals License, Renewable Resources Recovery Business Registration Certificate and other qualifications. (SELOT Environment and Recycling Co.,LTD, 2014)

The most successful strategic achievement SELOT has accomplished is that, SELOT is the first one established the 5H system for collecting WEEE and industrial waste. 5H system is a collecting network with a central system platform connected with collecting Service Centre, Collecting Services Points, Collecting Services Desk, Collecting and Transfer Warehouse and Mobile Collecting Services Points, covering over 800 services points, desks, and warehouses served by a logistics Team with 30 trucks. The 5H system has become an informatization management model with updated collecting data serving market demand and supply and served by logistics. The new success has made WEEE collecting activity integrated with local business, logistics and electronic commerce. SELOT has increased the volume from about 1000 pieces of WEEE in 2008, 300,000 units WEEE in 2009, 1.2 million units in 2013. (YI, 2014)

It has proven that the competition between WEEE recyclers and collecting firms is not only reflected in advanced technologies and right equipment, but also reflected in an efficient and effective collecting network. Only with stable income of E-Waste resources and relatively low cost of supply, WEEE recycling and collecting business shall survive.

### **2.2.3 About Case Company Kuusakoski Oy**

Kuusakoski Oy is owned by Kuusakoski Group, a family owned business, headquartered in Espoo of Finland, with over 100 years history operating recycling business around the world in 10 countries with 75 locations, and employs approximately 2600 people around the world. The company's turnover in 2013 is 622.2 M€, total volume of recycled and processed material is approximately 2.5 million tonnes. Kuusakoski Oy's investments focused on developing existing processes and recovery efficiency, as well as on strengthening strategic growth

areas, particularly waste electrical and electronic equipment recycling. Geographically investments in the recycling business focused on the USA. WEEE recycling will be continuing the focus for Kuusakoski Oy, due to the WEEE recycling has increased significantly worldwide and offers good opportunities for Kuusakoski's business. (Kuusakoski Oy, 2013)

Kuusakoski Group is a reliable partner in the recycling industry sector, he is striving to become a pioneer of complex material processing services and the market leader in the area of their expertise, focusing on improving efficiency of recycling process, developing new ways of sorting and recovery precious raw material. Kuusakoski Oy produces and sales Aluminium and aluminium scrap, electrical equipment, ferrous scrap, non-ferrous scrap, plastic scrap, precious metals and stainless steel scrap. Except its sales operation, Kuusakoski is also motivated in offering customer-oriented, innovative recycling services and solutions according to customers' orders. (Kuusakoski Oy, 2015)

The current situation of global WEEE recycling industry has significant impact to Kuusakoski Oy's decision on the business operations and investment plans, Kuusakoski Oy is following the trend of continuing to develop WEEE recycling business in the following years, which including not only WEEE recycling, but also both sales of recycling services and solutions. However, during previous years, several WEEE operating locations have more or less faced negative situations. (Kuusakoski Oy, 2013)

Kuusakoski Oy owns 21 plants in Finland, 1 R&D Centre, 4 car crushing plants among them, collecting plants are also included, Jyväskylä is one of them, responsible for collecting different waste and delivering them to other plants or partner plants to continue sorting or go the next recycling process. Metal collecting, recycling, casting are remain the biggest volume among other materials, as well as the most active industrial and business operations for Kuusakoski Group and its Foundry company Alteam Oy in the following year, its main markets are continuing

to be within Nordic Regions and European countries. Aluminium, construction, and plastics are the other main materials along its recycling chain. (Puranen, 2015)

All Kuusakoski Plants have approved by ISO 140001 standards, and all are connected by its own and other partners' logistics network, in order to supply demanded wastes to the right recycling plants, more importantly to produce the right products to meet customers' needs. (Puranen, 2015)

According to Kuusakoski Oy's company financial statement 2013, the WEEE recycling is going to be the focus of the company's business plan and operations. In USA and Great Britain the Kuusakoski Oy has successively built WEEE recycling plants. The main activities of these plants are making reusable electronic products, recycling scrap materials according to customers' orders. The main activities of these plants are making reusable electronic products, recycling scrap materials according to customers' orders. (Puranen, 2015)

As the focus of Kuusakoski Group's business strategy in the following years, WEEE Recycling business operations are going to be more active than ever before, however, based on the market statistics about WEEE Recycling industry, the area around Asia Pacific, especially in China, the annual growth of WEEE for recycling is about 11.10 million tons, about 22.7% of the whole world WEEE 48.9 million tons (UNEP, 2012), and more importantly, in order to meet demand from overseas and its domestic market, the consumption of China takes about 30% of global resources for manufacturing electrical and electronic equipment (Doctor Chen Yong, Director of Research Centre Academic Committee in Chinese Academy of Engineering, 2014) Therefore, what are the most challenges and concerns stopping Kuusakoski to participate in Chinese WEEE collecting and recycling sector?

## 2. RESEARCH PROBLEM AND RESEARCH QUESTIONS

The author has presented in previous chapter to readers about the current economic conditions, environmental and social impacts of the fast growing sector in EEE manufacturing, it shows that China is the biggest manufacturing and exporting nation. China's activities of stakeholders, including EEE Retailers, WEEE recyclers and Collectors are remained active and progressive through the WEEE industrial chain along with performances of case companies' main operations

China's political and economic reform towards social and environmental change, the constraint has been the inadequate amount WEEE for meeting the production capacities of both domestic and foreign enterprises. Recyclers have been of complaining the severe and unfair competition with uncertified WEEE dealers. Uncertified WEEE private dealers are usually operated by family businesses, whose operating and labour costs cannot even be compared with the cost of a single running production line for recovering plastics from WEEE.

In order to continue the research on the subject with the prospective of delivering instrumental information about the business activities of WEEE collecting and recycling recommendations and suggestions, it is vital to allocate what are the most interested areas where challenges, problems and solutions occur from an investor's point of view in the WEEE sector, Therefore, based on the introduction of the case companies including the difficulties, challenges, success and concerns they have encountered, the author is presenting the main objectives that the thesis is trying to achieve.

Research Questions:

1. If there are markets with educated and motivated customers, national incentives, updated regulations and a legislation framework, what are the determining factors that should be analysed analysed, or tested before considering a new investment plan in China?



2. Can a Chinese/Foreign Company change their strategies in favour of the Chinese Domestic market?
3. What will be the most important credentials that make a Chinese partner stand out in the future business cooperation in China?
4. What are the benefits and drawbacks while working with a Chinese Joint venture/partnership/private investor?
5. What are the most important and significant challenges and concerns stopping foreign investors from participating in the Chinese WEEE recycling sector?
6. What incentives, financial support and assisting services will be available for High-Tech WEEE recyclers? And what are the conditions of applying it?
7. From an investor's point of view, what would be the political and economic expectations foreign investors have in the near future in the recycling industry sector in China.

### **3. IMPLEMENTATION OF RESEARCH**

#### **3.1 Research Methods**

Through qualitative research of published data, references and a selected interviews with personnel in WEEE recycling enterprises and public consumers, as well as a case study of a national wide pilot project operating in China called 'Replacement for Household Appliances' will be conducted through the manners of facts and discussion presenting to help readers to understand the background and the current status of stakeholders in this industry; Based on the research of the background, project analysis, discussions with participants, an applicable recommendation will also be presented at the end of this research paper based on the knowledge of this industrial sector.

Investigating current WEEE/E-Waste recycling system and the material flow will assist readers to understand the circular economic chain, as well as the challenges

and concerned occurred along it. An exclusive market research through qualitative research method in the form of interview with business senior directors, managers will be shown in the chapter of Executive Interviews. Business practices in recycling sector along the Circular Chain will be shown in the Chapter of Case Study: Current Business Practice and Challenges for Chinese Enterprises, in this case study, based on the political, social and economic conditions, a conclusion, recommendable and applicable solution will be presented in the following chapter, which will summarize the final thesis with a statement as the results.

Therefore, in this section, providing an image of China's economic and social status, environmental policy and legislation framework, as well as social conditions in WEEE collecting and recycling area, the process of implementing theories and concepts into business practices become associated and it is the fundamental basis for continuing the research study on the following chapters or further investigations. It is of the interest and obligation as International Business student to present the facts and challenges Chinese and foreign enterprises are facing today along the WEEE recycling chain, which involves the key players called stakeholders in the circle, particularly in the sector of Recycling industry, it is a transitioning point for manufacturing, logistics, customers, retailers, and policy makers in the middle of the upstream and downstream in the industrial chain.

The thesis has been designed and formulated mainly in the following four stages:

1. Present the current status of WEEE recycling sector in legislation, economy, societal and environmental aspects;
2. State original material flow and the circulation of material flow process in China, and clarify the complication of combined challenges business enterprises facing in WEEE/E-Waste collecting and recycling sector;
3. Introduction of Case companies, and Case study of the WEEE/E-waste operations, investigate the core responsibilities of stakeholders along with the circulation chain of WEEE material flow in operation, indicate the advantages and disadvantages after the implementation of the pilot project

4. Involve the vital stakeholders to the interviews and discussions of what are the most challenging aspects for them to survive in WEEE/E-Waste Recycling industry, and what is their current solution for surviving in the industrial sector.

An interview among managers from enterprises in China had conducted online through questionnaire, email and international phone call. The focused interview group were invited separately from time to time from January to April in 2014. Interviewees had involved along the research are executive and senior managers from private, international and national enterprises, corporations, their statement and provided data will be quoted and referred in appendix. For the convenience to the observing group and the accuracy from the data collected through questionnaires, the questionnaires have two versions written in Chinese and English. At the final stage of this research is to conclude the results of this research study and presenting the reader with opinion, comments and conclusion from both public and private enterprises perspectives.

#### **4.2 Source of Research Data**

The secondary data are as supportive evidence to prove that the research environment and research target groups in WEEE collecting and recycling sector. These data are the occurring facts stated gradually in the previous chapters in four main aspects of economy, political, social and environment. The facts and data the research is investigating to support reaching the objectives are from published articles, journals, news, documentaries of government or international organization's policies, regulations, legislations, and other internet information source, cote are reliable based on a time frame, but lack of validity to future prediction and further study, can only be as historical acknowledgement, due to the instability and developing phase in the research country, as well as the projects and companies situated in the target market. Therefore, the principle of research method is relying on constant research towards the objectives in its environment and playing roles in the targeted markets.

There is also a lack of empirical evidence among the secondary data in the perspective of how targeted groups in business area interacting to cope with the implementation of political, economic reforms, therefore it is vital as the main goal in this research study to understand how main stakeholders, case company operate in pilot projects organized and promoted by Chinese government, and how companies survive before and after the milestone. However, based on the results of secondary data, the author is able to study and conclude the results to the readers regarding research questions.

The primary data have been collected through interviews with Enterprises managers, which is conducted at the phase after the study of case companies and pilot project. The participants are chosen according to the interviewee's working background. The main participants are from the area of recycling field. The interview results will be attached to the appendix. The objectives of research question will be answered in the discussion section, and recommended solution for recycling enterprises will be argued and presented at the following.

#### **4. THEORETICAL BASIS**

On a large scale, electronics manufacturers from around the world are nowadays obligated to follow the WEEE Directives and the regulations required by the importing countries in order to regulate the WEEE market and protect the environment and the well being of societies from the increasingly accumulating WEEE/E-Waste pollution. As the world's largest exporter and manufacturer of Electrical and Electronic Equipment, China is on the spotlight of her global customers, as well as the companies, to follow the international requirements in WEEE regulations and legislation in its own territory and other nations.

Under the guidelines of the EU WEEE Directives (European Parliament and of the Council, 2012), along with the concepts of developing business in a Circular Economy (TOWARDS THE CIRCULAR ECONOMY - Economic and business rationale for an accelerated transition, 2012), its Framework, implementations of 3R (Reduce, Reuse and Recycle), they are classified in Waste Management Hierarchy (Wikipedia,

2011), within the manufacturing sector, a traditional industrial framework is currently upgrading the industrial system to a Sustainable Industrial Systems (Frosch, A, E, & Gallopoulos, 1989, 144-152), as well as implementing a Sustainable Development (United Nation, 1987) strategy.

What is WEEE? WEEE is a complex mixture of materials and components that because of the imbedded hazardous content, and if not properly managed, can cause major environmental and health problems. Moreover, the production of modern electronics requires the use of scarce and expensive resources (e.g. around 10% of the total gold worldwide is used for their production). (European Commission, 2015) Therefore, it requires a specialized segregation, collection, transportation, treatment and disposal (UNEP, 2011).

China has been driven to encourage and give stimulation packages to electrical and electronic equipment (EEE) manufacturers and associated corporation entities to react to the change of her promotion of a circular economy. The government has been learning and introducing compatible social, economic and political strategies from developed countries in these aspects to the phase of integrating and implementing them among pre-test nationally driven WEEE oriented pilot programs and projects. Based on practical learning during pilot programs and projects, China has been building a compatible and adjustable legislation framework and a comprehensive system for a nation wide observation of collecting and recycling activities.

### **5.1 Key Conceptual Framework**

As China has been focusing on consolidating its economic and industrial infrastructure, the most energy consuming industry sectors are encountering changes from industrial revolution in the context of promoting Green Economy introduced by United Nations in United Nation Environment Program (UNEP), in an international scale, which has led China to face the state of over consuming its natural resources in an unsustainable pattern.

The introduction and enforcement of developing a Circular Economy to promote the idea of circular economy is far ideological from the current status of Chinese Economic Development. It is a generic term for an industrial economy that is, by design or intention, restorative and in which materials flows are of two types, biological nutrients, designed to re-enter the biosphere safely, and technical nutrients, which are designed to circulate at high quality without entering the biosphere. In reality, China's development in building Infrastructure, industrial chain and enterprises production system has been designed in the way that resulted in unsustainability and inefficiency in abstaining recourse from environment. (Wikipedia, 2015.5.10)

What is Circular Economy in short description? The circular economy is a generic term for an industrial economy that is, by design or intention, restorative and in which material flows are of two types, biological nutrients, designed to re-enter the biosphere safely, and technical nutrients, which are designed to circulate at high quality without entering the biosphere. (Wikipedia, 2015.05.10) In the aspect of WEEE collecting and recycling sector, Circular Economy is intended to improve the environmental management of WEEE and to contribute the economy by enhancing resource efficiency the improving collection, treatment and recycling of electronics at the end of their life. (European Commision, 2015)

Another important term is 3R (Reduce, Reuse and Recycle) (Wikipedia, 2011) along the industrial value chain it has become the tackling solution for dissolving the problems in increasing and maintaining sustainability for upgrading its industrial development through gradually changing its Linear Model system to a Circular System. (UNEP, 2011) Through A linear model of resource consumption encourages the "take - make - dispose" customer behaviour. Companies selling manufactured products, which extracted raw material from environment, sold to customers, who then discarded them when it no longer serves the purpose. The volumes and the prices used and disposed along the linear system have been increasing throughout the last decade. Therefore, while practicing and regulating the market of WEEE collecting and recycling among enterprises, programs and projects, implementing 3R is going to have significant impact to their performances.

## **5.2 Series State Reforms of Economy, Policies and Legislations**

Today's global economy has been dramatically influenced and changed since China's opening up to welcome foreign investment to its social development plan for market economy in various sectors since 1979 (Morrison, 2011) (Wayne M. Morrison, June 24, 2011, China's Economic Conditions), with a 9.8 % real growth in millions of US dollars (THE WORLD BANK GROUP), up to in 2011, had achieved GDP about 10.3 percentage real growth, after United States ranking at world number 2, before Japan, France, Germany, United Kingdom and etc. (THE WORLD BANK GROUP) It was Driven by China's market oriented economic strategy, there are environmental and social impacts arising along its development, vast natural resource and raw materials are pooling into the sector of manufacturing, accompanied the success of the its sector in exporting and importing to a global scale. By the time of electronic and information technology has become the vital tool in both developed and developing world, the label of "Made in China" has become a national brand to the global market, and nevertheless, the consequences are the loss of enormous valuable resources and raw materials behind its economic achievements.

Considering the circumstances that China's rapid development in urbanization, industrialization and integrated information society, electrical and electronic equipment (EEE)/products are becoming the most spread iconic representative of modernization and irreplaceable in people's life, it appears everywhere in business and industrial sectors, residential communities, public services, and it is the most growing sector overall in China's economic development. Especially, as China is becoming one of the biggest trading partners worldwide in Electrical and Electronic Equipment (EEE) manufacturing industry (Morrison, 2011), it has the highest contribution about 24.6% over all trading items in the catalogue shown in Table 1, and it has been one of the major revenue with a 388.9 billion US dollars to China's exporting, economic and GDP growth.

TABLE 1. Major Chinese Exports 2010

HS Code	Description	\$billions	Percent of Total	2010/2009 % Change
	World	1,578.4	100.0	31.3
85	Electrical machinery (such as computers and parts)	388.9	24.6	29.1
84	Machinery	310.0	19.6	31.4
61	Knit apparel	66.7	4.2	24.1
62	Woven apparel	54.4	3.4	16.3
90	Optical, photographic, cinematographic, measuring checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof	52.2	3.3	34.0
94	Furniture and bedding	50.6	3.2	29.9
89	Ships and boats	40.3	2.6	42.3
73	Iron and steel products	39.2	2.5	15.9
87	Vehicles, except railway (mainly auto parts, motorcycles, trucks, and bicycles)	38.4	2.4	37.4
64	Footwear	35.6	2.3	27.2

(Source: Morrison, 2011)

During the past decades, the prices of the most top used raw materials in Electronics manufacture industrial have been risen up dramatically, and the resources being used for generating the products are becoming more expensive year by year (MacArthur, 2012), it is crucially the reality that not only all manufactures are facing today, down to the bottom, it has become a burden to all end users as well, more critically for manufacturers in developing nation China. Mainly industrial revenues, China has been being concerned for its future plans in the prospects of changing its environment and social development towards abusively over taking its natural resources for industrial development purposes.

When the bloom of EEE manufacturing industrial sector is continuing to be, consequently, what China is facing today is the crucial fact that not only the market price of the amount of natural resources and raw materials needed to maintain its



production capacity, a sustainable growing economy, that have been strengthened up gradually in a yearly basis, but also the cause driven by its enormous market demand, for example, the metals consumption in China, the refined metal consumption grew by 17 times since 1990 and its share of world refined metal consumption have increased from 5 percentage to 41 percentage up still, while the demand in the rest of the world has not been essentially changed, it is unquestionably showing that China is the major driver of metals demand and market price (THE WORLD BANK, January,2012) shown in Figure 1. Without exception, China owns the biggest market share of EEE with a growing population of 1.3 billion in its domestic market, excluding its foreign market share. Therefore, once again, developing its domestic reusable and recyclable WEEE market should be one of the focus tasks while tackling WEEE issues.

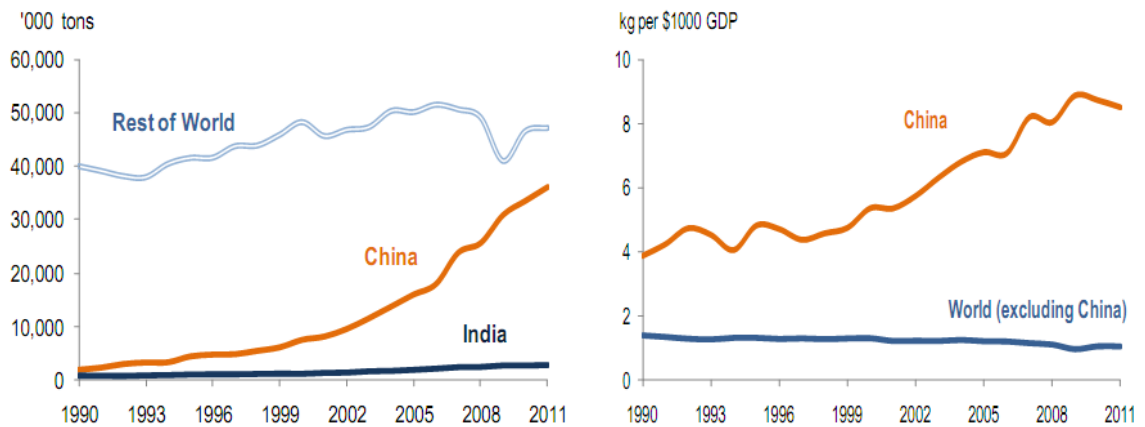


FIGURE 1. Refined metal consumption (right) and Metal consumption intensity (left)

The overview of the commodity trend in EEE industry in a global scale is surprisingly one of the fast growing sectors among all others in the 21 century shown in Figure 2. Today's economy, the price and the quantity of raw material resource extract from environment used in manufacturing has been increasing and volatile through timeline between 2000 – 2012, take a view of the latest "Price & Chart for High Grade Copper" as one example (NASDAQ MarketSite), in Figure 3, it

shows the Commodity Price Quotes for Copper in trend from January 2000 to April, 2012.

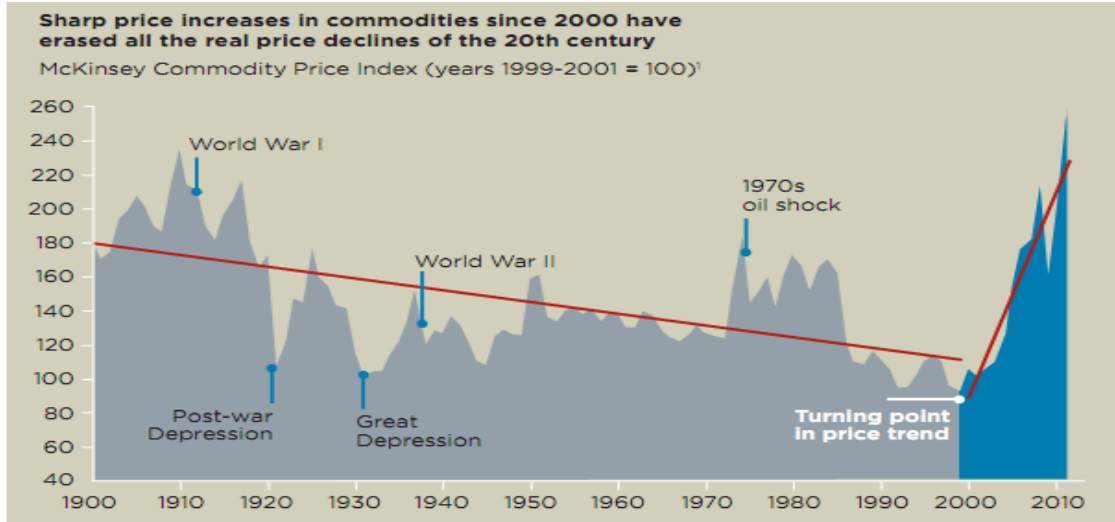


FIGURE 2. McKinsey Commodity Price Index (years 1999-2001 = 100) 1

(Source: TOWARDS THE CIRCULAR ECONOMY - Economic and business rationale for an accelerated transition, 2012)



FIGURE 3. Latest Price & Chart for High Grade Copper

(Source: NASDAQ MarketSite)

It is no doubt, in order to be continuously growing in its industrial sectors to meet both domestic and global need, meanwhile the demand of natural resource and raw materials is going to be continuously robust and constantly volatile, it put China at a position where a long term strategy towards a sustainable circular and eco-economics (Wikipedia, 2015) has to be implemented and it is going to take a considerable amount of periods to come across development barriers, more importantly, once it succeed to meet its development requirements, it is going to be historical momentum for China with its political and economic infrastructure changes. Therefore, to apply the concept of mining and refining the rich mineral resources and other raw materials reserved within its 'Urban Mines' is going to be beneficial of China's overall development in a green way.

In order to recover its overall negative influences to environment and social damages caused by industrialization development, a continuous and gradual change in China's political and economic reforms during the past decades concerning development status in the industrial field, as well as the upcoming challenges toward upgrading it to a more advanced development phase, where a more sustainable economic and political strategy with a comprehensive and effective infrastructure system have implemented gradually, in the case of implementing a strategy and practical programs while conducting and adjusting the WEEE directive within Chinese social context, it is necessary to explore the challenges, difficulties and intentions of upgrading the Chinese industrial system.

While China is growing into the biggest market in emerging economies for home appliances, personal electrical and electronic products with the world's biggest population above 1.3 billion in its domestic market, excluding an annually growing exporting global market share of electronic and electrical equipment (EEE), inevitably, China is the centre of manufacturing industry for EEE in the world, even though, gradually, the cost of labour and raw material is currently arising up in a yearly basis, which has lead to the result of the shifting change for domestic and foreign investors in EEE manufacturing business to decide to relocation in less

expensive countries in Southeast Asia, such as Vietnam, Thailand, Malaysia and etc., where labour and material cost are still relatively low compare to China. However, according to the facts from some foreign investors and multinational corporations have EEE manufacturing located in mainland (Economist, 2012), China is still holding advantages in sophisticated supplying chain and social infrastructures that other countries such as Vietnam, Malaysia are currently still not sufficient enough for them to relocate all their factories to there, it is still risky at this moment.

China has been transitioning towards its Growth Economic Strategy from attracting Foreign Direct Investment (FDI) to Overseas Direct Investment (ODI) since 1990s. Chinese Government initiated the ODI in 2000 to encourage enterprises to participate in international market in foreign countries, especially for State-Owned Enterprises (SOEs). Originally, the FDI economic growth strategy was planned to gain access to foreign technology, management skills through Joint Ventures, in order to help domestic firms to become competitive in international competition. Now, attempting to approach its economic goals by launching ODI is substantially the fundamental need in order to upgrade and maintain its global economic status not to fall, accompanied by the rapidly growing competitiveness from other neighbouring nations. To be able to guarantee the opening portal for industries to obtain adequate energy and raw materials to run its economic growth, In 2006, Chinese government issued its goal of “building a harmonious socialist society”, amongst, improve the regulations, enhance environmental protection are addressed as the initial steps taken to achieve it.

After the European Union introduced the Waste of Electrical and Electronic Equipment (WEEE) recovery and recycling legislation in 2002, it was six years later, A Circular Economy Promotion Law was developed and approved on August 29 in 2008 in People’s Republic of China, and it came into force on January 1 in 2009. The core of WEEE legislation is the Extended Producer Responsibility (EPR). In China, the WEEE is based on existing environmental legislation from other parts of the world, and its key function is to apply the idea of establishing a centralized recovery and recycling system. In the following year 2009, the enforcement of China’s Circular Economy Promotion Law (Standing Committee of 11th National People's Congress,

2008) have planted into its legal system, the focus of its economic development strategic plan and implementations have been at the stage of tackling the problems caused by massive production, consumption and waste, which has led to severe and critical consequences to its further growth under the current societal, environmental and economic conditions. The principal of Circular Economy Promotion Law is to apply 3R “Reduce, Reuse, and Recycle” for the development of China’s sustainable economy, society and environment preservation (Invest in China, 2008). The regulations generated after the Circular Economy Promotion law is the enforcement of the first time introduction of Recovery Processing of Waste Electrical and Electronic Products law (Country Analysis Paper, 5-7 October 2011) in China.

Along with environmental policies taken action in China, there are other challenges facing China’s economic oriented development strategy during financial crisis (2008) towards the growing world trade in industrial sector of electronics manufacturing and accompanied by its supplier chain and distribution line in a traditional linear consumption model (TOWARDS THE CIRCULAR ECONOMY - Economic and business rationale for an accelerated transition, 2012), which follows the pattern of ‘take-make-dispose’ while a product reached its end of their life-cycle. In order to be sustainable in economic and social development, further steps have been taken by the government of PRC, a series plan of piloting Circular test among major cities and stimulating projects have taken places. A national wide pilot project in major municipalities, such as Peking, Shanghai, Tianjin, Shandong and etc., to pre-operate the WEEE collection movements among stakeholders in EEE Industry, in order to observe and improve the overall progress and outcomes of the implementation of WEEE National Demonstration Projects.

### **5.3 Impact from WEEE to Environmental and Society**

Since the development of Information Technology has become the biggest industry, and the accelerated replacement rate of various types of electronics products are continuous introductions of new products to the markets, the phase out EEE have become one of the fast growing types of solid wastes, such as discarded computers,

appliances, telephones and other EEE scrap generated along with the manufacturing processes. During the life-cycle transition from raw materials to e-waste, the outcomes are not only the loss of a huge amount of natural resources, but more severely, the damage of vast environmental and social wealth caused by improper disposal and handling means. There is about 2.3 million tons of EEE waste generated every year in China, which is becoming the second biggest e-waste dumping ground in the world. The extended contamination of e-waste pollution is more severe than any other nation is facing. (EEDU Organization, 2011)

The content of WEEE can be harmful when it is exposed to the environment, or dismantled improperly. The components within WEEE (such as the separate parts from wasted televisions, computers, monitors, refrigerators, washing machines, mobile phones, etc.), half of which contain a large amount of toxic chemicals and hazardous substances (such as lead, cadmium, mercury, hexavalent chromium, PVC, brominated flame retardants. In one CRT set, there are about 4 to 8 pounds of lead contained in the Cathode-ray tube; there are about 700 kinds of chemical materials used for manufacturing one computer, and among them about 300 are harmful to the safety of a human being. More than 1 kilogram of lead contained in a CRT monitor has a destructive effect on the blood system, nerves and kidney; the computer switches and chromium compounds and mercury, chromium compounds will cause asthma through the skin cell infiltration; mercury affects the nerve system; chromium, mercury and other chemical elements contained in the disk drive will have destructive effects on human cells, DNA and brain tissues. (Zha Xi, 2007, p. 1)

#### **5.4 Performances of WEEE Stakeholders**

The stakeholders are from political aspect, individual customers, business and governmental sectors, registered and authorized home appliance and EEE retailers, collectors and recyclers. Each of them is playing a critical role in the information, material flow and conducting of WEEE/E-Waste recycling production. However, the principal among the contributors and the activities emerging along the circular

industry chain, no doubt, the central responsibilities are lying on the political policy makers, leaders in central and local government agencies, associated with influential roles on the business and industrial side in manufacturing, retailing, logistics and recycling field. More importantly, a constant commitment need to be in place, where a cooperative, strategic and effective plan and target settled by both parties, in order to create a more changing and improving environment.

The so-called 'Urban Mines' has become a new concept and path for China to exploring and developing the unreleased value among itself, it requires the fully participation from stakeholders within its own society in manufacturing, distributing, collecting and recycling aspects. The government of China has been playing a leading role in building a sustainable economy model for developing 'Urban Mining', including the planning and implementing a long term oriented green economic strategy, such as installation and practices of reconstructing its industrial chain in its local economic industrial zones in major cities, enforcement of legislation in environmental, social and corporate aspects, installation of collection and recycling system in EEE manufacturing industrial sector, promotions for encouraging 3R in waste management industries (UNITED NATIONS, 2004).

In practices, WEEE flow from the consumers to reach its final destination for recycling through the whole industrial chain, there are several informal and formal channels along the chain, and in the past decades, it has been gradually involving different parties in private business sector, MSEs specializing in recycling and recovery sectors, as well as central and local governments' as observation and administration role. Some of their performances have great influence to the overall Chinese social and environmental wellbeing, and it has also drawn attentions in international scale.

Along the WEEE flow, start from WEEE inventory and crude dismantling, they are mostly taken place at the less developed remote rural areas from cities, where dismantling and recycling process are being held mainly by intensive workforces and unprotected labours. In many places, such as in the countryside, there are only using temporary and exposing inventory at the backyard of individual owner's

workshop, the small scale businesses are usually owned by families or informal partners. They are playing the role as private dealers with the two main functions: one is to repair those electronics for consumers or sold them to second hand markets for larger profits, the unfixable products or parts will be sold to local reclamation depot, but unfortunately the ones with value contained will be brutally taken out through using chemicals or burning methods to withdraw from, such as gold, copper, different metals. The private dealers are also called collectors or hawkers in China.

At most local reclamation depot, under the observation from local environmental mechanism, the electronics wastes have to be sent to the recycling sites, where environmental companies with recycling certificates such as ISO14000 related to environmental management (ISO International Organization for Standardization, 1947) production capacity, approved operation paper from central and local government.

Over the recycling sites, the cost of maintain its production capacity and operating cost has huge amount of barriers to come across, in most environmental projects, to be able to meet monthly or seasonal production targets, there are difficulties of be able to procurement the sufficient WEEE from the local supplying channels, in order to guarantee its operating activities, as a common, results, most of the enterprises in this industrial field, have to operate under governmental support in finance, which is rarely adequate for them to survive.

Chinese Electronics Manufacturing Companies with large amount of trading quotes to its local and global markets, such as manufacturing for exporting to its domestic markets and foreign countries within Europe Union, have to adopt Europe's Recycling and Manufacturing Standards, all of the manufactured products comply with Directive 2002/96/EC, a legislation enacted by the European Union regulating the disposal of WEEE, also commonly called the WEEE directive. Since then, electronics producers are obligated to the Producer Responsibility Principle of WEEE for these exported and retired products, including registering in the host nation for financing take back scheme and recycling operations.



Retailers and wholesalers are recently playing a central role among WEEE collectors and recyclers in China, this is due to a Policy issued by Central Chinese Government for stimulating domestic demand, and to promote upgrading in Electronics Manufacturing industry development. Strategically speaking, it is an economic stimulus package promoted by Chinese Government to reduce the influence from a spreading global financial recession since 2007. Retailers have an established distribution chain and mature logistic channel to assist the take back scheme of retired home appliances and the circulation of WEEE. A case study will be studied in the following chapter, concerning the economic stimulation package and the cooperation among stakeholders.

## **5. CASE STUDY OF WEEE DEMONSTRATION PROJECT**

A national stimulation package to boost domestic demand was a successful strategy implemented by Chinese government during the World Financial Crisis in 2009, in order to maintain China's growing trend in GDP. The estimated amount of investment for Sustainable Environment Projects was settled up to 210 billion Yuan among a '4-trillion-Yuan investment portfolio', according to NDRC Director Zhang Ping at the NDRC Conference. (CAIJING MAGAZINE, Wang Changyong, 2009)

To achieving the goal of maintaining sustainable environmental from negative impacts from WEEE, in 2009, during Executive meetings of the State Council of People's Republic of China, the special operational policy measurement of- Replacing Households Appliances, had submitted and approved to the stage of operation for achieving the goals of expanding domestic demand, increasing efficiency in energy usage, reducing environmental contamination, energy saving and emission deduction, circular economic promotion. A Financial aids up to two billion Renminbi (RMB) Yuan were injected by the government agency of Ministry of Finance, approved in the State Council Meeting. It is a historical beginning for the further upgrading and development of WEEE (National Development and Reform Commission).

## 5.1 Project Implementation and Incentives

The period of the Pilot Project was set from January, 1st, 2009 until 31st, November, 2011 and the first experimental cities for Replacement of Households Appliances was held in main urban cities and provinces including Beijing, Shanghai, Tianjin, Jiangsu, Zhejiang, Shandong, Guangdong, Fuzhou, and Changsha. In 2010, the participated cities were extended to 8 metropolises, 22 provinces, 5 autonomous regions and 1 in XPCC across China as shown in Table 2.

Without understanding of the main statistics of regional geographical characteristics, it is hard to estimate the necessity of increasing amount of stakeholders in regional markets, more importantly, the intensity of local population per square kilometre (sq.km), GDP per Capital, and the number of certified stakeholders in retailing, collecting and recycling along the industrial value chain will be the determination for both central government agencies and other stakeholders to observe and adjust practical strategies in their operation planning. In the following Table 2 shown that, most of the main 9 cities are above the ranking list according to population density per sq.km and GDP per capital of US dollars. On the other hand, due to the investment risks and high industrial standard in recycling business, the numbers of recyclers are not comparable to the number of stakeholders in EEE retailing and collecting business. There is a big percentage of stakeholders from retailing sector also certified and given permission of collecting WEEE. However, the gap between the numbers of stakeholders in EEE retailing, collecting with recyclers has been one of the central factors.

TABLE 2. Regions in National Demonstration for Replacement of Household Appliances

NO	Experimental Regions	Registered and Certified Companies			Population Density (p/sq.km)	Geographic Dimension (mil sq.km)	GDP Per Capital\$
		EEE Retailing	Collection	Recycling			
<b>(Cities)</b>							
1	Beijing	22	31	2	823	1.68	12447
2	Changsha	39	21	2	596	1.18	11000
3	Chongqing	24	20	3	382	8.23	5373
4	Dalian	12	12	1	468	1.26	11000
5	Fuzhou	36	36	1	570	1.2	2098
6	Qingdao	34	31	1	801	1.1	10835
7	Shanghai	60	30	5	2640	0.58	12784
8	Tianjin	22	19	4	886	1.1	13392
9	Xiamen	15	16	1	2245	1.6	10947
<b>(Provinces)</b>							
10	Anhui	42	49	5	429	13	3932
11	Fujian	2	5	1	285	12	7344
12	Gansu	14	15	2	57	39	3009
13	Guangdong	53	51	5	481	17.79	7819
14	Guizhou	17	15	2	200	17	2495
15	Hainan	13	18	2	224	3.4	4429
16	Hebei	40	40	3	355	19	5221
17	Heilongjiang	28	29	2	81	46	5053
18	Henan	80	89	7	553	16	4446
19	Hubei	28	36	7	325	18	5300
20	Hunan	70	64	4	304	21	4628
21	Jiangsu	98	98	5	724	10	9448
22	Jiangxi	44	42	4	247	16	4226
23	Jilin	19	19	5	151	18	5863
24	Liaoning	15	14	3	291	15	7795
25	Qinghai	13	12	1	7.2	72	4463
26	Shandong	17	19	2	579	15	7273
27	Shan(-)xi(-)	17	25	4	212	15	4769
28	Shan(v)xi(-)	18	23	1	185	19	5140
29	Sichuan	28	29	4	172	48	4048
30	Yunan	30	19	2	109	38	3952
31	Zhejiang	92	85	5	460	10	9115
<b>(Minority Autonomous Regions)</b>							
32	Guangxi ZhuangZu	32	35	1	190	23	3945
33	Inner Mongolia	17	17	2	20	110	8773
34	Ningxia HuiZu	12	14	1	85	6.6	5062
35	Tibet	3	3	1	2.1	120	3120
36	Xinjiang Uygur	16	22	2	11.7	160	4685
	TOTAL	1122	1103	103	--	935.72	

(Source: China Internet Information Center,Zhangshao Lei, 2012)

The WEEE or obsolete electronic equipment were including 5 major electronic equipment, they are television, refrigerator, air conditioning, wash machine, computer. The stakeholders involved in this national movement are manufacturers, retailers, collectors and recyclers in those experimental cities. A subsidy of 10 % of discount had given to customers after they have purchased new products, the subsidy are under a limit of discount maximum up to 400 RMB will be given to customer, depending on the waste and obsolete unit. Who returned and purchased new products from registered and certified retailer store (National Development and Reform Commission). Rumours of restarting the Pilot in 2012 has been discussed in local social media channels, but there has not been any officially claimed by Central Government.

The total amount of stakeholders along the collection and recycling chain have received financial aid from Local Finance Bureau in a monthly or seasonally basis is not released, but by interviewing WEEE recyclers in major cities, they are constantly reporting and receiving funds from its local commerce commission offices, but not in a regular basis. The collector in the logistic chain will receive a fixed amount of subsidy from local government for the registered model of a WEEE, which was registered during the purchasing process in a retailer store, after the monthly or seasonal data of total WEEE collection shown as in Table 3. As well as the recycler, they will be given a fixed amount of subsidy for every dismantled WEEE showing in Table 4.

TABLE 3. Standard Subsidy of collection Cost for Replacement of Household Appliance

WEEE	Model		Original Standard(Yuan/Per Set)		New Standard(Yuan/Per Set)	
			<150 km	>150 km(incl.150 km)	<150 km	>150 km(incl.150 km)
Television	CRT SET	<21" (incl. 21")	20	30	30	40
		>21"	30	40	40	50
	Flat Television	<25" (incl. 25")	20	30	30	40
		>25"	25	35	35	45
Refrigerator	< 220L (incl. 220L)		30	40	40	50
	>220L		40	50	50	60
Washing Machine	<5kg (incl. 5kg)		30	40	40	50
	>5kg		40	50	50	60
Air Conditioner	window air conditioner		20	30	30	40
	wall-hanging air conditioner		30	40	40	50
	Vertical air conditioner		40	50	50	60
Computer	<14" (incl. 14")		20	30	30	40
	>14"		25	35	35	45

(Source: Ministry of Commerce, Ministry of Finance of PRC, 2009)

TABLE 4. Subsidy of Recycling for Replacement of Household Appliances

WEEE	Model	Standard (Yuan/Per Set)
Television	CRT Set	15
	Flat Television	
Refrigerator	-	20
Air Conditioner	-	-
Wash Machine	-	5
Computer	-	15

(Source: Ministry of Commerce, Ministry of Finance, PRC, 2010)

## 5.2 Analysis and Discussion

The gap between EEE Retailing, Collecting with Recycling activities have about less than or around 10% of recyclers in each city shown in Figure 4, in comparison with the number of recyclers in provincial level, the result of percentage is fluctuating among provinces, see Figure 5. Although the numbers of recycling operators in

autonomous are similar to the degree of percentage in main cities shown in Figure6, however the density of population and GDP per capital between those 2 categories are not comparable at all.

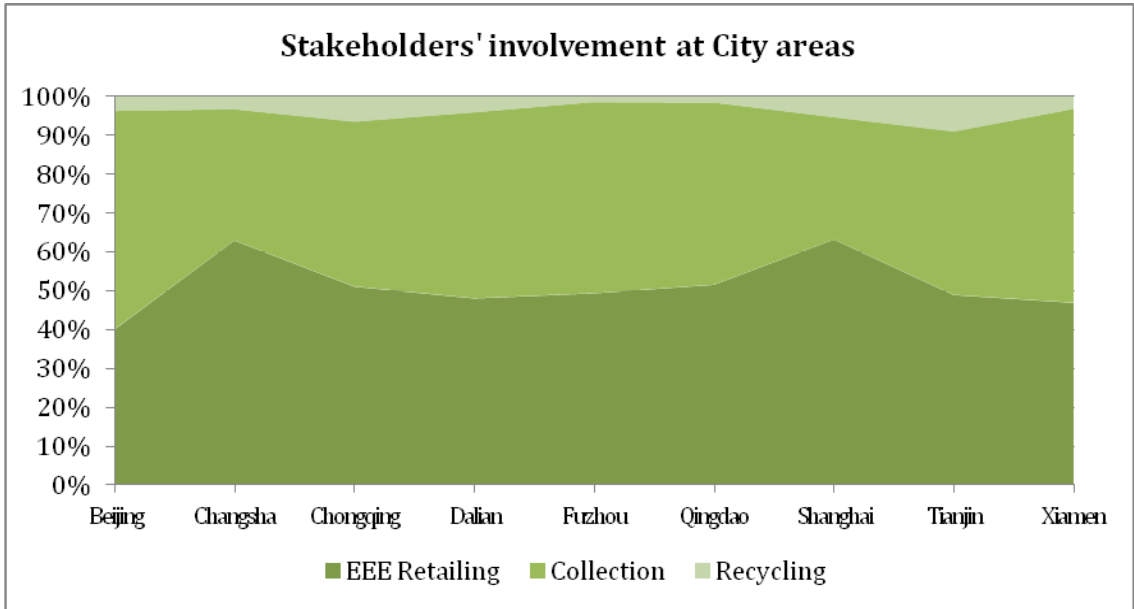


FIGURE 4. Stakeholder's involvement in demonstration cities

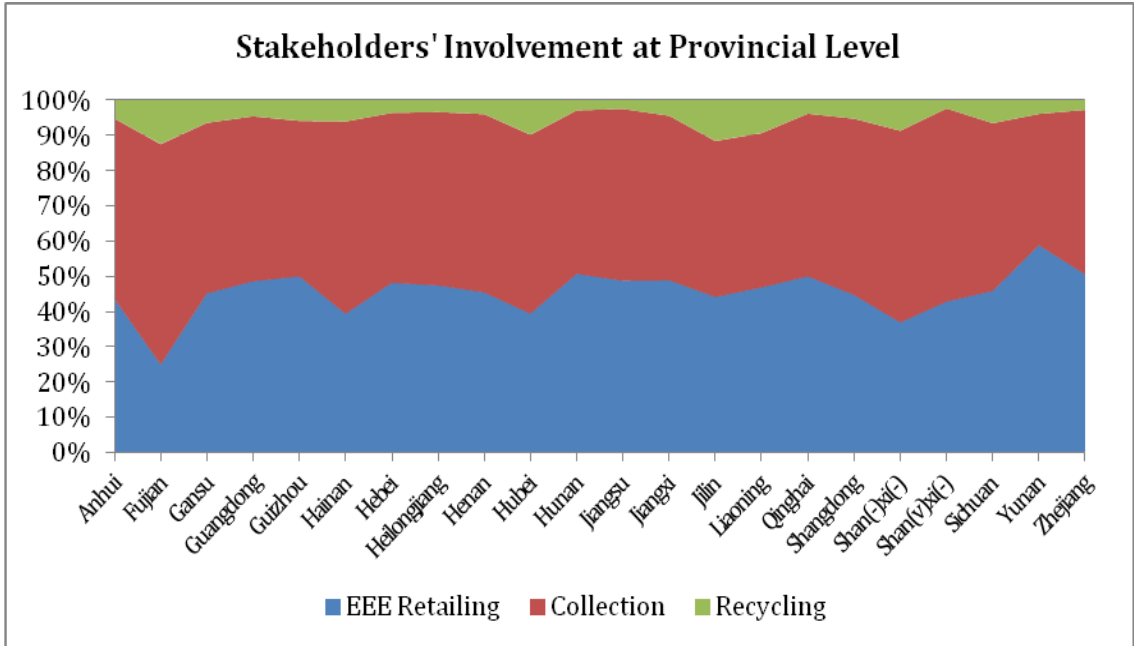


FIGURE 5. Stakeholder's involvement at the provincial level

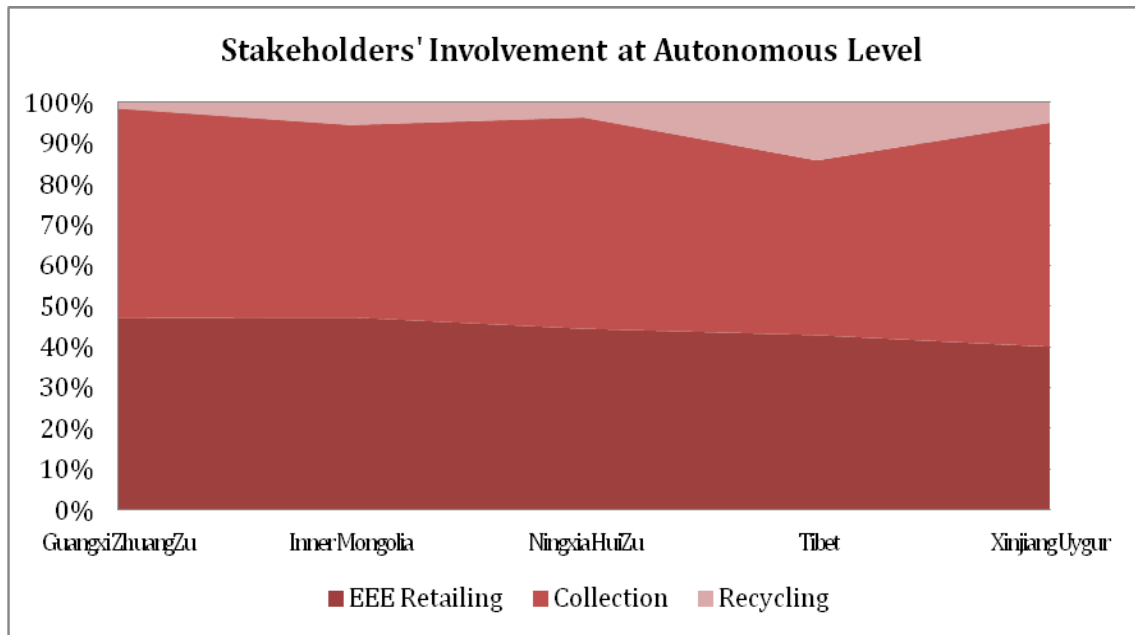


FIGURE 6. Stakeholder's involvement at the autonomous level

The number of certified EEE retailers is almost comparable to the number of collectors in each region, even the number of WEEE recyclers is far behind see Figure 7, the capacity for recyclers in each region are remained operational production towards the amount of WEEE received from collectors and retailers. As a demonstration project for recruiting and recycling WEEE, the central goal is to promote sustainable economy by recycling and circulating reusable materials in the industrial value chain. However, geographically speaking, the determinant factors of whether and how to implement the demonstration project are based on the population figures, degree of development, and geographic size of the regions. For example, as shown in Figure 8, in the areas of Xinjiang and Tibet, the numbers of recyclers, retailers and collectors are considerably small than in any other metropole such as the Jiang Su province, even though the geographic scale is massive, but the level of development has been lower in comparison to the cities in the southeast of China or on the central mainland.

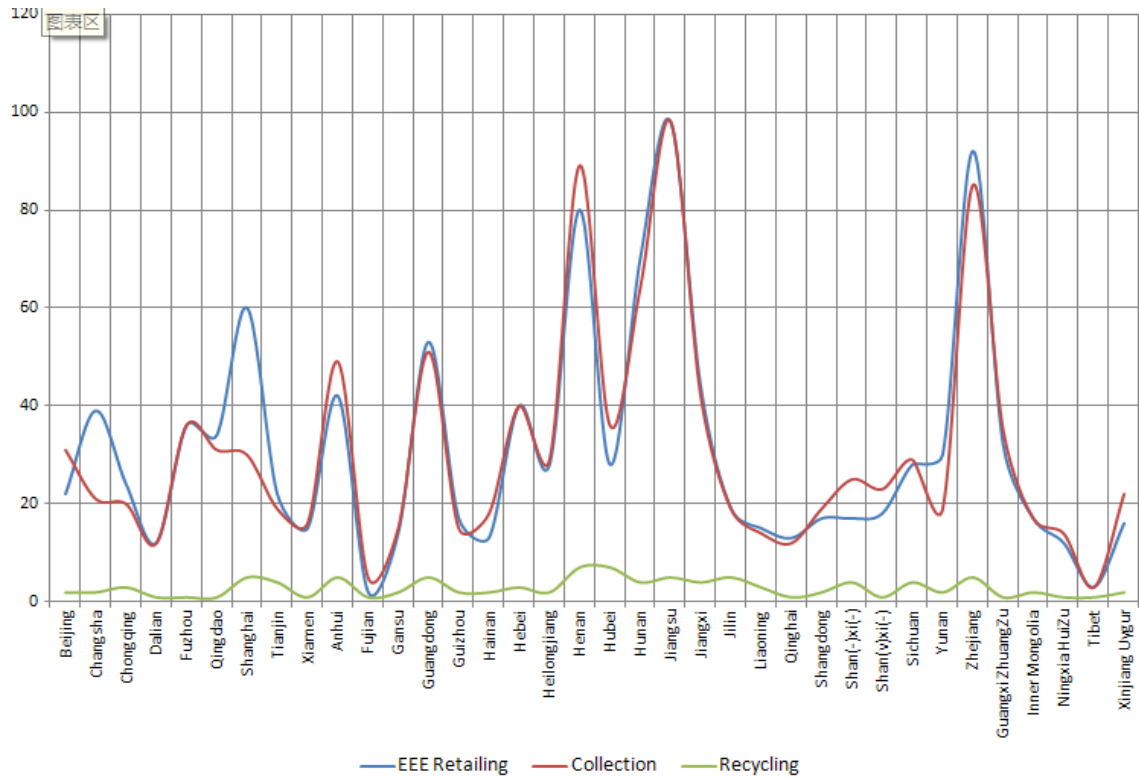


FIGURE 7. National demonstration in regions

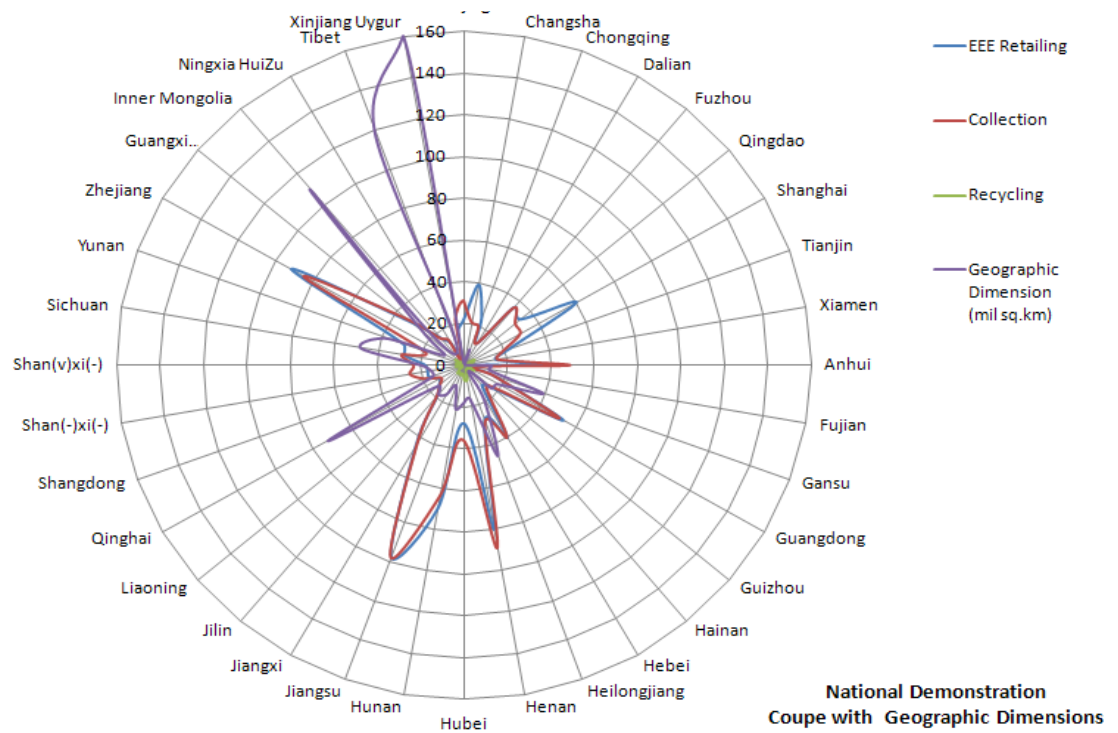


FIGURE 8. National demonstration coupe with geographic dimensions



The nation wide movement has involved vital roles in this pre-operation for WEEE/E-Waste Collection and Recycling Practices. According to the data release from Ministry of Commerce and Finance internal system (Ministry of Commerce, 2011), the revenues generated from this nationwide promotion in the retailing sector are about 207.5 billion Yuan RMB. Among the major five home appliances, there are 18,624 million televisions, 14,082 million air conditioners, 8,473 million computers, 7,552 million of refrigerators, 6,982 million of washing machines sold respectively in the Chinese domestic market. The total number during the take-back scheme of retired home appliances is 57,609 million. This pre-operation had terminated at the end of 2011.

There were further discussions among stakeholders of the next take back scheme of WEEE/E-waste, the risen topics of whether the scope of the scheme among cities and provinces will be extended to more participation, for remote areas depending their local infrastructures and preconditions, such as having qualified recycle manufacturing sites, distribution of logistics, competencies within their within their internal management within companies and governmental agencies as well. There are adjustments and experiences to be applied and adopted after these two-years long take back scheme.

### **5.3 Discussions and Interviews with Key Stakeholders**

After reviewing Chinese development history, environmental, social and economic impact from the growing sector of Electrical and Electronic Equipment manufacturing and its consequence of increased Urban Mine in WEEE, it has been clear to audience and potential foreign investors and local enterprises, developing a long-term, sustainable, environmentally friendly, more importantly, a efficient and effective WEEE collecting and recycling system is the ultimate goal, and a complete system without effective regulations , proper technological solutions and adequate support from social, public funds, the participated enterprises and potential

investors will have to face many barriers for barely surviving, it is not the goal a circular economy framework and the mission for promoting a harmonious society in modern China, therefore, to collect ideas, methods, expectations and concerns from Investors and enterprises in WEEE field is vital for improving a functioning circular industry chain between EEE and WEEE sectors. The following is the discussions and interviews with case companies introduced in the beginning chapter of the thesis, they are TCL-AOBO, SELOT Environment and Recycling Co., LTD, and Kuusakoski Oy, the managers from each company will be interviewed by the author concerning the most concerned objectives and barriers they have encountered or are going to encounter through international videoconference, the following are the interpreted statements from the participants from China and Finland.

### **5.3.1 Interview with TCL-AOBO and SELOT Environment and Recycling Co., LTD**

TCL-AOBO and SELOT are the both one of the largest WEEE recyclers in China, TCL-AOBO's Vice president and SELOT's Marketing manager have agree to answer the research author's interview questions by emailing them, the following is the main content of the email interviews:

- A. What are the most challenges and concerns for the Chinese WEEE Recycler in collecting and recycling process in Chinese WEEE recycling sector?

First of all, TCL-AOBO has been facing the situation that partial production line for recycling WEEE are not operating in a regular schedule, for example, the Television Recycling Line is relatively busy comparing to other production line, the amount of other WEEE, including refrigerator, washing machine, computer, mobile phone are not reaching production running point for a production period, without enough products, it will cost more to run the production line one time, it is going to cause low efficiency and low return from investment, therefore the collection volume and the production schedule are not always rescheduled according to the supply chain of the WEEE.

Another concern is about quality of WEEE collected from the down stream of

the industrial chain, the collecting system is lack of observation and inspection from the outsourced logistics partners, which has caused the problem of missing spares from returned WEEE. The companies are trying to build their own logistics network and branches around their main markets to avoid such situation, to increase security and safety along the collecting chain.

- B. Shall companies change their strategies in favour of Chinese Domestic market?

The Public Relations and Marketing Department of the companies have maintained a straightforward communication network with the responsible officials from government departments, organizations, and public associations. The newly issued regulations and policies regarding WEEE collecting and recycling sector are the basis, TCL-AOBO and SELOT having been learning and suggesting comments to the responding government division, to assist and contribute policy makers with practical and realistic opinions.

- C. What will be the most important credentials that make the Foreign Partner stand out for future business cooperation in China?

TCL-AOBO and SELOT are the biggest manufactures in China, integrated their production line with collecting, recycling and circulating raw material flow to up stream level where EEE manufacturers require to produce new EEE products. About the choice of choosing new future Foreign Partners, corporations are interested not only the uniqueness Foreign Partner owns in its technology, but also very interested in if the foreign partner has qualifications of providing their products to China, as well as its customer networks.

- D. What are the benefits and withdraws while working with a Foreign Investor?

The most advantage in cooperation with Chinese enterprise for a foreign investor is that, first of all, the foreign enterprise is able to claim their market territory quickly, especially the cooperation with the biggest recycling leader

will bring financial returns in a rather short time of period. The barrier the foreign enterprise most likely to encounter is in corporate management, corporate communication and corporate culture, in these aspects, the foreign partner and Chinese company will need time to learn and smooth communication with each other and get through from difficult time.

- E. What incentives, finance support and assisting services have TCL-AOBO and SELOT both received? And what other stimulus package available to High-Tech WEEE recyclers? And what are the conditions of applying to it?

Both companies have received gradually incentives and funding from local and central government departments regarding 'Urban Mining' Circular Economy Funding and recycling and collecting subsidies from local and central government departments for the amount of WEEE enterprises have collected and recycled in total each season, the funding both TCL-AOBO and SELOT have received is about over 100 million Chinese Yuan after production construction accomplished as promised in their Business Plan. There are other technology and innovation based funding for applying companies, who owns the intellectual property rights are granted with funding according to the budget from local and central government. The applying enterprises are required to show full document files from Business, Technology approval, finance, investment and various certificates authorized by the regarding government parties, most importantly, the applying enterprise must have invested 70% their investment as promised in their business plan and accomplished 80% of their construction and production projects. Joint Ventures also can access to funds offered by United Nations, however, the amount of funding compare to Chinese Government's incentive package is much more less, and the period of applying also takes time and process.

- F. Which area is suitable for collecting & recycling WEEE and which factors are crucial to business performance?

The WEEE Collecting and Recycling areas mostly are located near metropolises like Beijing, Shanghai, Tianjin, Guangzhou etc., and the WEEE

sector areas around the urban cities are only permitted to locate and build within the economic and industrial zone, where companies are having easy access to government branches for business or project registration, custom, inspection, commerce, taxes, bank services, logistics, etc., therefore the WEEE enterprises have convenient access to all official works with government departments. The companies can set up a centre office in the centre of each targeting market to communicate with customers, suppliers and other media agencies.

- G. From an investor's point of view, what would be the political and economic expectations WEEE collecting and recycling enterprises are looking to foresee in the near future in the recycling industry sector in China.

As the largest recycling leaders, TCL-AOBO and SELOT, they are constantly paying very close attention to the environmental, economic and financial policy updates regarding WEEE management. Due to the existence of illegal dismantling of WEEE still spreading in some remote areas and along the coaster regions, these small workshops are using environmentally unfriendly methods to dismantle toxic electronic parts, causing underground water and soil pollution. In dealing with small workshops with their illegal dismantling business, the government legal department is expected to issue new legal acts to eliminate these illegal actions. In economic aspect, the government has confirmed the increase of incentives; subsidies and public funds to support authorized and innovated enterprises in the WEEE industry sector. The WEEE recyclers are also intent to increase expense in R&D and technologies for developing efficient recycling methods and refining more types of materials in rare metals from WEEE. To sum up, the complete image of the Chinese WEEE market is positive at the present for both foreign and domestic WEEE collecting and recycling enterprises.

### 5.3.2 Interview with Kuusakoski Oy

Kuusakoski Oy's account manager from its collection site in Jyväskylä city has accepted the interview proposed by the research author, the following is the main conversation interpretation:

- A. Based on acknowledged that as the focus of Kuusakoski Group's business strategy, WEEE Recycling business operations are going to be more active than ever before in the following years, however, based on the market statistics about WEEE Recycling industry, the area around Asia Pacific, especially in China, the annual growth of WEEE for recycling is about 11.10 million tons, about 22.7% of the whole world WEEE 48.9 million tons (UNEP, 2012), and more importantly, in order to meet demand from overseas and its domestic market, the consumption of China takes about 30% of global resources for manufacturing electrical and electronic equipment (Doctor Chen Yong, Director of Research Centre Academic Committee in Chinese Academy of Engineering, 2014).

Therefore, what are the most challenges and concerns stopping Kuusakoski to participate in Chinese WEEE recycling sector?

Kuusakoski Oy has invested and expanded its market in both USA and Britain, based on our knowledge and research of local legal, environment system, and WEEE industry chain, as well as players contribute along the chain, it has been a progressive process, although, increasing volume of collected WEEE is the vital factor while choosing the investment direction in an international market, but without our knowledge of Asian Pacific market, we are not in a short period of our business going to enter the Chinese market. However, Chinese market is at the current state a promising investment choice, the Kuusakoski Group will take a big step forward to that direction until we have held consolidated research results and feedbacks from the Chinese side.

- B. China has initiated and successively implemented several national WEEE Collecting, Recycling projects in over 30 metropolises, with incentive packages for customers, they are more than ever before motivated to replace

new products with their used and wasted electronics, more importantly, collecting and recycling companies also received incentive package for the cost of logistics and recycling, therefore, a booming industry sector in WEEE has not only marketed according to market-oriented economic strategy, but also saved the recycling business from bankrupt, more important is that it has reached the goal of saving environment from pollution.

So the following question is, if there are markets, with educated and motivated customers, national incentives, updated regulations and legislation framework, what are the determining factors should be understudied, analysed, tested before considering a new investment plan in China or Asia Pacific markets.

As the scenario is that if Kuusakoski Group are going to consider investment in Chinese WEEE market, the determining factor mainly relying on the aspect of supply chain's material flow, and regulations alongside its development, however, the difficulties can be avoid, but not at all, there are still other unknown factors should be investigated in the favour of Kuusakoski Group's concerns.

- C. We have learnt from Mr Pasi Puranen, that the strategic investment of Alteam Oy made in Suzhou is for meeting the demand of Kuusakoski Group's customer network, providing precise services and efficient sales to local and foreign telecommunication companies including Nokia. Therefore the following question is that will Kuusakoski welcome Joint Ventures or customers interested in cooperating with Kuusakoski Group's business activities? And what will be the most important credentials that make them stand out for future business cooperation in China?

At present, we are welcoming all interesting groups, including potential business investors or joint ventures to visit Kuusakoski Group in Finland, or other nearby place, where Kuusakoski has local office and factory. The most credential is accountable liability from a our point of view in international business/project corporation, it might include many factors in liability,

however, the key factors are the company's influence and market share in Chinese domestic market.

- D. From an investor's point of view, what would be the political and economic expectations Kuusakoski Oy is looking to foresee in the near future in the Recycling industry sector in China.

Kuusakoski Group is looking forward to a complete and updating political and economic system in the WEEE sector in China, especially in regulation and legislation aspects, it will protect a foreign company's legal right in our operations.

- E. What Kuusakoski Oy is interested to know and get results from our research subject?

Kuusakoski Group would like to see practical case/project studies, evidence and figures about the Chinese WEEE market, as well as other important aspects in the current situation about China's WEEE Directive. Kuusakoski would like to be informed about the updated situation in the WEEE sector in the most developed areas in China.

## **6. RESULTS AND CONCLUSIONS**

Based on the study on the background of China's development in WEEE collecting and recycling, the author gave a general introduction to the reader about how WEEE have become more and more concerned in today's Chinese society with what impacts WEEE have had on the environment, human health, and more importantly, how WEEE can be maintained within a circular economic framework with the experiences, concepts and technologies learnt from developed nations to benefit and guarantee China's top position in today's global economic competition.

China has determined to regulate the WEEE collecting and recycling market with caution by making suitable and adaptable policies, regulations and a supporting legal system in order to best serve the changing and growing industrial sector in the



Electrical and Electronic Equipment manufacturing area. However, with the participation of the business side, China is going through a century of revolution for changing her industry infrastructure and system in order to save natural resources. Participants from the government, local and international organizations, electronics manufacturers, WEEE collecting and recycling enterprises and other related industrial fields are the main force in changing the society to a circular eco-system, and the assistance from both the political parties and enterprises is contributing to finding solutions to how to away barriers blocking them from approaching the goal.

At present, the future of Investing in WEEE Recycling Project in China is unpredictable in the long term but in the current active national programs, projects and business activities, the future is foreseeable in a short period of time. From the political point of view, China has been adjusting the WEEE Directive, and the legislation framework to regulate and minimize risks while developing a green economy, Moreover, the participating Chinese government has been encouraging enterprises to extend their responsibilities by participating in WEEE collecting and recycling projects and programs with attractive incentive packages and subsidies, which has received positive feedback from enterprises in the WEEE sector. On the other hand, enterprises are not only relying on government funding in order to survive. Many leading WEEE collectors and recyclers are putting more effort to R&D and marketing, and becoming more and more interested in finding new ways of collecting WEEE, innovating new techniques to refine more types of material, these actions and encouragement have turned China to a competitive market for promoting the concept of 'Urban Mines'.

However, China has a long way to go from being satisfied with discovering her own urban treasure mining business. Comparing with developed nations in the west, the fundamentals for building a real circular economy are remained within first of all, the governing parties have to adjust and complete the legal system, second of all, to encourage WEEE enterprises to invest more in R&D, the last but not least, is to provide not only supporting services to business, but more securer way of funding from not only public fund, but issuing funds from financial institutes to business enterprises.

To summarize, WEEE collecting and recycling is part of an extended industry chain, the ultimate future of which is to reach the recovery rate 100% while recycling WEEE, and even developed nations are still targeting this objective of refining 100 percent of the WEEE materials. However, the author believes that in the future, China and its WEEE enterprises are going to become the top urban mining leaders around the in the whole world, then, products with the label 'made in China' can be all returned back to China without any loss in the material value.

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## 8. APPENDICES

### 8.1 QUESTIONNAIRE IN ENGLISH WITH FINNISH ENTERPRISE

- 1) Company:
- 2) Interviewee :
- 3) Title:
- 4) Would you like to fill this Questionnaire form concerning the research subject of Potential Market Development for WEEE/E-Waste Recycling Business in China
- 5) Yes  , No
- 6) Would you provide the information as references for the purposes of research?
- 7) Yes  , No
- 8) Would you like to participate further study on research purpose relevant to the subjects regarding WEEE/E-Waste in the future?
- 9) Yes  , No
- 10) What is the biggest concern occurred over issues in social, environmental and political challenges and difficulties the enterprise is facing while operating WEEE collecting and recycling activities in your city/ in a foreign country like China?
- 11) Has the enterprise been heavily relying on fulfilling the production capacity?
- 12) What would be the most concerned and expected assisting services for enterprise to develop international business within China?

- 13) Regarding enterprise's development strategy, what would be the most influential aspects from the reforms of environmental policies and regulations concerning WEEE Regulations and Policies?
- 14) To what degree, has central government been given incentive policies and supportive funds to WEEE recyclers and collectors?
- 15) As WEEE recycler, do you wish the national supportive funds to be given according to which one of the following figures? Production inputs, outputs, and degree of environmental sustainability?
- 16) Since the introduction and reinforcement of Chinese Environmental Law and WEEE Directive, what influences have contributed to the change of business strategy?
- 17) Has enterprise taken market and policy investigation during the preparation phase of project planning?
- 18) As WEEE recycler, How to facilitate development of industrial chain through extended degree of cooperation with other shareholders along the chain?
- 19) Regarding developing WEEE markets and exploring advanced WEEE Recycling technology, is enterprise interested in importing new intellectual property and venture capital cooperation?

## 8.2 INTERVIEW QUESTIONS WITH CHINESE WEEE ENTERPRISES

- 1) 机构名称：
- 2) 机构代表：
- 3) 是否同意参加本次关于《中国废旧电子垃圾潜在市场开发 研究报告》的调查问卷？
- 4) 同意 ，不同意
- 5) 是否同意提供该份调查信息作为学术参考及研究？
- 6) 同意 ，不同意
- 7) 是否愿意参加今后关于废旧电子垃圾相关课题的商业及学术研讨？
- 8) 同意 ，不同意
- 9) 企业在面对废旧电子垃圾的回收和处理中遇到了那些社会，环境及政策方面的问题与挑战？
  
- 10)企业对于国家开展的“以旧换新”活动是否有依赖性？
  
- 11)企业对于在开展关于进口《限制类固体废物》的业务中，最关心并期待提供协助服务的项目是那些？
  
- 12)环境政策及法规对于企业发展的最大影响，主要体现在哪些方面？
  
- 13)政府在废旧电子垃圾的回收和处理方面是否给企业提供了一定的鼓励政策和扶持资金？

- 14)对于国家扶持资金的发放, 企业是否期望以一种鼓励生产按生产量和供应量发放?
- 15)废旧电子垃圾回收处理相关政策实施以来, 对于企业发展和决策带来怎样的影响, 突出在那些方面?
- 16)企业项目建设的初期是否对于市场及政策实施风险分析调查?
- 17)作为销售, 回收或者处理企业, 如何可以进一步通过扩大合作力度而促进产业链发展?
- 18)对于发展和扩大废旧电子垃圾回收处理项目方面的技术及市场, 企业是否对于新技术引进及金融合作感兴趣?