CHAPTER 1: INTRODUCTION

1.0 Introduction

Electronic waste has been one of the fastest growing components of the municipal solid waste stream (Herat and Agamuthu, 2012). This is as a result of people enhancing their mobile phones, computers, and audio equipments (Jang, 2010). These are causing big issues as they are replaced most often (Herat and Agamuthu, 2012). Globally, it was projected that 3 billion electrical and electronic equipment will become electronic waste (e-waste) by 2010. In European countries, e-waste is predicted to grow 12 million tonnes by 2020 (United Nations University, 2007b). Developing countries are expected to generate twice as much as e-waste for the next 6-8 years as developed countries (Science Daily, 2010).

Recently, the amount of electronic products discarded globally has increased, with 20-50 million tonnes produced every year (Science Daily, 2010). This brings about significant threat to human health and the environment. Many countries around the globe have been struggling to deal with this rising issue which has been expanding rapidly (Herat and Agamuthu, 2012). Therefore, electronic wastes have become a new policy priority around the globe. The responses towards global e-waste in terms of policy include international trade in end-of- life electronics. In relation to the management of e-waste, several policies are being implemented on a state, national, and federal level which will, to some extent, help to tackle the issue (Resource Recovery, 2006). Even though, the current focus is on end-of-life management of e-waste such as remanufacturing, disposal and recycling, the reduction of upstream

generation of e-waste has been gaining much concern through cleaner production and green design (Herat and Agamuthu, 2012). Awareness of recycling opportunities for e-wastes are extremely resricted (United Nations University, 2007b).

In addressing this growing issue, one of the most promising policy options is the Extended Producer Responsibility (EPR). The aim of EPR is to extend responsibility of the producer for their products until end of its useful life. The policy tool is an environmental protection strategy aiming to achieve the objective of a total decreased environmental impact of a product (Tojo and Naoko, 2004).

1.1 Background Study

Developing countries have become hazardous dump yards of e-waste. There is an increase in export of electronic wastes to countries like China, India and few parts of Africa that causes harm to the environment. Recycling of copper, silver, gold, and other materials from discarded electronic devices is considered better for the environment (Hawari and Hassan, 2008).

In addition, countries like Taiwan, South Korea, and Southern China have set up billion-dollar industries in refurbishing used ink cartridges, single-use cameras, and working cathode ray tubes (CRTs) (Electronics Takeback Coalition, 2012). Whereas, U.S.A has domestic laws restricting the export of hazardous waste and is one of the countries that has not ratified Basel Convention. The Basel Convention Network made an estimation that about 80% of the electronic wastes that are sent to the U.S.A for recycling does not get recycled, but is sent to countries like China for processing (European Recycling Platform, 2012). The U.S.A, a world leader in producing

electronic waste, generates approximately 3 million tonnes of e-waste yearly. Coming in second is China, which produced about 2.3 million tonnes of e-wastes. However, China still remains a major e-waste disposal ground for developed countries despite having banned imports of e-wastes (Hicks *et al.,* 2005).

According to a report by UNEP titled, "Recycling - from E-Waste to Resources," over next decade, e-wastes being produced could increase to as much as 500 percent in certain countries, such as India (UNEP, 2009). A rough estimation from The Environmental Protection Agency (EPA), indicates that only 15-20% of e-waste is recycled, while the rest of these electronics go directly into landfills and incinerators (Basel Action Network, 2010).

1.2 Problem statement

Environmental problems resulted by e-waste disposal are three fold. E-waste has already taken up significant amount of space in crowded landfills which persists for centuries. Second, by simply discarding them is a great amount of waste age of resources that can be reused. Third, the discarded electronic equipments contain hazardous substances such as lead, mercury, cadmium, chromium, brominated flame retardants and polychlorinated biphenyls which can affect the health of both developed and developing nations (Huo *et al.,* 2007). Transboundary movement of e-waste also happens to be one of the global concerns around Asian countries and dealing with the informal recycling sector is a social and environmental issue (Herat and Agamuthu, 2012). E-wastes are being sent to countries like Kenya, China, Malaysia, India, and various African countries for processing, which are also illegal.

The rising consumption of EEE and production of WEEE has led to an increase in e-waste levels, which could be hazardous posing a possible threat towards environment and sustainable growth of economy (Zhang *et al.,* 2010). Since, e-waste disposal is becoming a major crisis and many electronic gadgets are replaced regularly, the e-waste recycling industry is in the process of coming up with a consistent e-waste management programme (Zhang, 2011). The expanding e-waste generation in Malaysia has become a driving force behind the development of waste and environmental management policies (Agamuthu and Dennis Victor, 2011). Since, Malaysia has been working under the DOE guideline of Waste Electrical and Electronic Equipment (WEEE), and seeking towards attaining a sustainable development, this study provides an insight in broadening e-waste concern among the nation by implementing the practice of EPR under electronic industry.

The practice of EPR is slowly picking up its steam, most prominently in the Information Technology Industry (ICT) (Tojo and Naoko, 2004). This is of crucial importance in e-waste management as electronic equipment contains toxic constituents in its components. According to Banerjee (2007), the management of e-wastes equipment from these industries have become a business opportunity for some. This is due to the high value of recoverable content in WEEE and high volume of used equipments discarded through the recycling and recovery of materials (Babu, 2007).

Therefore, EPR is seen as a radical new direction towards e-waste management that is significantly better for the environment and public health than any other practices (Tojo and Naoko, 2004; Van Rossem *et al.,* 2006). Greater levels of responsibility have been undertaken by growing number of companies for the environmental

impacts of their products (Hotta *et al.,* 2009). They realize the benefits of building stronger bonds with their increasingly environmentally-conscious customers, as well as, reducing costs of e-waste manufacturing and management (Van Rossem, 2008). In the electronics industry, the EPR's purpose is to shift the costs of the wastes back onto those with control of product design by creating a better waste management, product design and marketing system.

1.3 Overview of Extended Producer Responsibility

EPR is classified as a protection strategy towards the environment in making the producer or manufacturer responsible for the complete product's lifecycle. The producer's responsibility is extended to the post consumer stage (Khetriwal, 2009) which includes take back, recycling and final disposal of the product (OECD, 2008).

EPR is a principle in which the producer is not the only responsible party but also the packaging manufacturer, retailer and the consumer that have responsibility towards the life cycle of a product (StEP, 2005). In this way, the manufacturers, distributors and users have shared responsibility in preventing pollution towards the product's life cycle. Among the activities that comes under the EPR include product stewardship programmes, product design for life cycle environmental performance, take back scheme and end-of-life management. The application of EPR potentially include more effective use of resources, cleaner products and technologies, productive manufacturing, reduced environmental threat associated with storage, shipping, handling and disposal, improved recycling and recovery, and greener consumption (Qin *et al.*, 2011).

EPR though initiated by European countries, has been introduced by many countries around the world as a useful tool. It is recognized as an efficient way to dematerialize our economy (Hawari and Hassan, 2008). EPR has become an important practice in motivating producers to take up environmental responsibilities (Walls, 2006). Since producers find it difficult in adapting to economic and environmental benefits, such policy intention is yet to be realized. A much more theoretical research is required in order to guide producers to more extended responsibilities based on practical leadership (Townsend, 2011).

Apart from the producer's involvement in extended responsibility, EPR also needs congruent systematic conditions to make it a beneficial policy in terms of environment and economy. According to the Organization for Economic Cooperation & Development (OECD) (2001), EPR is seen as a policy approach that extends the producer's responsibility for a product to the post-consumer stage of a product's life cycle. Producers are in their best position in reconstructing their products for durability and recyclability. This has eventually made the manufacturers more aware of their product in creating a drawback; which could be noticed in the products' change of design. This happens to be the ultimate core of an EPR principle that differentiates it from elementary take-back systems (Scott and Thompson, 2007).

The EPR concept has gained recognition globally. Several countries have adopted to the standards and systems of EPR, and its effectiveness has been demonstrated in several countries such as Sweden, Germany and Switzerland (Manomaivibool *et al.*, 2007). However, in the developing world, a few countries such as China, Argentina and Thailand have adopted the EPR principles, yet the operationalization aspects of EPR still remain as a challenge. EPR has become a necessity due to the transboundary

movement of e-wastes and lack of waste disposal and recycling facilities (Osibanjo and Nnorom, 2008).

1.4 Overview on e-waste

Electronic wastes or *e-waste* has emerged as one of the upcoming concerns in Malaysia. The generation of e-waste in 2009 was about 134,036 metric tonnes and is forecast to be 11.1 million by 2020 (Department of Environment Malaysia, 2012). E-waste is classified as scheduled wastes as the electronic components contain toxic materials; such as lead, cadmium, nickel etc. that are considered hazardous causing environmental issues (Hawari and Hassan, 2008).

In Malaysia, e-wastes are classified as 'used' assemblies of electrical and electronic equipments referred to as scheduled wastes in the First Schedule of the Environmental Quality (Scheduled Wastes) Regulations 2005, administered by the Department of Environment (DOE) (2010). E-wastes are scrapped from the electrical and electronic equipments containing components such as mercury switches, accumulators, glass from tubes of cathode-ray and other activated glass. E-wastes that comes from the landfill usually contains leachate which are highly contaminated that pollutes the environment particularly surface water and groundwater. If disposed on the ground, acids and sludge from melting computer chips causes acidification and contamination of soil and subsequently groundwater contamination (DOE, 2010).

E-waste covers a broad range of electrical and electronic products from as big as a refrigerator to as small as a calculator. Examples of e-wastes are the components of waste but not restricted to the appliances shown in Table 1.

Table 1: Examples of e-wastes

Television	Computer/Notebook
Telephone/Cellphone	Printer & Other Accessories
Photostat machine	Video Camera
Facsimile machine	Digital /other camera
Stereo/ Audio device	Electronic Game Device
VCD/DVD Player	Oven/Microwave
Refrigerator	Vacuum cleaner
Radio/Hi-Fi	Electrical Fan
Air condition	Rice cooker
Washing machine	Iron

Source: Terazono (2008)

According to Wang (2009b), disposal of e-wastes has been an issue around the globe. The volume and extent of e-waste generation that has been growing worldwide have been the focal attention especially among the selected Asia Pacific countries. The capacity of e-waste is expected to grow at an even faster rate for many more years to come (Tang, 2010a). In addition to that, instituted legislations and administrative frameworks have been implemented in selected countries under the Asia Pacific region in an effort to manage their e-wastes (UNESCAP/IGES, 2007). With that, EPR laws are being adopted by many governments as a measure in making sure the manufacturers keep their products away from the municipal solid waste (MSW) stream. To be able to function effectively, EPR laws should establish recycling targets and take-back activity (Tojo and Naoko, 2004).

1.5 Take-back Programme

Waste management policies have been adopted by several countries in which manufacturers or producers have responsibility in taking back their products from end users (Herat and Agamuthu, 2011). The activity first began in Europe, where government-sponsored take-back initiatives arose from issues about landfill space and potentially toxic constituents in component parts (Ahmed, 2011). Primary goal of the take-back law is to ensure that all wastes are managed in a way that protects environment and public health. The target of take-back laws are to

1. encourage companies to design products for reuse, recyclability, and materials reduction;
2. incorporate waste management costs into product's price;
3. promote innovation in recycling technology.

Take-back programs help to promote these goals by creating incentives for companies to redesign their products. This will minimize waste management costs, by designing their products to contain safer materials or easier to recycle and reuse (DOE, 2010). These programs have been now adopted in nearly every OECD countries (Abbas, 2011).

1.6 Scope and Research Objectives

The research is aimed at exploring EPR's application in Electronic Industry, targeting e-waste with particular focus on computers. In another aspect, this study also looks into public awareness and knowledge on EPR and E-waste. The objectives of the

study look at the practice of EPR in electronic companies, computer sector in particular, with the aim of streamlining the existing end-of-life management of used computers. The research also seeks to engage the public to gauge on EPR as well as the take-back programme. The specific objectives of this study are as follows;

1. To evaluate the extent of EPR Practice in selected Electronic industries.

2. To compare EPR activity among selected electronic companies using Expertchoice software.

3. To assess the level of awareness on EPR among the management staff in the electronic industry.

4. To investigate the public response towards EPR in terms of their knowledge and awareness.

The scope of this study is restricted in various ways; that it covers the information and communication technology sector within electronic industry targeting computers and limited reference to other equipments. The choice of computer is based on the fact that the computer industry is a growing industry not only in Malaysia but in other developing countries as well, such as China and India. Most of the computer based electronic companies are based within Klang Valley. The institutions are also well developed and traceable within given timeframe to conduct this study.