IGES Policy Report

Development of E-waste Management Policy at the Local Level: A Case Study of Cebu City, Philippines

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Abstract

Electrical and electronic waste (e-waste) is currently one of the fastest growing waste streams in the world. Thus, managing e-waste has become an important concern in both domestic and international material cycles for environmental preservation, efficient resource utilisation and sustainable development. Many developing countries are making an effort to establish national legislation to regulate the e-waste management system based on the policy models introduced by developed countries. However, progress in the practical implementation of these national policies and legislation at the local level is still limited and challenging.

The Philippine is no exception. Considering the continued e-waste generation coupled with the increasing concern over its environmental pollution and resource utilisation, the government of the Philippines legislated the recent Administrative Order 2013-22 (DAO 2013-22) indicating e-waste as a new class of miscellaneous waste with Waste Number M506 and M507, recognising the role of local governments to ensure successful implementation of the national law at the local level. However, progress of the practical application of these national laws at the local level is not encouraging, as seems to be the case in many other developing countries. This policy report, therefore, aims to review the experience of Cebu City in developing an e-waste management system in cooperation with its Japanese partners in Kitakyushu City. Based on this quick assessment, it reviews the state of e-waste management practices, including e-waste generation, collection, recycling business, and the final treatment, as well as existing policies and regulations in Cebu City. The main barriers to implementing effective e-waste management systems based on national laws are also identified in terms of the public response and official points of view. Finally, the report gives some policy recommendations for local decision makers and city officials in Cebu City as well as other cities in the Philippines. These recommendations may also provide a broad framework for practitioners in national and international agencies who are providing support for local governments for the design and implementation of technical specifications for e-waste management in developing countries.

The study indicates that the future of e-waste management in developing cities depends not only on national and international initiatives, but also on the effective practices of local governments working with the waste producers (citizens) and operators of recycling services (both formal and informal sectors). Providing resources and building capacities of local governments is therefore essential to develop e-waste management systems in an environmentally sound manner through the establishment of public and private partnerships. International partners can play a significant role through city-to-city cooperation in providing technical know-how and capacity building opportunities, facilitation of research and best practices, and provision of development assistance to improve the city's e-waste management system. However, those recommended local policies and techniques of the developed cities should be adapted to the local context of the receiving cities.

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Table of Contents

Tables and Figures

Tables

Figures

Abbreviations

ASEAN	Association of Southeast Asian Nations
BEO	Barangay Environment Officers
BSWMC	Barangay Solid Waste Management Committee
CCENRO	Cebu City Environment and Natural Resources Office
CESET	Cebu Environmental and Sanitation Enforcement Team
CERRI	Cebu E-Resource Recovery Inc.
DPS	Department of Public Services
DENR	Department of Environment and Natural Resources
E-waste	Electrical and Electronic Waste
EPR	Extended Producer Responsibility
EMB	Environmental Management Bureau
EEE	Electrical and Electronic Equipment
IGES	Institute for Global Environmental Strategies
IT-BPM	Information Technology and Business Process Management
JICA	Japan International Cooperation Agency
JPEPA	Japan-Philippine Economic Partnership Agreement
JPY	Japanese Yen
MRF	Material Recovery Facility
METI	Ministry of Economy, Trade and Industry
MOE	Ministry of Environment
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
MRI	Maritrans Recyclers, Incorporated
MEPZ	Mactan Export Processing Zone
NGO	Non-government Organisations
NMD	Nippon Magnetic Dressings Co. Ltd
OECD	Organisation for Economic Cooperation and Development
OIC	Officer in charge
ICT	Information and Communication Technologies
SWM	Solid Waste Management
SWMB	Solid Waste Management Board
TSD	Treatment, Storage and Disposal
WB	World Bank
WEEE	Waste Electrical and Electronic Equipment

Executive Summary

E-waste is one of the fastest growing waste streams in the world. This is especially true in the Philippines, where the electronic industry plays a significant role in the country's economic growth. While considering the continued e-waste generation coupled with increasing concern over its environmental pollution and resource utilisation, the government of the Philippines legislated the recent Department of Environment and Natural Resources (DENR) Administrative Order 2013-22 (DAO 2013-22) indicating e-waste as a new class of miscellaneous waste with Waste Number M506 and M507. Though national legislation recognises the crucial role of local governments to ensure successful implementation and enforcement based on the polluter pays principle at the local level, the progress of the practical application of national laws at the local level is not encouraging, as evidence shows in many other developing countries.

In this background, the importance of development and regulation of efficient e-waste management systems at the local level has been widely acknowledged. This policy report, therefore, aims to review the experience of Cebu City in developing an e-waste management system in cooperation with its Japanese partners in Kitakyushu City. Based on this assessment, it reviews the state of e-waste management practices, including e-waste generation, collection, recycling business, and the final treatment, as well as existing policies and regulations in Cebu City. The main barriers in implementing the national laws at the local level are also identified in terms of the public response and official points of view. Finally, the report gives some policy recommendations, considering the effectiveness of the legislation, system of collection coverage, capacity building for establishing a formal recycling system, incorporating informal operators based on the experience of the pilot project implemented by Cebu City in collaboration with its Japanese research and business partners in Kitakyushu City.

Cebu, the Philippines' second fastest growing city after Manila, faces a tremendous challenge in managing the increasing amount of e-waste in the city. However, the implementation of national laws on establishing an e-waste management system in the city is constrained by a number of challenges, such as lack of legal frameworks and strategic plans, inadequate enforcement due to the lack of accurate data, low recycling and treatment capacity, weak monitoring and enforcement capacity, and lack of recycling technology and financial resources to adequately manage the e-waste. Thus, a large volume of e-waste generated in the city is processed by the informal sector in backyards and ends up at the illegal dumpsites or final landfill sites, creating adverse impacts on the natural environment and public health. In order to improve this situation, a number of strategic interventions are recommended and briefly described below for the successive implementation of e-waste management system in Cebu City. These recommendations also provide a broad framework to assist in designing and development of technical specifications for e-waste management in other developing country cities.

- ***Establishment of a multi-stakeholder dialogue:*** a successful e-waste management system needs the participation of various stakeholders including the public sector, private sector, civil society and the academic sector. Establishment of the multi-stakeholder platforms gives the opportunity to meet, exchange different views, and can facilitate the development of an integrated e-waste management system for the city.

- ***Inventory of the current e-waste situation:*** the lack of accurate e-waste related data in Cebu and elsewhere reveals a high need for e-waste assessment. The city can work with both academics and practitioners to introduce a comprehensive inventory and monitoring system for e-waste. This exercise can start from a selected few e-waste items and gradually expand to other areas considering the capacity and resource availability. International agencies can provide the required technical and financial assistance.

- ***Develop an e-waste management strategy including regulations:*** Cebu City has drafted an e-waste management ordinance based on the national legal framework (DAO2013-22). However, the necessary regulatory and legal frameworks that incorporate responsibilities of all stakeholders including manufacturers, waste generators (users), informal and formal recyclers, academics and policy makers, need to be developed and implemented.

- ***Establishment of e-waste management business models:*** establish a favourable climate that encourages e-waste management business models, which include collection, transportation, recycling, treatment and exporting or disposal systems. The formal private sector should play a crucial role in developing an e-waste management system in the city. However, the importance of the current informal recycling sector that operates in the city providing employment for a large number of people in poverty, as well as existing activities of the informal sector, must also be taken into consideration. A review of its occupational risks, capacity building, financial support, regulation and enforcement to establish decent working conditions are some of the possible entry points to address the adverse impacts of the informal sector.

- ***Establishment of effective monitoring and certification systems:*** Cebu City should more strictly supervise e-waste collection, storage, and recycling, treatment and disposal. The city, in partnership with the Department of Environment and Natural Resources (DENR) Regional Office, should develop and monitor the standards and guidelines for environmentally sound management of e-waste, and create a certification system.

- ***Develop and carry out awareness programmes:*** while the awareness of e-waste risks and management is in general still very low in the city, there is a strong need for awareness-raising at the household level. The appropriate awareness programmes need to address the risks of improper handling of e-waste, storage and disposal, as well as the new waste collection system and its benefits.

Further, the study recommends that the national government should establish some specific supportive policy mechanisms for the efficient implementation of an e-waste management system at the local level. The national government can allocate technical and financial assistance for establishment of e-waste inventories, business models for e-waste management, monitoring and evaluation of various projects for their effectiveness, and sustainability and documentation of best practices and lessons learned. Further, a regional platform can be established to exchange information, provide training, and strengthen enforcement and monitoring.

The experience of the pilot project implemented by Cebu City in collaboration with its partners in Kitakyushu City, Japan also shows the potential of inter-city cooperation to mainstream and disseminate environmentally sound e-waste management in developing countries. The cities of developed countries with experience can assist in establishing e-waste legislation and capacity building for their partners in developing countries in designing sustainable e-waste management business models that include an effective take-back system, sound recycling, and end-processing facilities. However, those recommended policies and techniques of developed country cities should meet with the local context of developing country cities. Further, international cooperation can also facilitate the lessons learned by documenting best practices from their practical projects through regional and global partnerships that helps to strengthen political motivation, and provide information to close the knowledge gap on the subject.

1. Introduction

1.1. Background

E-waste generation is growing rapidly due to economic growth, coupled with rapid urbanisation and changes in production and consumption patterns (Babu et al., 2007; World Bank, 2012). Currently, e-waste is one of the fastest growing waste streams in the world with an annual growth rate of approximately 4% (Lundgren, 2012). The total amount of global e-waste generation has increased from 40 million tonnes in 2005 (SWEEPNET, 2014) to 49 million tonnes in 2012 (UN University/StEP, 2012). In general, there are three categories that account for almost 90% of e-waste generation, including large household appliances (50%), information and communication technology equipment (30%) and small consumer electronics items (10%) (Lundgren, 2012).

The increasing quantities of e-waste and its management represent a great concern across the world from the viewpoint of environmental protection and resource utilisation (Terazono et al., 2006). E-waste is a complex waste stream containing both hazardous materials and valuable secondary resources (Zhang and Forssberg, 2000). E-waste can contain more than 1,000 different substances (Puckett and Smith, 2002), many of which are toxic metals, such as lead (Pb), mercury (Hg), lithium (Li), arsenic (As), cadmium (Cd), selenium (Se) and hexavalent chromium/ chromium VI (Cr VI) (Babu et al., 2007). The previous studies indicated that the burning of insulated wires, which typically occurs in open iron barrels, generates 100 times more dioxins than burning municipal solid waste (Gullett et al., 2007).

Thus, e-waste management requires specialised segregation, collection, transportation, handling, treatment, recovery and final disposal to prevent environmental pollution and efficiently utilise resources. Unsound practices of e-waste disposal pose serious health, socio-economic and environmental impacts to society (BAN and SVTC, 2002).

The Extended Producer Responsibility (EPR) based national legislation for e-waste management is one of the most attractive e-waste management policies that many developed countries have successfully applied. The EPR requires producers to take responsibility for all stages in a product's lifecycle including the responsibility of its disposal and encourages producing less toxic equipment that can quickly be recycled (World Bank, 2012). The previous work of the Institute for Global Environmental Strategies (IGES) on the subject found that many developing countries are now trying to apply the EPR policies at the national level based on the experience of developed countries (Akenji et al., 2011, Akenji and Bengtsson, 2010, Hotta et al., 2009). However, the progress in the practical implementation of these national regulations at the local level is still limited and challenging.

This situation is no exception in the Philippines, where the electronics industry plays a significant role in the current economic development. According to the Makati Business Club (2013), the performance of the electronics industry shows a 9.3% growth rate of the total exports and 21.8% of total imports

when compared to figures from 2012. Further, a study on domestic e-waste generation in the Philippines conducted by Peralta and Fontanos (2006) based on the end-of-life methodology estimates that over a period of 15 years (1995-2010), a total 39 million units became obsolete while more than a million units went into landfill every year.

While considering the continued e-waste generation coupled with the increasing consumption of electrical and electronic equipment (EEE) for disposal, the government of the Philippines legislated the recent Department of Environment and Natural Resources Administrative Order 2013-22 (DAO 2013-22). The Administrative Order regulates the E-waste as a new class of miscellaneous waste with Waste Numbers of M506 and M507.

The category of M506 is adopted for the e-waste generated by industries such as Information Technology and Business Process Management (IT-BPM) service sector and other service sectors, including all waste electrical and electronic equipment that contain hazardous components such as lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs) and polybrominated diphenyl esters (PBDEs) that are present in peripherals, i.e., ink cartridges and toners. In contrast, M507 is focused more on addressing household hazardous wastes emanating from residential and commercial sources, such as consumer electronics, white goods (i.e. refrigerators, washing machines, air conditioners, etc.), batteries, oil, and broken lamps (DENR, 2013).

According to the DAO 2013-22, local governments have a crucial role to ensure successful implementation and enforcement since all M507 wastes need to go through a Material Recovery Facility (MRF) in the city. Each MRF will be required to register as a treatment, storage and disposal (TSD) facility under Category F (Facilities that store hazardous wastes which were not generated at that facility). As such, MRFs will be required to obtain the customary transport permits and register as hazardous waste generators in the Barangay, which is the lowest administrative and political system in the city. It also emphasised that e-waste management by the local government should be based on the polluter pays principle. Households and other e-waste generators should be requested to pay a certain fee for the disposal of their waste. It is ultimately expected that the operating expenses of the MRF will be generated through the fees collected from the households. However, it was observed that the implementation of the national legislation at the local level is not promising, similar to the situation in other developing countries.

1.2. Objective of the study

This policy report, therefore, aims to review the experience of Cebu City in establishing an e-waste management system in cooperation with its Japanese partners in Kitakyushu City. It investigates the current status of e-waste management in Cebu City and identifies the key barriers to implementing a proper e-waste management system in the city. This report also gives some policy recommendations for the local decision makers and city officials in Cebu City on how to improve the current e-waste management system based on the experience of a model project that commenced with the technical assistance of Kitakyushu City, Japan. These recommendations may also helpful for other

developing cities which are aiming to modernise their e-waste management systems.

1.3. Methodology

The study employed a number of methods to collect the relevant information. Some data was gathered from the internet and some were provided by city officials. Informal interviews, stakeholder meetings, discussions and personal observations were carried out with public and private representatives during three field visits made to Cebu City during the period of December 2013 to July. Key information was provided by various organisations such as government agencies (Cebu City, DENR, academic institutions, non-governmental organisations (NGOs), electrical and electronics companies, recycling businesses, and shopping malls involved in e-waste market in the city. The experience of the pilot project implemented by Cebu City in collaboration with Kitakyushu City was also reviewed to understand the practical lessons for understanding the policy recommendations.

1.4. Structure of the report

The report comprises an executive summary and five main sections. The first introductory section gives a brief background, objectives, research methodology, and the structure of the report. Section two explains current practices of e-waste management in Cebu City and provides an understanding of its e-waste management hierarchy including the e-waste generation, collection, transportation, treatment and final disposal. Section three identifies the key barriers to improving the existing e-waste management system in Cebu City, based on a preliminary survey and the perceptions of the different stakeholders. These barriers are discussed under the sub-headings of policy/ legislation, social/ cultural and the recycling business/ technology. Section four shares the lessons learned from implementation of the pilot e-waste management project in Cebu through city-to-city cooperation between the cities of Cebu and Kitakyushu. It describes technical interventions introduced at each step including planning of e-waste collection, transportation, treatment, and management of e-waste disposal. Finally, Section five concludes the study by giving some detailed recommendations. These recommendations provide a broad framework to assist in design and development of technical specifications for e-waste management in Cebu City, and could be applied to other similar cities in developing countries.

2. E-waste Management in Cebu City

2.1. City profile

Cebu is the capital city of the province of Cebu. It is the second most populous metropolitan area in the Philippines after Metro Manila. Cebu also plays a significant role as a centre of administration, commerce, trade and education in the country. The city is divided into 80 barangays for the effective decentralization of the municipal functions, including solid waste management. With a total population of 866,171 (NSO 2010), Cebu City generates about 500 tonnes of solid waste per day (Cebu, 2014). The economic activities of the city are largely dependent on the service (tourism) and business process outsourcing (BPO) industries (information and communication technologies) due to its strategic location accessible by both air and sea transport.

Figure 1: Location of Cebu City in the Cebu Island. Source: Cebu City, 2012

Cebu, the queen city of the south, has received national and international awards recognising its commitment to establishing an Eco Model City. Even though these national and international acknowledgments bring honour and pride to the city, it still faces many environmental challenges to be resolved. Among them, solid waste management (SWM) is the first and foremost. The majority of solid waste in the city originates from households; uncollected waste can be found in the streets and canals contributing to flooding and spread of insects. The collected waste is transported to the Inayawan landfill site. The uncontrolled disposal of MSW results in serious local, regional and global public and environmental health problems, including air pollution, soil and groundwater contamination, and emission of greenhouse gases (GHGs).

Many households in the city are also heavily dependent on the use of electronic appliances (televisions, DVD players, washing machines, refrigerators, and microwave ovens) for making life easier and more comfortable, as in other major cities in the region (Cultural, et al., 2013). Further, use of mobile phones, telephones, and computers with internet connection is increasingly popular with households in order to share knowledge and information with the rest of the world. The increasing quantities of e-waste, informal

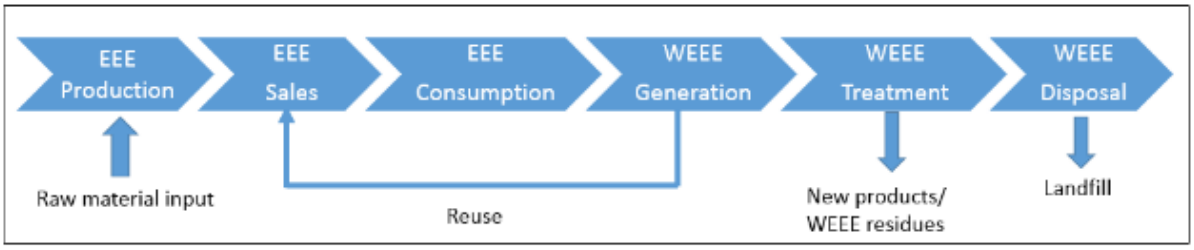

Figure 2: Life cycle of e-waste. Source: UNEP, DTIE, 2007

recycling and illegal dumping is creating adverse impacts on the natural environment and public health.

2.2. E-waste Management in Cebu City

E-waste management requires considering the whole life cycle of EEE from production to final disposal (See Figure 2). The supply chain of electronic items in Cebu City starts from importation and distribution. Even though the entire life cycle of EEE occurs in the organised or formal sector in developed countries, a larger part of recycling and treatment occurs in unorganised or informal sectors in the city. Finally, Waste Electrical and Electronic Equipment (WEEE) ends up in a landfill or is exported in the form of electronic scrap for further processing.

E-waste management in the city can be divided into four stages: (i) generation, (ii) repair, reuse and storage, (iii) collection and pre-processing, and (iv) final processing and disposal. Figure 3 shows the material flow of EEE in Cebu City and key steps are briefly described below.

2.2.1. E-waste generation

Like many other cities in the Philippines, Cebu City does not have official data on the total amount of e-waste generation. According to the staff of the Cebu City Department of Public Services (DPS) and the Cebu City Environment and Natural Resources Office (CCENRO), e-waste belongs under the category of special waste. The special waste accounts about 0.1% or 180 tonnes of the total annual waste generated in the city. Cebu City collects e-waste together with other municipal solid waste (MSW) and dispose of it at the landfill site.

The e-waste generators who consume EEE and discard them as waste can be broadly divided into two categories based on the E-waste Assessment Methodology Training and Reference Manual (2012) and DAO 2013-22, namely (i) corporate and (ii) private or household consumers.

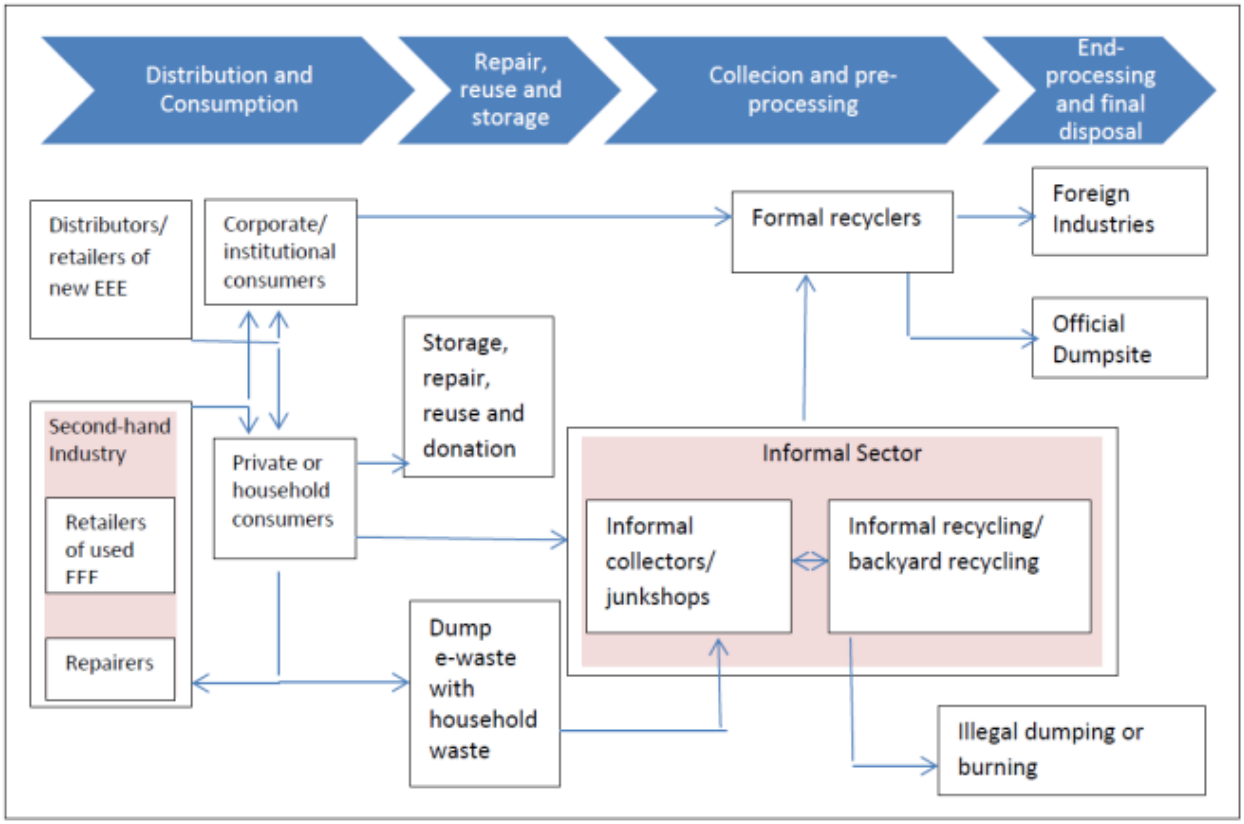

Figure 3: The material flow of EEE in Cebu City. Source: Compiled by the Author, 2014

(1) Corporate Users

Commercial, industrial and government entities are classified as corporate consumers. Some of the offices and commercial users in Cebu City have a prior arrangement with formal recyclers and second-hand shops for collecting old and discarded e-waste such as personal computers. Industrial users in the city send their e-waste to the recyclers who are operating within the industrial processing zones or ship them to recyclers in other parts of the country, including Manila.

For institutional users such as government agencies like the Cebu City Government, discarded personal computers and electronics have to undergo a bidding process prior to discharge, and the process itself is cumbersome for recyclers.

The Self-Monitoring Reports (SMRs) submitted by the corporate users to the Environmental Management Bureau (EMB) – Region VII of the DENR shows that about 200 tonnes of e-waste is generated by the corporate sector annually in the region (Florencio, 2014). However, the staff of the DENR-EMB VII confirmed that this figure does not give an adequate picture of the total e-waste generation by the corporate sector because many of them do not send the monitoring reports as required by the Ministry.

(2) Private or household users

The non-functional electronics from household users often end up in the hands of scavengers (waste pickers). The scavengers sell the disposed electronics to junk shops, which later sell to a formal recycler for dismantling,

recovery of precious metals, and further processing.

Even though city officials need to know about the volume of e-waste generated by the households for taking practical policy decisions on e-waste management and recycling systems, there is no official information about the volume of e-waste generated by households in Cebu. This study therefore made an attempt to estimate the e-waste generation of selected EEE items using the Consumption and Use Method (Bureau B&G 1993) considering its easy application and limited data requirement for calculation.

Table 1: Formula of consumption and use method

E-waste generation per year $= \frac{M_n \times Hh \times R_n}{Ls_n}$
Where, M_n **= medium weight of item (n)** **Hh = number of households** R_n **= saturation rate with item(n) per household** Ls_n **= medium lifespan of item(n)**

Source: Bureau B&G, 1993

According to the Consumption and Use Method (Table 1), the medium weight, lifespan, the saturation rate of the selected electronic item, and the total number of households are the basic parameters required to estimate the e-waste generation of the selected household electronic items. For each electronic item, an assumed weight will be multiplied by the total number of households and the saturation rate. Then, dividing this amount by the average life-span, the expected annual e-waste potential can be found (Bureau B&G 1993).

A sample survey carried out by the A2D in 2012 covering 75% of Barangays, including both urban and rural areas, found that the most commonly used EEE in households are: large household equipment (TV, refrigerator, washing machine and air conditioners), small household equipment (electric fans, iron, and rice cookers), and ICT consumer electronics (cellular mobile phones, computers, laptop and cameras) (A2D, 2012).

The same study further indicated that the majority of households owned at least one unit of each EEE regardless of income disparities. Households in urban Barangays can own multiple units of the same type of equipment. When it comes to cellular mobile phones, it was found that families in Cebu City own two to four mobile phones, averaging one for each person in the family (A2D, 2012).

Due to the lack of official information on the average weight, average life span and saturation rate of e-waste in Cebu City, these figures were obtained from a sample study carried out by the GTZ-AHT supported Project on Solid Waste Management for Local Government Units (SWM4LGUs) in Metro Cebu (2010). The total number of households in Cebu City was obtained from the National Statistics Office (NSO 2013). The estimated figures are presented in Table 2. The calculation was based on the assumption that each household owns at least one unit of selected electronic items.

Table 2: Estimation of E-waste Generation of Selected EEE in Cebu City in 2013

Type of EEE	Ave weight (kg)	Average life span (years)	Saturation rate (years)	No of households	Estimated e-waste generation per year (kg)
Large household equipment					
Refrigerator	40.0	10	12	195,461	9,382,128
Air conditioners	28.0	10	10	195,461	5,472,908
TV	31.6	15	11	195,461	4,529,482
Washing machines	31.0	10	8	195,461	4,847,432
Small household equipment					
Electric fans	5.0	10	8	195,461	781,844
Electric iron	1.0	10	8	195,461	156,369
Rice cooker	5.0	10	7	195,461	684,113
ICT and consumer equipment					
Mobile phones	0.1	10	7	195,461	13,682
Desktop PCs	6.0	10	8	195,461	938,213
Laptop PCs	3.0	10	7	195,461	410,468
Camera	0.3	10	8	195,461	46,910

Source: Compiled by the Author, 2014

2.2.2. Consumption, repair, reuse and storage

The study found that the corporate users sent their e-waste to recyclers soon after the end of the life-cycle. In contrast, the most common method of household users is storage, reuse, or donating their e-waste to family members. The same study of A2D in 2012 found that 77% of respondent households used to store, reuse, or donate their e-waste to the family members (A2D 2012).

Televisions, refrigerators, washing machines, and mobile phones are the household electronic products most commonly stored in homes. The families often keep them for one to five years before selling them to the scrap buyers or disposing of them with other household wastes. Each household has its own ways to use obsolete electronic products during storage, for example, some families use damaged refrigerators as a cabinet for storing clean clothes, while others place these products in the backyard waiting for a scrap dealer to come and buy them, because there is no proper municipal collection system in place, and they also do not know where to bring them (Florencio 2014).

In addition to storage, some households prefer to donate their used electronic items to relatives and friends, or re-use them after repairing the equipment. These actions make obsolete electronic products usable, and the

life spans of the EEE are extended by preventing them from being disposed of in the landfill. In Cebu, second-hand shops sell refurbished and reconditioned imported second-hand items such as computers and mobile phones, especially those imported from China, Japan, Australia, Korea and United States (US).

Table 3 shows the data of imported used electronic items in the Philippines in 2013 based on the import clearance numbers. It indicates that the primary sources of used electronic equipment are coming from Japan and Korea. According to the Japan-Philippine Economic Partnership Agreement (JPEPA), free trade and easy movement of goods and services are promoted between two countries. Because of this trade agreement, most of the used electronic items are easily imported into the country (Carima, 2009).

Table 3: Imported e-waste based on important clearances for 2013

Materials	Quantity (units)	Country of origin
Used TV sets		
CRT screens	91,433	Japan
	179,609	Korea
LCD screens	3,718	Japan
	33,700	Korea
Used refrigerators		
	10,476	Japan
	1,033	Korea
Used air conditioning		
	5,673	Japan
	724	Korea
Used washing machines		
	1,326	Japan
	567	Korea
Used WEEE		
Assorted	5,861	Japan
	4,623	Korea
	4,970	USA
Electronic parts and assembles	6,429	Laos
	2,000	New Zealand
Used other household items (Amplifiers, speakers, rice cookers, etc.)		
	1,520	Japan
	25	Korea

Used IT equipment		
Monitors	17,020	Japan
	28,108	Korea
CPUs	600	Japan
	27,450	Korea
Laptops	1,689	Japan
	4,350	Korea
Computer with monitors/ computer parts	45,833	Japan
	34,594	Korea
Computer parts and accessories	1,422	Japan
	26,385	Korea
Printers and copiers	113	Japan
	2	Korea
	1,165	Other countries
Computer peripherals	94	Japan
	13,040	Korea

Source: Adopted from Ballesteros, 2014

In Cebu City, second-hand shops for mobile phones and personal computers are widespread. These second-hand stores offer multiple services such as software upgrades, addition of new parts, personalised accessories, changing LCD screens, altering original lights with new colours, and additional ringtones. In addition, second-hand shops also sell reconditioned units restoring the old, defective and non-functional units.

Old mobile phones will be restored to their original physical condition with a limited lifespan.

The second-hand shops also provide limited warranty period for their reconditioned mobile phones to attract more customers. Further, these second-hand shops reuse the parts of discarded EEE for cannibalisation or refurbishing which is often practiced for mobile phones, laptops, and personal computers (See Figure 4).

The shops enhance the EEE parts, replacing parts using the functional parts of discarded mobile phones and computers, such as changing RAM and CPU, and create new mobile phones and computers out of the different rejected components.

2.2.3. Collection and pre-processing of E-waste

The collection of special waste, including e-waste is the responsibility of Cebu City. However, no special waste collection system has been set up by the city so far to collect the e-waste separately. There is no waste separation at source, and households throw away the e-waste along with other household wastes. It was found that a lack of knowledge on how and where to dispose of household e-waste is one of the main reasons for this

Figure 4: Mobile phone repair and cannibalisation activities in Cebu City.
Source: by Author

practice. It was also observed that E-waste that is disposed of along with municipal waste by the households is then collected and disposed by Cebu City as general waste.

Some Barangays set up MRF to promote waste recycling and composting. However, MRF is not widely available in Barangays and there are no proper initiatives to address the e-waste collection, recycling and treatment as a part of its existing MRF in the city.

The majority of households in the city sell their e-waste directly to the junk shop dealers or informal collectors, including waste pickers and garbage collectors. Informal collectors are also involved in scavenging and recovering electronic items from municipal waste streams and open dumpsites (Carisma, 2009). The scavenged e-waste is then sold to the junk shops, which act as a middleman for factories or informal recyclers. Informal recycling is usually carried out in backyards. E-wastes are disassembled using bare hands; integrated circuits, wires and cables are burned openly to recover metals, exposing recyclers to toxic fumes (Carisma, 2009). Most of these backyard and informal recycling activities are taking place in high-density low-income housing areas (slum and shanty areas) in the city (See Figure 5).

2.2.4. End- Processing and disposal

Cebu City has very limited e-waste recycling and hazardous waste treatment facilities. Maritrans Recyclers, Incorporated (MRI) is one of the largest and oldest e-waste recycling and processing companies in the city. It was established in 2000 and collects e-waste from institutions, commercial facilities and factories

Figure 5: Informal and backyard recycling in Cebu Barangays
Source: by Author

with prior arrangement. The facility receives a large amount of e-waste from the industries of the Mactan Export Processing Zone (MEPZ), which is a 120-hectare industrial estate located in Lapu-Lapu City, next to Cebu City. The MEPZ started its operation with eight companies in 1986. By the year 2000, MEPZ 1 had 148 companies, including some industries from the United States (US), the European Economic Community, and Japan.

The recycling process adopted at the MRI facility includes the activities of cutting, destruction, sorting, segregation and compaction of electronic scraps. Processed waste is then exported to business partners in other Asian countries, especially Japan, for smelting, metals recovery, and further processing (Carisma, 2009). Although MRI claimed that they have full recycling capacity, the observation found that it has only a dismantling process.

The last stage of the end-of-life of electronics in Cebu City ends up either at landfills, or is exported as partly-processed e-waste to other countries under the Basel Convention. While the Philippines have limited capacity and infrastructure for additional processing of e-waste in an environmentally sound manner, partly-processed e-waste, in the form of scrap liquid crystal displays, printed wiring boards, cathode ray tubes, scrap lithium-ion batteries and scrap adapters are widely exported to Korea, Japan, and Singapore (Florencio, 2014).

The end-of-life of electronic parts that is captured by the informal and backyard recycling activities is largely unknown and un-documented. According to the scavengers, it is very common to find a large amount of unusable electronic scraps in the landfill site, even though city officials claim that dumping e-waste in a landfill site is prohibited (See Figure 6).

Figure 6: Informal collection and scavenging at final landfill site of Cebu City

Source: by Author

3. Key Barriers to Improving the Existing E-waste Management System in Cebu City

This section briefly discusses the key barriers to improving the existing e-waste management system of Cebu City based on the preliminary survey and the perceptions of the different stakeholders presented at the stakeholder workshops (See Figure 7).

3.1. Policy and legislation

3.1.1. Absence of legal and institutional framework

Though the national government of the Philippines has passed relevant laws and legal frameworks to ensure a proper e-waste management system, the implementation of this national legislation and legal frameworks at the local level is not adequate. Most cities do not have by-laws and policies to clarify e-waste categories, separate collection, or ensure appropriate treatment and disposal of e-waste in an environmentally sound manner.

3.1.2. Poor data management

Due to the city's the lack of data and unavailability of proper inventory of e-waste generation and its characteristics, it is difficult to clearly understand the existing level of domestic e-waste generation and its management. To take effective policy measures, decision-makers in Cebu City need more accurate information about the current status and trends of e-waste generated in the city.

3.1.3. Weak policy enforcement

The study observed that Cebu City is very committed to creating environmental policy measures due to the strong political commitment of the existing administration, but it is weak in implementing and enforcing them. According to the perception of different stakeholders in the city, including households, policy-makers, academia, and environmental groups, the No Segregation No Collection Policy for Municipal Solid Waste Management (MSWM) in 2011 based on the RA 9003 enacted by the city is not being enforced. The interviewees argued that nothing would change much even if there were legislation on e-waste until the city has established a proper mechanism for compliance with the policies.

3.2. Social and cultural

3.2.1. Low environmental consciousness

A low environmental consciousness and low awareness of environmental laws is also an issue in e-waste management in Cebu City. About 42% of households in the city are unaware of the categorization of e-waste and hazardous waste as well as the correct disposal methods of these specific waste items (A2D, 2012). Some reasons for low environmental consciousness are lack of education, limited information sharing, and a lack of effective promotion and educational programmes to raise environmental awareness.

3.2.2. Low incentives and inconvenience in the existing take back systems

There are very limited efforts that have been practiced to promote material recovery and take-back systems, such as the activities organised by the SM Malls. However, the success of these activities is minimal due to the inconvenience and lack of incentives for users. It was found that the recycle buyers, who participate in the monthly recycling market, buy e-waste at the same price or less than the price of the junk dealers who are visiting houses to buy e-waste. Furthermore, residents have to bring their e-waste to the recycling markets at the parking lot of the malls. People, especially those who don't have their own transport, found carrying the bulky e-waste using the public transport to be inconvenient. These issues discouraged many residents from participating in the e-waste recycling events, even though they would like to do so.

3.3. Recycling business and technology

3.3.1. Lack of formal e-waste treatment, storage and disposal (TSD) facilities

Cebu City needs e-waste treatment facilities that meet national and international standards. The official e-waste treatment facilities should follow the appropriate rules and regulations for hazardous waste TSD facilities, prescribed in section 5.1 of the DAO 2013-22. Only one TSD facility can be found in the city that operates according to the standards. However, this facility is also located on the outside of the city limits and is limited to simple treatment, storage, and exporting waste to other countries for end-processing and treatment. A majority of recycling occurs in the informal sector without any compliance with the regulations.

3.3.2. Low recycling penetration and low supply of domestic e-waste

Another potential barrier to promoting the e-waste recycling business in the city is the low supply of domestic e-waste (Carisma, 2009). According to MRI, the formal e-waste recycler in the city, the plant receives about 2-5 tonnes of e-waste per week. Most of it is coming from commercial and institutional customers as bulky waste. The company cannot get enough domestic e-waste to sustain its operation due to competition from the informal sector.

3.3.3. Competition between the informal and formal sectors

Competition between the informal and formal sectors in the city is high, especially in the areas of the personal computer and cellular mobile phone markets (Carisma, 2009). Informal recyclers have various options in reusing the discarded EEE before the final treatment. The collected computers are often repaired, and then installed with counterfeit software and outfitted with computer add-ons and accessories. Further, mobile phones are usually repaired, reconditioned and cannibalised, and no-name and pirated and copycat electronics (e.g. iPod) are imported from Taiwan, Thailand and China. Because of these different income earning opportunities, the informal and second-hand market can pay higher prices for used or broken mobile phones at a better price (one mobile phone at 15-20 Pesos) than the formal recyclers (2-10s Peso per unit).

3.3.4. Lack of skills, technology and financial capacity to establish recycling facilities to meet international standards

Both formal and informal e-waste recycling businesses in the city face tremendous challenges due to lack of skills, technology and financial capacity to manage the e-waste recycling facilities to meet international standards. The improper treatment attributable to lack of technology and expertise may cause health problems as well as air and soil contamination in the barangays.

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Figure 7: Group discussions with barangay staff in Cebu City

Source: by Author

4. Inter City Cooperation for Establishing the E-waste Management in Cebu City

This section briefly shares and discusses the experience of model projects implemented between the cities of Cebu and Kitakyushu that are aiming to establish an e-waste management system in Cebu City.

4.1. Development and expansion of city-to-city cooperation between Cebu and Kitakyushu

Kitakyushu City, one of the leading environmental model cities in Japan, has been providing its technical assistance to Cebu City for improving the SWM system for the last 15 years. Like many other major cities in Japan, Kitakyushu developed as an industrial city while supporting the economic growth of the country. At the same time, the city experienced air pollution and severe water contamination. However, through the efforts of city government in partnership with its citizens, academic and private sector, Kitakyushu overcame its environmental pollution so successfully that it was even praised around the world for transforming "from a gray city to a green city" (OECD, 1985).

During its revitalisation process, Kitakyushu adopted the Kitakyushu Eco-Town project as a unique policy that combines industrial promotion and environmental protection measures. Kitakyushu Eco-town contributes to its local re-development of industrialising environmental activities in the form of waste recycling. Further, it has been designed to make the most of Kitakyushu's experience in building the technological capabilities that accumulated during its history as an important manufacturing city, as well as human resource and industrial infrastructures, and the networks of civil society, academia, government and the industry that came to be established in the process of overcoming environmental pollution (Premakumara, 2015).

Kitakyushu has been sharing its experience and technology in waste management and environmental improvement with Cebu City since 2000 (See Figure 8). At the first stage of the cooperation (2000 - 2010), technical assistance was focused on providing training and capacity building for environmental education, introduction of the methodology for cleaner production, and establishing an environmental monitoring and management system (Premakumara, 2012).

Later, a partnership between the two cities has expanded to the provision of technical assistance by dispatching experts from Kitakyushu City to assist Cebu City in implementing an integrated solid waste management plan based on the RA 9003 in the second period of cooperation (2010-2012).

The main support of this period included technical assistance for the planning and

implementation of a community-based solid waste management system at selected Barangays, and promotion of composting and 3R activities for waste minimisation. With this technical assistance from the Kitakyushu City and its partners, including the Institute for Global Environmental Strategies (IGES), a multi-pronged approach to establishing environmental officers in each Barangay, enforcement of the "No Segregation, No Collection" policy, financial and technical support for the establishment of MRF, promotion of city-wide composting and a sustained information education campaign was introduced by Cebu City to achieve 30% waste reduction in 2015.

However, both Cebu City and Kitakyushu partners learned that, in order to realise Cebu City's target to reduce the volume of waste disposed through landfills, source separation and volume reduction should be addressed in a more integrated solid waste management plan that includes other waste categories. A partnership between the two cities thus further developed to address a sound material cycle based on the Kitakyushu experience in establishing eco-town development.

4.2. Technology transfer for establishing an e-waste management system in Cebu City

As a request of the Office of the Councillor Nida C. Cabrera, Chair of Environmental Committee of Cebu City, an e-waste management pilot project was launched in 2013 with the technical assistance of the Nippon Magnetic Dressing (NMD), one of the

Figure 8: City-to-City Cooperation between Kitakyushu City and Cebu City

Source: Compiled by the Author

pioneer e-waste recycling companies in Kitakyushu City in collaboration with the Kitakyushu Asian Centre for Low Carbon Society, NTT Data Institute of Management Consulting and the Institute for Global Environmental Strategies (IGES) under the financial assistance of the Ministry of Economy, Trade and Industry (METI) in Japan. The pilot project aimed to improve the e-waste collection and recycling system in Cebu based on the experience of Kitakyushu city.

In Japan, e-waste is regulated by two main laws. The first of these is the Home Appliances Recycling Law that came into force in April 2001 targeting four main items: televisions, refrigerators, washing machines, and air conditioners (Chung and Murakami, 2008). It states that retailers are obliged to take back end-of-life appliances of consumers and bring them to manufacturers or importers for recycling (See Figure 9). The consumers pay fees for the collection, transportation, and recycling of their discarded appliances. The recycling costs differ according to the appliance. For example, recycling costs are 2,700 JPY for a TV, 4,600 JPY for a refrigerator, 2,400 JPY for a washing machine, and 3,500 JPY for an air conditioner (MOEJ, 2001). The role of the government institution is to provide information related to recycling, imposing recommendations, orders, and penalties on any businesses that make improper claims. A manifest system was established to ensure that the e-waste from specified kinds of home appliances is properly transported from

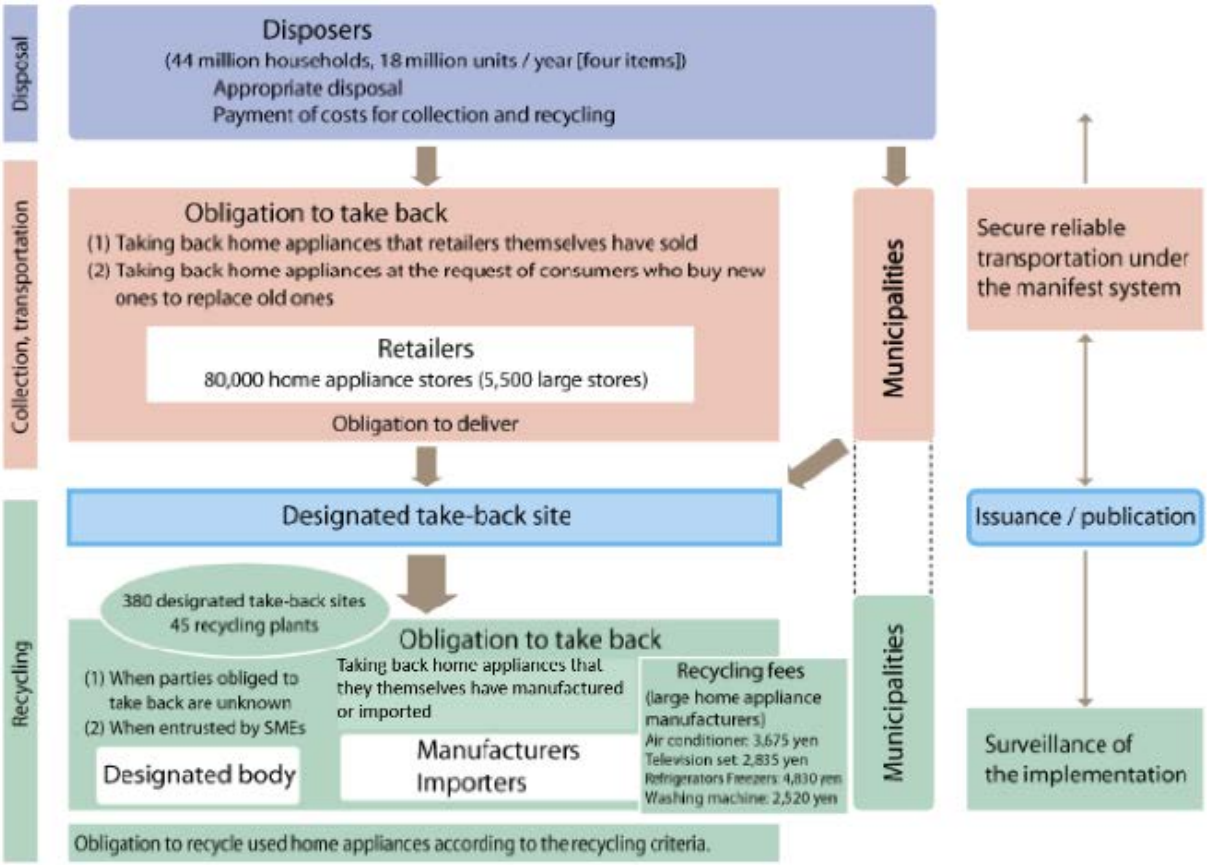

Figure 9: Flow of the take back system of Home Appliance in Japan

Source: http://www.env.go.jp/en/laws/recycle/08.pdf. Accessed on 20 June 2014

consumers to manufacturers through retail stores. It also helps users to check whether the discharged waste has been properly transported and disposed.

Second, a new law called the Act on Promotion of Recycling of Small Waste Electrical and Electronic Equipment was enforced by the Japanese government in April, 2013 to promote the recycling of small waste electrical and electronic equipment such as cellular phones, digital cameras, and portable game consoles. The primary objective of this law is to build an eco-friendly, recycling-based society by encouraging recycling of home appliances, promotion of recycled products, reducing the amount of e-waste, and achievement of sustainable environmental management through environmentally friendly treatment and reduction of environmental challenges to the new resource by using recyclable resources (MOEJ, 2012).

Under this law, respective local governments are responsible for collecting small electrical and electronic equipment wastes discharged by citizens, adopting proper collection systems in line with the current conditions of each region, and handing them over to those who are able to recycle them appropriately (MOEJ, 2012).

According to this national legislation, Kitakyushu City in partnership with the NMD, an e-waste recycling company with headquarters in Kitakyushu and 14 plants

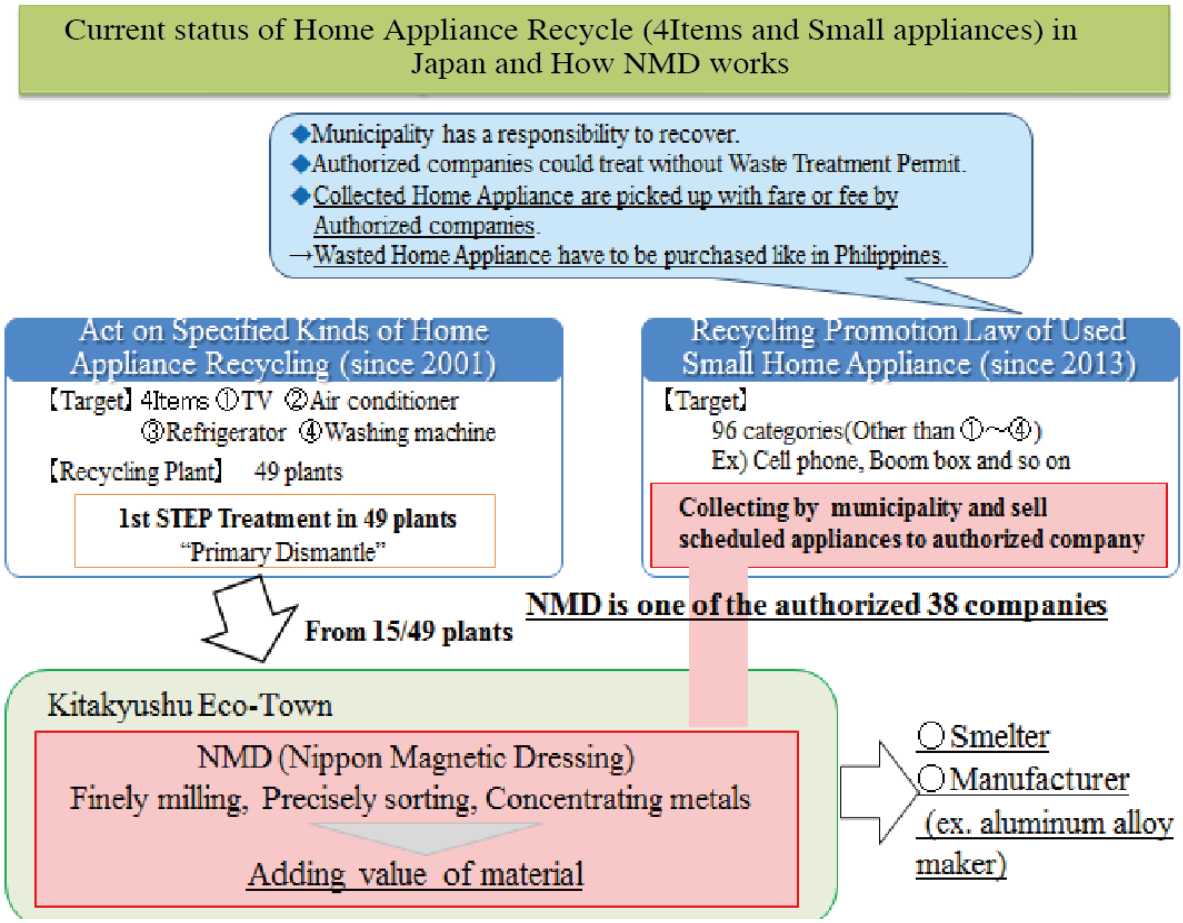

Figure 10: E-waste collection and treatment system of NMD in Kitakyushu City

Source: NMD, 2014

Figure 11: Overview of material recycling in the NMD recycling plant in the Kitakyushu eco-town

Source: NMD, 2014

throughout Japan, set up an e-waste collection and recycling system in the city (See Figure 10). The collected e-waste is properly treated at the treatment plant in Kitakyushu Eco-Town using environmentally friendly technologies with final products sent to the related manufacturers as raw materials (See figure 11). The NMD plant in eco-town can process about 4,000 tonnes of e-waste annually.

In addition, the city integrated cleaner production into its industrial waste management approach, aiming to reduce the volume of waste by reviewing and improving the production system as a whole. Improvements can be made through changes in raw materials, production processes, and production equipment.

Further, institutions discharging large-scale waste in the city have been requested to submit disposal plans under the Waste Management Law, and measures are taken to reduce disposal volumes in accordance with these disposal plans. For example, the city government has introduced an "environmental future tax" as a new tax not stipulated in the local tax law for establishing a continuous and stable source of revenue to take environmental measures actively, including appropriate waste disposal and eco-town measures (UNEP, 2013).

Figure 12: Signing of the MOA between Cebu City and other key partners
Source: Author

4.3. Development of e-waste management model project in Cebu City

Based on the experience of Kitakyushu City, a model project was started by Kitakyushu City, NMD and other partners in 2014 to develop a proper e-waste management system in Cebu, including collection, transportation, treatment and final disposal through the installation of collection boxes in Barangays (local wards) and in business districts, such as large-scale malls. For the successful implementation of the technology transfer between two cities, a number of strategic actions were planned and implemented under the pilot project and some of them are described below.

4.3.1. Institutional and capacity building

(1) Establishment of a multi-stakeholder working group to manage the project activities

Recognising the importance of wider participation in policy making, a multi-stakeholder working group was established under the leadership of the Councillor Nida C. Cabrera, Chair of the Environmental Committee. It included the core members of the city's Environmental Committee, Solid Waste Management Board (SWMB), the

representatives from the SM Mall, Cebu Common Treatment Facility Incorporated (CCTFI)/ Cebu E-Resource Recovery Inc. (CERRI), and the respective Barangay officials.

(2) Signing a Memorandum of Agreement (MOA)

A memorandum of agreement (MOA) was signed by the principal partners on 15 May 2014 at the City Office to ensure more political support and institutional recognition as well as legal entities to the activities of the working group (See Figure 12). The Mayor of Cebu City signed the MOA formally starting the e-waste management project in Cebu City.

(3) Awareness raising and capacity building

A number of study meetings, workshops and focus group discussions were held to understand the existing e-waste management system in the city (See Figure 13), identify potential solutions, and share the experience of e-waste management policies and practices in Japanese cities (especially Kitakyushu City), including the recycling activities and business model of the Nippon Magnetic Dressings Co. Ltd (NMD).

In addition, two field visits were organised for Councillor Nida Cabrera, Chair of Environmental Committee and Mr. Teodoro B. Locson, President of the CCTFI during their visits to Kitakyushu City in 2013. Both of them have learned the take-back system that was set up at the shopping malls in Kitakyushu City

Figure 13: Staff training in Cebu

Source: Author

and the operation of the recycling plant of NMD at the Hibiki Eco Town (See Figure 14).

4.3.2. Development of the model collection system

The project had developed three model collection systems to collect mobile phones as the first stage of the project (See Figure 15).

(1) Trash to Cash Programme:

The Trash to Cash Programme of the SM Mall, which encourages residents to bring collected e-waste to its monthly recycling market, is conducted on Friday and Saturday during the first week of every month at the parking area. Here, the appointed e-waste recycler (CCTFI) buys the e-waste at the same price as the junk shops and transports it to its store, recovers, and exports to the recycling factory of NMD in Kitakyushu City in accordance with the Basel Law, to practice proper treatment.

(2) Drop-off Boxes:

Based on the lessons learned from Kitakyushu City in setting up the drop-off boxes in shopping malls in the city, the drop-off boxes were established in the SM Mall, city office, two selected Barangays, and the Cebu Chamber of Commerce and Industries to collect waste mobile phones from citizens at no charge. The CCTFI is collected and stored on a regular basis from the drop-off boxes and, in accordance with the Basel Convention, exported to Japan where the waste will be properly treated (See Figure 16).

Figure 14: A staff training in Kitakyushu City

Source: Author

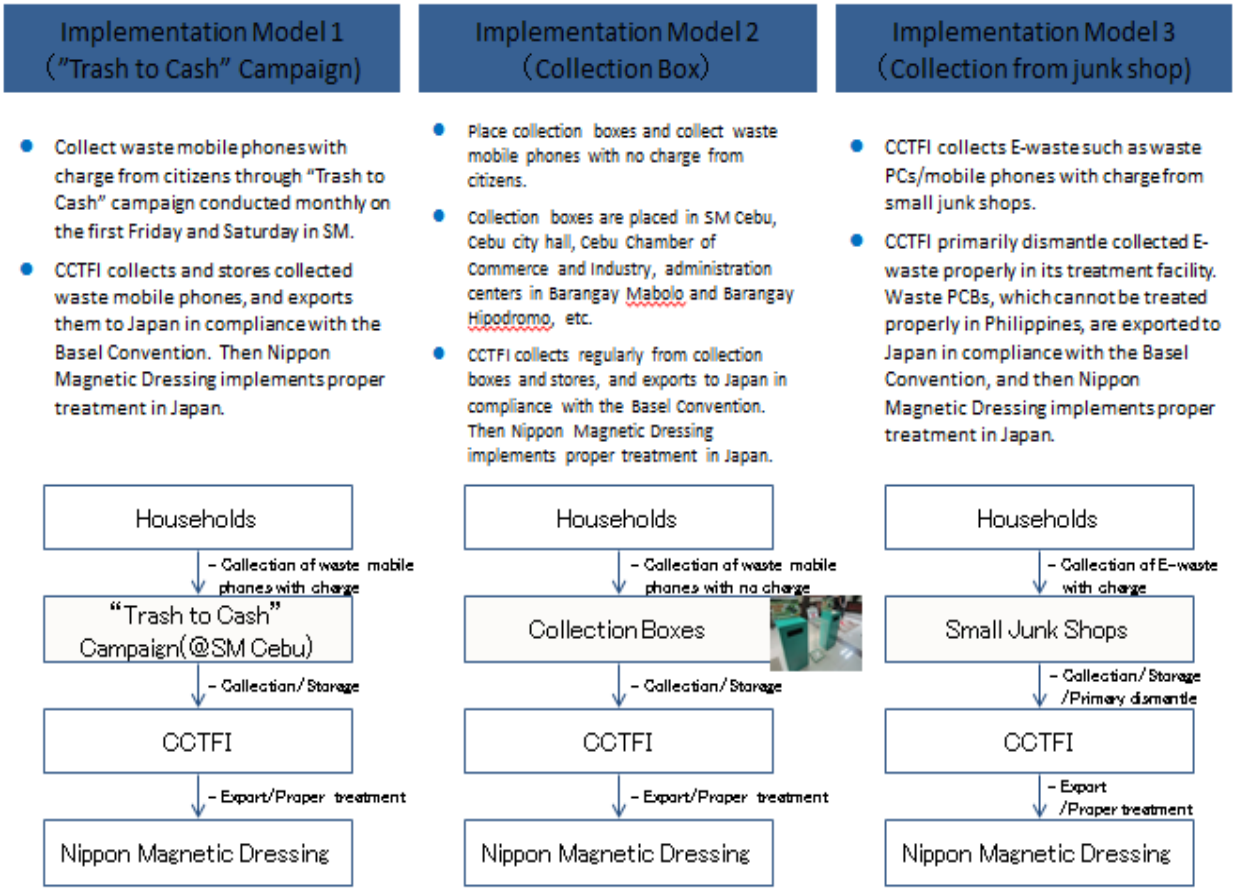

Figure 15: Proposed three models for mobile phone collection in Cebu
Source: NMD, 2014

(3) Junkshop recovery:

CCTFI also aims to recover e-waste such as mobile phones or PCs from small junk shops for a fee. After collection, CCTFI will do primary separation and dismantling correctly at the company processing facilities in Cebu. Materials such as motherboards that contain substances such as PCB cannot be adequately treated in the Philippines, and will therefore be exported to Japan in accordance with the Basel Convention for further recycling and proper disposal.

4.3.3. Integrate the existing informal sector to the mainstream

Whereas recycling activities in Kitakyushu City are highly formalised, activities in Cebu are widely operated by the informal sector. The project team therefore stressed the importance of working with this existing informal sector, especially the junk collectors and dealers, due to the market opportunity and potential of creating job opportunities for low-income groups.

However, considering the public health and adverse environmental impacts that arise through backyard recycling, the main partners of the project identified some steps to stop informal recycling in low-income settlements. These actions include mobilising the informal sector to collect e-waste from households, train them about healthy collection of e-waste, provide financial assistance to start collection businesses, buy the collected waste at market

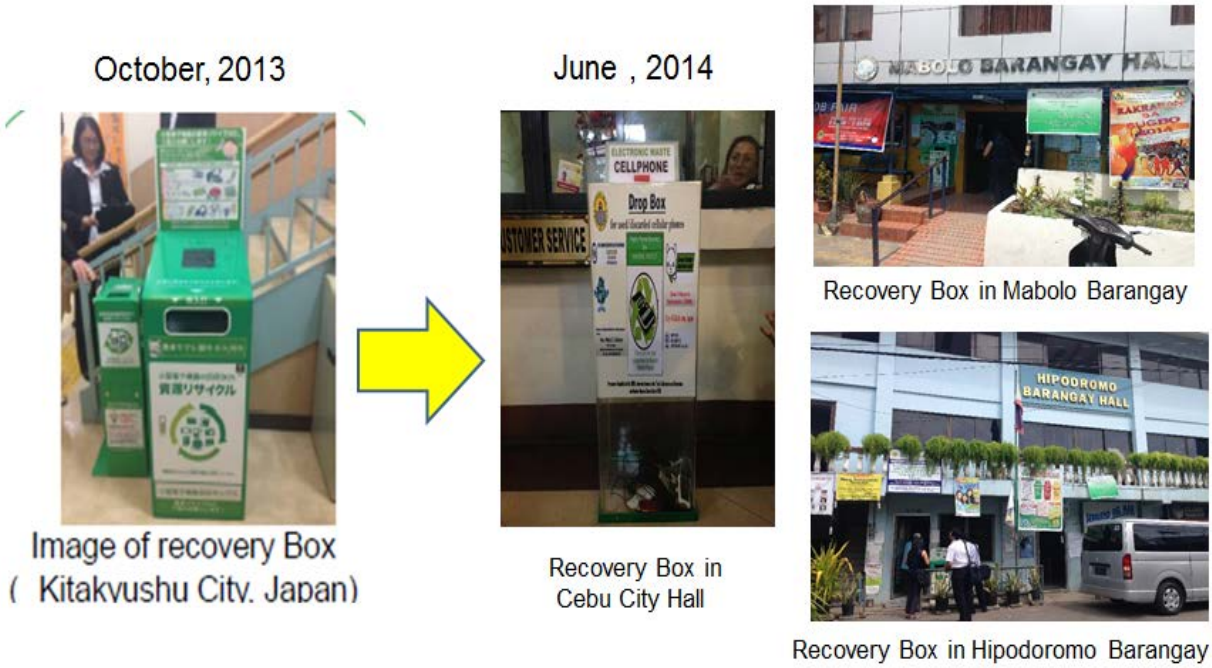

Figure 16: A proposed system of drop-off boxes in Cebu City based on Kitakyushu's example
Source: NMD, 2014

prices, and enforce regulations to prevent illegal dumping and backyard recovery of collected waste.

4.3.4. Development of a business partnership to establish a recycling facility in Cebu

While CCTFI has been authorised by the DENR (EMB VII) as a licensed hazardous waste collection and treatment facility, the project was intended to build its capacity for handling the e-waste. At the first stage, CCTFI will buy the e-waste from informal collectors, e-waste markets, drop of points and formal collectors and send them directly to NMD in Japan for processing and treatment.

However, the necessary technical expertise will be transferred to the CCTFI to do the initial processing in Cebu and export the recovered material to NMD for final treatment at the second stage. Finally, both NMD and CCTFI would like to establish a joint e-waste recycling facility in Cebu to do all the treatment activity in the city, creating more job opportunities for the poor informal sector. Figure 17 shows some on-going activities related to capacity building and construction of new e-waste treatment facility in Cebu City.

Figure 17: An e-waste treatment facility under construction
Source: Author, 2015

5. Conclusion and Recommendations

This study identified that e-waste management is a growing concern in Cebu City, as it is in most other fast-growing cities in the Philippines and elsewhere, due to its risks for public health and the environment as well as its economic value and business opportunities. However, the implementation of national laws and policies at the local level is limited due to a number of challenges faced by the cities, such as lack of legal frameworks, strategic plans, enforcement capacity, environmental consciousness and awareness, recycling technology, and financial resources to adequately manage the e-waste in an environmentally friendly manner. Thus, the majority of e-waste generated in the cities is managed by the informal sector in backyards, and ends up at the illegal dumpsites or final landfill sites mixed with other municipal solid wastes.

Based on the initial results of the rapid study and the experience gained from the implementation of the model project with the technical assistance of Kitakyushu City, the following key measures are recommended for Cebu City to improve its e-waste management system in accordance with the national laws:

Establishment of multi-stakeholder dialogues: A successful e-waste management system needs the participation of various stakeholders; especially the public sector, private sector (including both formal and informal), civil society, and the academic sector (SWEEPNET, 2014). Thus, creation of a multi-stakeholder platform involving all these key stakeholders gives the opportunity to exchange different views and develop an integrated e-waste management system for the city. Although the inclusion of all related interested parties in the planning and implementation process facilitates the wide acceptance and the efficiency of the e-waste management plan of the city, experience also shows there are some challenges that must be taken into account. With so many actors involved in the process, reaching consensus on strategic issues can take a long time compared to the traditional decision-making process. In addition, city officials require additional knowledge and understanding of collaborative and participatory planning techniques and methods to move from hierarchical forms of the decision-making to more flexible forms of partnership with other stakeholders. To facilitate this multi-stakeholder participation at the city level, a special committee headed by the Mayor can be appointed to the Cebu City Solid Waste Management Board (CCSWMB) to provide a long-term vision and necessary policies. In addition, a special committee of e-waste management can be established under the Barangay Solid Waste Management Committee (BSWMC) to ensure effective planning and implementation of e-waste management programmes in their respective Barangays.

Carry out e-waste assessments and inventory preparation: The lack of e-waste related data creates a strong need for carrying out the assessment of the current situation regarding e-waste in the city. The city can work with both academics and practitioners to

introduce a comprehensive inventory and monitoring system for e-waste management. The inventory can include the type, generation, existing storage, collection, recycling industries, technologies involved, and final treatment of the selected e-waste materials. Considering the limited resources (both financial and human) available, the city can begin from the selected types of e-waste that are used more and amount to a high volume of waste in the city. For example, Cebu City can start with Mobile phones, PCs, TVs, refrigerators, and washing machines. Technical and financial assistance can be provided by international organisations and partner cities such as Kitakyushu City and its project partners based on the methodology developed in Japan and other Organisation for Economic Cooperation and Development (OECD) countries. The data should give a holistic view to policy-makers who can make efficient and practical policy interventions in this respect by improving the system and use for monitoring the impacts on public health and the environment. Based on learning and experience, the programme can gradually be expanded to cover other electronic items.

Adopt and implement the E-waste management ordinance in the city: Based on the input of the model project, Cebu City has drafted an e-waste management ordinance based on the national legislation, DAO2013-22. The draft e-waste management ordinance is now in the city council documents. Cebu City should adopt an e-waste management ordinance and develop an action plan to implement the ordinance. In order to address the issue of e-waste, policy-makers and different stakeholders should work together and take into consideration the existing institutions and conditions in introducing e-waste management intervention, especially the role of the informal sector. The implementation of the e-waste management ordinance should be in line with the city's overall solid waste management strategy which is focused on promoting waste separation and 3R (reduce, reuse and recycling). Cebu City should strictly enforce the No Segregation No Collection Policy, which helps to separate hazardous/ e-waste from the MSWM stream. The new category must be added to the current municipal waste collection system, and proper collection and take-back systems should be introduced. The priority of the e-waste ordinance should be waste prevention and minimisation of its generation. In this regard, Cebu City should establish e-waste reduction goals, both short-term and long-term seeking to reduce the quantity of e-waste to be landfilled. The city can introduce more public awareness programmes aiming to change the lifestyles of its residents and encourage them to use electronic materials throughout their lifespans before disposal.

Develop and carry out public awareness programmes: Since the public awareness of e-waste risks and management is still very low in general, there is a strong need for awareness- raising at the household level. Awareness programmes should address the risks of improper handling of e-waste, storage, and disposal, as well as information on the new waste collection system and its benefits. Cebu City can communicate its policies to residents and carry out information, communication and awareness programmes at the Barangay level through its Barangay Environment Officers (BEOs), a team of volunteers who serve as facilitators of the city's environmental education programmes.

In addition, the city can utilise the services of the Cebu Environmental and Sanitation Enforcement Team (CESET), an environmental enforcement team in the city to monitor and enforce the implementation of e-waste management system.

Establish an enabling environment to encourage an e-waste business model: There is a strong need to develop a business model for a sustainable e-waste management system including collection, transportation, recycling, and export or disposal systems (SWEEPNET, 2014). The private sector plays a crucial role in developing an e-waste management system in the city. While the informal sector plays a leading role in recycling e-waste in Cebu City, formalisation of e-waste collection and recycling remains an important issue. Based on the experience of Kitakyushu City in implementing the pollution control laws, the formalisation of the informal recycling sector can start with the encouragement of the registration of all e-waste collection, recycling and treatment facilities in the city, request to submit an e-waste management plan, and adopt a tax system for landfill dumping. In addition, the city should set rules and enforce their implementation by the recycling facilities. Further, the experience in implementing a model project in Cebu recognised the importance of creating a favourable climate to support both the private sector and residents to take part in the programme. To encourage private sector involvement in the e-waste business, tax reductions, subsidies, and low-interest loans can be provided to purchase pollution control equipment and establish recycling industries. Environmental awareness should be increased to encourage the participation of residents in e-waste recycling efforts. Further, foreign companies such as NMD of Kitakyushu City could build business partnerships with local firms in Cebu, including CTFI to introduce new technologies and to demonstrate the benefits of a sustainable e-waste management system incorporating different stakeholders. The city can facilitate the establishment of e-waste recycling facilities along with other recycling facilities in the same area in order to reduce pollution.

Establishment of effective monitoring and certification systems: Cebu City in cooperation with the DENR Regional Office should develop and monitor the standards and guidelines or policies for an environmentally sound management of e-waste and certification system. These standards and principles should be reasonable, easily implementable and enforceable.

The study also concluded that specific policy support mechanisms at the national level are essential for the efficient implementation of e-waste management systems at local level. For the effective implementation of national policies at the local level, the national government should allocate technical and financial resources for preparation of e-waste inventories, including a directory of recycling companies with their technologies, and development of business models for e-waste management at the local level. Further, the national government should build the capacity of city officials, policy makers, businesses and citizens by providing information on the new e-waste management policy and its implementation. The national government also can develop tools and guidelines in cooperation with Cebu City and the DENR Regional Office for monitoring and evaluation

of various projects for their effectiveness and sustainability and documenting best practices and lessons learned. In addition, a regional platform can be established to exchange information, provide training, and strengthen enforcement and monitoring.

The experience of the pilot project implemented by Cebu City in cooperation with its partners in Japan's Kitakyushu City also demonstrates the potential of inter-city cooperation to help mainstream and disseminate environmentally sound e-waste management practices in developing countries. The cities of developed countries with experience can assist in establishing e-waste legislation and capacity building for their partners in developing countries in designing sustainable e-waste management business models that includes an effective take-back system, sound recycling, and end processing facilities. Meanwhile, cities like Kitakyushu in developed countries that have private companies with proper treatment facilities can facilitate business promotion through the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal to help developing countries export waste materials to be treated at their plants in Kitakyushu. It would help to prevent the dangerous treatment by the informal sector in developing country cities, while at the same time providing a source of rare metals for the factories in Kitakyushu City. In addition, it would contribute to further developing the Kitakyushu Eco-Town to be the Asian hub for collecting precious metals from waste, supporting the national policy of Japan to realise an adequate rare metal supply by using recycling technology. However, this study also recommends that local policies and techniques should be adapted to the local context, taking into account the needs, capacities, business models etc., of the developing cities. Further, the new business models should consider the role of informal recycling activities in developing cities and incorporate them into the operation protecting the livelihoods of poor. International cooperation can also facilitate the lessons learned by documenting best practices from practical projects and using regional and global partnerships to raise political motivation, and share information and knowledge.

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