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## Electrical and Electronic Waste Management Practice by households in Shah Alam, Selangor, Malaysia

Junaidah Ahmad Kalana

Department of Environmental Management, Faculty of Environmental Studies, Universiti Putra, Malaysia (UPM), 43400 Serdang, Selangor, Malaysia  
junearjue@gmail.com

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### ABSTRACT

Increase in the end of life of electrical and electronic products depends on the economic growth of the country, population growth, market penetration, technology upgradation, and obsolescence rates. It can be assumed that the disposal of electronic products is fundamentally driven by the production of new ones. The management of electronic waste has become an environmental concern in many developing countries as urbanization continues to take place. Hence, this study was conducted in Shah Alam City which is the state capital of Selangor, Malaysia. The aim of this paper is to identify current electronic waste management practices by households in Shah Alam, Selangor. In order to ensure a higher response rate, face-to-face interviews were employed for primary data collection as the interview survey method. Information on knowledge level, attitude and practice on use and EEE disposal was collected using questionnaires. The findings show that the preferred methods of electronic waste disposal by Shah Alam residents are storage and sale as second-hand equipment, is about 48% and 37% respectively. Only a fraction of electronic waste (22%) finds its way to recycling facilities as there is no efficient take-back scheme for consumers. Most of the households do not know where and how to dispose of electronic waste in a proper manner. Consequently, they resort to disposing electronic waste outside their premises together with other household wastes. The government needs to improve collaboration among stakeholders in order to enhance public awareness on electronic waste.

**Keywords:** Electronic waste, management, practice, household, awareness

### 1. Introduction

Electrical and electronic waste, also known as electronic waste or waste electrical and electronic equipment (WEEE), or in short called e-waste, is used to describe obsolete or end of life (EOL) electrical and electronic equipment (EEE). There is no generally accepted definition of e-waste around the world [1]. However, e-waste is often misunderstood as comprising only computers and related IT equipment, or worse still, mistaken as email spam [2]. It is universally understood as electronic waste disposed of by end users and includes a wide range of products, from simple devices to complex goods. Therefore, e-waste comprises both white goods such as refrigerators, washing machines and microwaves, and brown goods which consist of TVs, radios and computers that have reached their ends for their current holder [2]. E-waste mainly comes from several sources: 1. Residue or leftover materials from electronic products manufacturing process; 2. Leftover parts or materials, or discarded electrical and electronic equipment generated from a repair shop; 3. Obsolete electrical and electronic equipment coming from governments, companies, and other facilities; 4. Obsolete electrical or electronic products mainly from households; 5. Obsolete electrical or electronic products brought in by smuggling [3].

Increase in the end of life of electrical and electronic products depends on the economic growth of the country, population growth, market penetration, technology upgradation, and obsolescence rates. Besides that, due to the increase in affordability of new products and technological advancements, it is easy to purchase rather than repair outdated equipment [4]. It can be assumed that the disposal of electronic products is fundamentally driven by the production of new ones [5] where, according to William (2005), this implies that the growth in global electronic production of 4.4% in 2002 and 6.8% in 2003 will result in similar growth in e-waste generation [6]. However, the issue on how much e-waste is generated, from where and to where it is moving, is difficult to estimate [5].

Currently, most consumer electronic devices (CEDs) end up in landfill sites without proper treatment because there is no segregation mechanism. Thus, more than 90% of e-waste was landfilled while in other countries, a large fraction of e-waste from households ends up in waste incinerators [7]. Many consumers do not immediately dispose of or recycle unused electronics since they think that the products still have value [7]. E-waste management is relatively widely practised by the industrial sector. It is at the domestic or rather household level that e-waste management is an issue [8].

### 1.2 E-waste related law in the context of Malaysia

In Malaysia, all environmental issues are controlled by the Department of Environment (DOE) under the Ministry of Natural Resources and Environment (NRE). DOE's main roles are to prevent, control and abate pollution through the enforcement of the *Environmental Quality Act 1974* (EQA 1974) with its 34 subsidiary legislation made thereunder. Under EQA 1974, the Environmental Quality (Scheduled Wastes) Regulations 2005 (EQSWR 2005) are enforced to replace the Environmental Quality (Scheduled Wastes) Regulations 1989 (EQSWR 1989). In EQSWR 1989, the Regulations were based on the cradle to grave concept where the generation, storage, transportation, treatment and disposal of wastes are regulated. In EQSWR 2005, the scheduled wastes are now categorized based on the type of waste rather than the source or origin of the waste [9].

### 1.3 Environmental Quality (Scheduled Wastes) Regulations 2005 (EQSWR 2005)

Malaysia already has existing regulations on scheduled wastes where e-waste is categorized under SW110 in the First Schedule of EQSWR 2005. However, these Regulations do not directly deal with e-waste from households. Before 2005, e-waste was not recognized by DOE as waste that can bring adverse effects to humans and the environment. With the enforcement of EQSWR 2005, which came into force on 15 August 2005, no person is allowed to dispose of any e-wastes into landfills. The wastes shall be recycled and recovered at prescribed or licensed premises while disposal must take place at prescribed premises only and must be carried out in an environmentally sound manner. EQSWR 2005 came into force on 15 August 2005 to replace EQSWR 1989. After e-waste has been analyzed as containing hazardous substances such as lead, cadmium and mercury, it has become an issue because of its inappropriate system of management. Currently, there is no mechanism on a proper segregation or disposal system to encourage the public to recycle and discard e-waste. Continued generation of e-waste over time, together with lack of structured mechanisms of

institutional framework and inadequate infrastructure, results in improper e-waste management. Even though at present electrical or electronic appliances are rarely disposed of indiscriminately, with little regulation in place this has created hazards to the local population as well as the environment.

#### **1.4 Guidelines for the Classification of Used Electrical and Electronic Equipment**

A set of guidelines on e-waste, known as the Guidelines for the Classification of Used Electrical and Electronic Equipment, has been issued by DOE. The scope of e-waste in these Guidelines is to assist parties such as waste generators, waste importers or exporters and relevant authorities involved in e-waste management. These Guidelines were issued in January 2008 and they have identified the different categories of e-waste and specified the characteristics of e-waste. Currently, these Guidelines only distinguish between e-waste and non-e-waste. The Guidelines also specify the criteria for the import and export of used electrical and electronic equipment or components that are not categorized as e-waste. Waste categorized as e-waste is not allowed to be imported without approval from the Basel Convention [10]. There are two main types of e-waste generators mentioned in these Guidelines but only e-waste from industries is managed well. These Guidelines do not provide any information on how users in Malaysia should manage their e-waste at the end of the product's lifespan. Essentially, these Guidelines could have served as an information tool to inform electrical and electronic consumers on how to identify which product qualifies as e-waste and which does not. In addition to this, the Guidelines could also present the government with alternatives on how to achieve higher levels of reuse and recycling of e-waste, and ultimately to reduce the generation of e-waste which currently ends up in landfill sites or are being treated in an inappropriate way. Yet, these Guidelines do not supply any information on how to manage e-waste.

#### **2. Methodology**

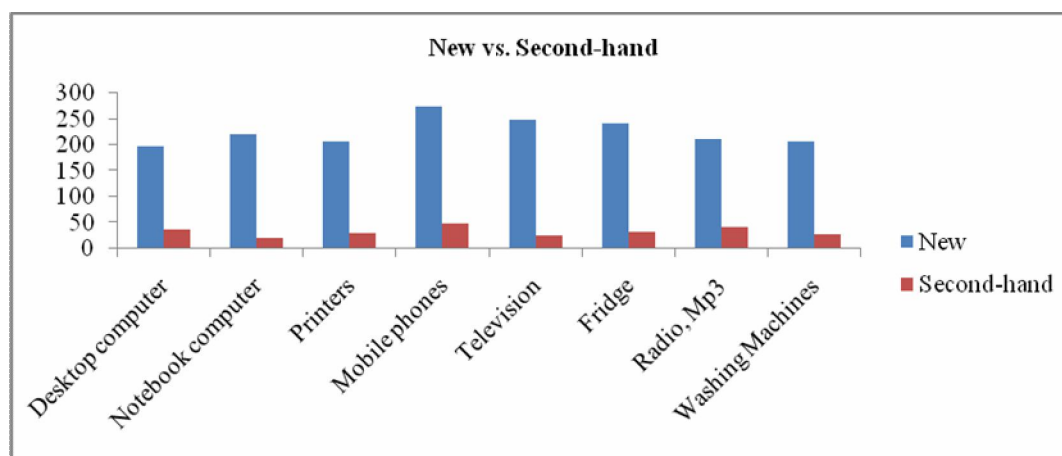
Increased consumption of electrical and electronic equipment due to its utilization in the day-to-day life of individuals has indirectly explained the increase in the generation of e-waste. The management of e-waste has become an environmental concern in many developing countries as urbanization continues to take place. Hence, this study was conducted in Shah Alam City which is the state capital of Selangor, Malaysia. Shah Alam City Council (MBSA) administration covers an area of 29,030 hectares or 290.30 sq km. The households which are the consumers of electrical and electronic equipment and also the e-waste generators are the target population in this research. The reason for this is because the consumers are the key stakeholders in any e-waste system as they are the buyers of the product in the first place; they are also the ones who store, exchange, repair, refurbish or dispose of the products after use [11]. The survey was conducted among community members aged 18 to 50 years above, who typically have high disposable income and the willingness to spend their money on consumer gadgets. To ensure an adequate level of confidence in the findings of the study, a sample size of 300 was targeted. In order to ensure a higher response rate, face-to-face interviews were employed for data collection as the interview survey method would give better results than mail surveys. Information on knowledge level, attitude and practice on use and EEE disposal was collected using questionnaires. Key documents collected include materials in the form of publications such as reports, journals, books, and the internet. The data was gathered from sources such as the report on the e-waste inventory project in

Malaysia, the annual publication of *IMPAK* magazine by DOE, Malaysia and the environmental quality report from DOE, Malaysia. Besides that, it also used to support the results obtained. Understanding e-waste management and to determine the best approach is a difficult task due to lack of study and reliable data on E-waste management system in Malaysia. Therefore, the aim of this paper is to identify current e-waste management practices by households in Shah Alam, Selangor.

### 3. Results and discussion

#### 3.1 E-waste status in Shah Alam, Selangor, Malaysia

In the early stages of Malaysia's economic development, electronic appliances were considered as luxury items and were unaffordable to the common people. However, electrical appliances provide satisfaction and increase convenience in everyday life and, as a result, their usage becomes more and more popular in Malaysian households. Rapid development of technology in electrical and electronic industries not only offers a wide range of product choices but also price choices. Now some products are available in more affordable prices. With the increase in purchasing power and the generally affordable prices of EEE, Malaysians are able to own more than one type of EEE or multiple units of the same type of EEE such as mobile phones [12]. It gives individuals the opportunity to have electronic goods in their home. In a study by PGE (2009), the types of EEE that used to be possessed by only high-income households in the past are just as equally owned by medium and some low-income households [12]. Once a household has used the electrical and electronic equipment until its end of life, the equipment will undergo the mechanism of disposal. Figure 2 shows the amount of new and second-hand equipment owned by 300 households in Shah Alam City.



**Figure 1:** Amount of new and second-hand electrical and electronic equipment

The number of both desktop computers and Notebooks owned by the respondents is around 419 units. This indicates that IT and telecommunication, and computer networking have penetrated nearly every aspect of modern life [13]. The trend of EEE consumption nowadays is the growing dependence on technological information. The purchase or use pattern of EEE

was analyzed to determine the possession of EEE, the duration of use and the ratio between second-hand and brand new EEE. The figures show that there are more new equipment compared to second-hand equipment, with TVs, PCs and mobile phones leading the list. Most of the respondents are first-time buyers of electrical and electronic equipment. Therefore e-waste being generated from households is in minimum quantities [14] compared to e-waste generated from businesses or industries. Yet, electronic products are present in almost every aspect of our lives. The heavy reliance on such equipment nowadays has resulted in the growth of electronic items in the waste stream [15].

About 95% of the respondents' preferred method of obtaining EEE is by purchasing the electrical and electronic equipment from retail outlets or shops. This indicates that consumers are purchasing the electrical and electronic equipment mostly from established operators. For second-hand equipment, the respondents purchased the products from formal second-hand markets because the price offered by the retailers there is cheap. About 3% and 2% obtained the equipment from informal second-hand markets, and purchased them through the internet and from relatives.

### 3.2 Source of e-waste in Shah Alam, Selangor

Shah Alam City is a well-planned city with residential areas located adjacent to the Federal Highway and the industrial areas concentrated on the other side. The source of generators in Shah Alam consists of electrical and electronic (EE) manufacturers or multinational companies, assemblers, individual consumers, government agencies, corporate users, etc. The types of e-waste generated by waste generators and collected by e-waste contractors in Shah Alam, Selangor are summarized in Table 3. The type of e-waste generated depends on the type of generators and each quantity generated or collected is different from one another.

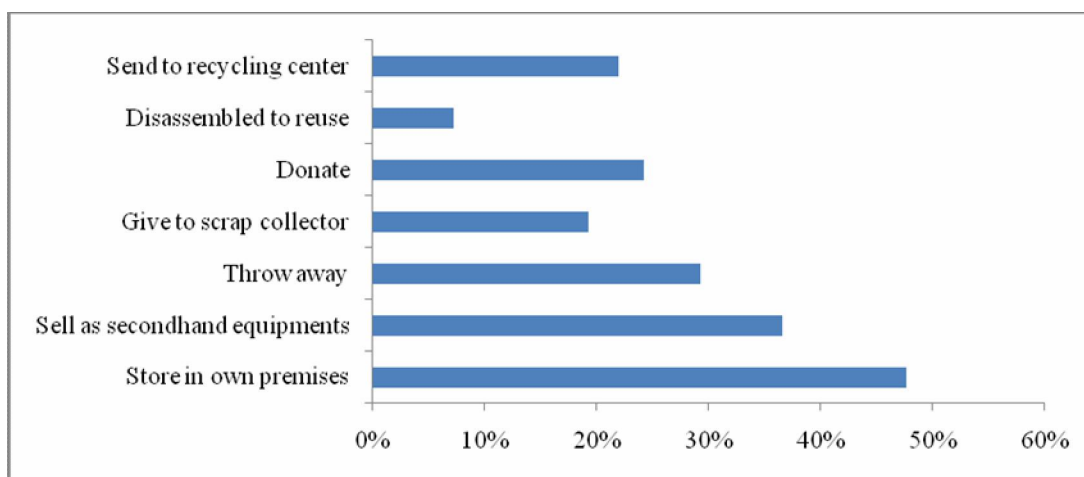
**Table 1:** E-waste generators, type of e-wastes and e-waste collectors in Shah Alam, Selangor

E-waste generators	Type of e-waste	E-waste collector
Manufacturing industries	Disassemblies such as metal scrap, ICT board, rejected wires, etc	Licensed e-waste contractor under DOE
Government organization, institution (corporate users)	Whole units of e-waste such as computers, telephone, printers, etc	Alam Flora Sdn Bhd; licensed e-waste contractor under DOE
Individual households, the public	Sub-unit of e-waste or whole unit of e-waste	Shah Alam City Council (MBSA)

E-waste produced by multinational electrical and electronic manufacturers and other larger companies is properly collected by licensed e-waste contractors. On the other hand, e-waste derived from individual households is not commonly collected, and only a certain number of e-waste contractors collect e-waste from the public. The reason is because e-waste produced from these sources is in small amounts. Macauley (2003) has ascertained that e-waste

generally generated by businesses is more homogeneous and is in large quantities compared to e-waste generated by households [14]. This is because individual households are not regular generators of e-waste compared to business users. E-waste generated by households is managed indirectly by Alam Flora concessionaire and Shah Alam local authority. E-waste from households will be collected if the unwanted equipment is sent by the public to the recycling centre set up by Shah Alam City Council in Section 17, Shah Alam, Selangor or through any campaign launched. Alam Flora, on the other hand, will provide pickup services for members of the public who wanted to dispose of their e-waste.

### 3.3 E-waste management practices by households in Shah Alam, Selangor



**Figure 2:** E-waste disposal practices

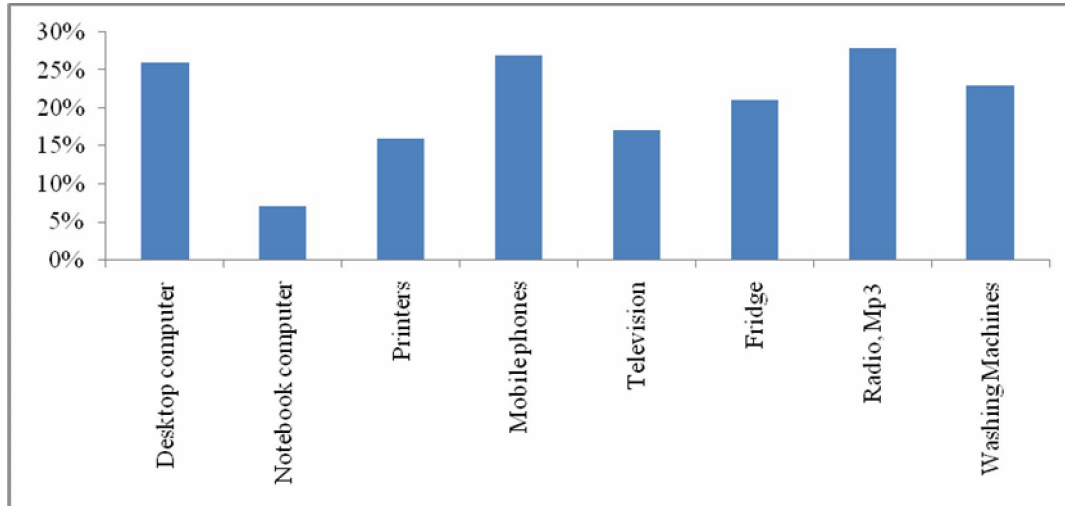
The preferred methods of e-waste disposal by Shah Alam residents shown in Figure 5 are storage and sale as second-hand equipment, is about 48% and 37% respectively. Only a fraction of e-waste (22%) finds its way to recycling facilities as there is no efficient take-back scheme for consumers. Currently, no structured mechanism is in place to handle e-waste from households compared to e-waste generated from industries as the management was in accordance with EQSWR 2005. Extensive literature has proven that most consumers store their unused or broken electrical and electronic equipment for years before the equipment is resold or otherwise disposed of [6].

Those who either give their equipment to the scrap collector or disassembled in order to reuse some parts made a combined percentage of 26%. It can be considered that a certain percentage of the equipment has trickled down to downstream vendors from the consumer level [16]. An e-waste management system should be established in order to extend the life cycle of EEE [17]. Reusing the equipment is one of the alternatives that can be employed to reduce the amount of e-waste and to delay the movement of e-waste into landfills.

Many consumers do not immediately discard or recycle unused electronics since they think that the products still retain some value. According to USEPA (2000), more than 70% of retired CEDs are kept in storage for 3–5 years [18]. The fact that the storage method was



chosen rather than the disposal or reuse of the old technology is a crucial factor. This highlights lack of awareness on where to dispose of old technology and psychological factors such as belief that e-waste has some value.



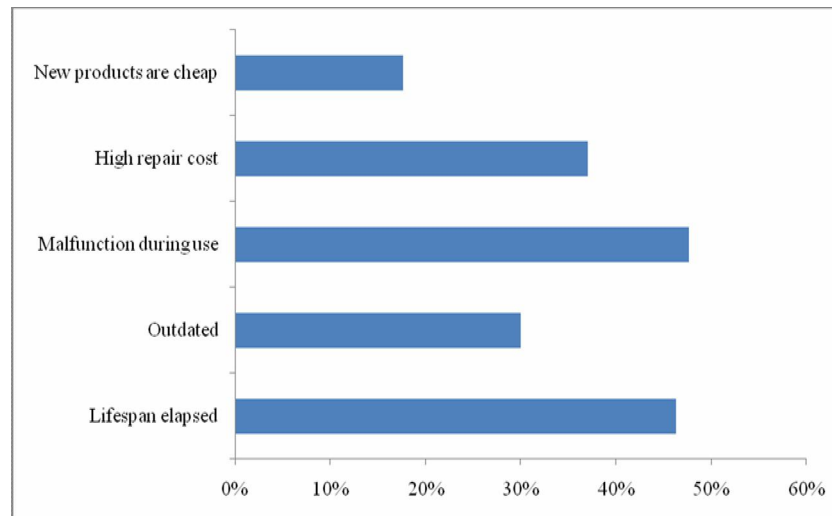
**Figure 3:** Amounts of e-waste disposed of by the respondents

The rapid growth of electronic industries and the consumer culture which encourages consumption of electronic products have led to the increase in the rate of e-wastes [14]. According to Amit Jain (2006), increase in consumption patterns leads to an increase in product obsolescence which will result in higher generation of e-waste [19]. Figure 6 shows the amount of electrical and electronic products that have been disposed of by the respondents. This indicates that there is a high potential for accumulation of e-wastes in the waste stream. The amount of e-waste especially for ICT equipment and mobile phones will continue to grow following the government's call for citizens to be more IT savvy. UNEP (2008) has found that the increase in e-waste generation is the result of increased usage of EEE in human daily life (computers, mobile phones, mp3, etc) [20].

Most of the respondents use their equipment for more than 5 years. However, this is not restricted to any specific electrical and electronic equipment. It indicates the period of use before disposal. Different people have different ways of using their equipment depending on their attitude and practices of usage. The duration of use also depends on the lifespan of each electrical and electronic product as the duration of a product's life is estimated to be between 2 and 4 years for corporate users and 2 and 5 years for domestic users [21]. The usage depends on the condition of the equipment whereby most of the respondents disposed of their EEE because it is broken and unfixable. Although 37% of the respondents sell their old equipment as second-hand equipment, and donate the items to their relatives, there is a possibility that over 98% of the equipment are broken and thus can be considered as e-waste.

This survey also found that 20% of the respondents disposed of EEE that is broken but can still be fixed. This is because consumers rarely take broken devices to be repaired as it is often easier and cheaper to buy new products than repair old ones [22]. About 6% responded that the equipment is actually still in good working condition. Electronic products are very

often retired early even though they still work perfectly because new products offer more or better features or have more fashionable designs [22]. However, William et al. (2008) reported that normally the purchase of new equipment is driven by the desire to update new software or other functionality, not due to breakage of the machine [23], and at the same time it is due to the decreasing lifespan of all consumer electronic products [22]. Figure 7 further shows the reasons for EEE disposal by the respondents.



**Figure 4:** Reasons for e-waste disposal

About 48% of the respondents disposed of their electrical and electronic equipment because of malfunction during use, followed by the fact that its lifespan has elapsed and the high cost of repairing the equipment at 46% and 37% respectively. These reasons correspond with the results shown in Figure 6. Due to the increase in affordability of new products and technological advancements, it is easier to purchase new goods rather than repair outdated products [4]. 18% of the respondents prefer to buy new products rather than repair old ones. It is often much cheaper and more convenient to buy a new machine to accommodate a newer generation of technology than it is to upgrade an outdated machine [24].

#### 4. Knowledge and awareness of Shah Alam community on e-waste

This paper also discussed the level of knowledge and awareness of the community in Shah Alam, Selangor. The survey shows that 57% of the respondents are knowledgeable about e-waste and the rest have no idea on what e-waste entails (43%). Most of the respondents do not know the proper ways of disposing their e-waste. This explains why they tend to store e-waste in their houses or premises and to throw away the waste with other general wastes. It has also been determined that most of the respondents in Malaysia kept their e-waste because there is no information on how to dispose of the e-waste appropriately [12]. The respondents' knowledge is assumed to be interrelated with the practice and attitude in managing the EEE at end of life. It has been indicated that the respondents who store or throw away e-waste with other wastes don't know how and where to dispose of these equipment. It is assumed that the respondents who know of proper ways to dispose of their e-waste know that e-waste is hazardous. An analysis by [25] has shown that most people were aware of the hazardous



materials present in electronic products but only a few actually knew the practices adopted to recycle their waste. In actual fact, many e-products can be reused, recycled and refurbished.

#### 4.1 Source of information

There are various sources of information on how to dispose of electrical or electronic equipment at the end of its lifespan. Some reports and pilot projects have shown how advertising can affect the amount of collection for recycling, especially if special events are carried out [18]. This indicates that advertising is a useful way of informing the public about e-waste and the best method for handling e-waste at the end of its lifespan. This study has found that most of the respondents get information from newspaper articles, the mass media or their friends. Furthermore, with advances in today's technology, the internet plays an important role in information dissemination and promotion of knowledge around the world. Some of the respondents stated that they obtained information on e-waste and its proper disposal from the internet, their workplace and their place of study. According to Pelle Gatke (2003), the public needs to be well informed on the reasons for sorting out hazardous household waste, and the best way to get rid of it [26]. It is indicated that these types of formal and informal education are essential and the media can play a major part in informing the public about e-waste and on how to handle the waste at the time of disposal.

#### 4.2 Willingness to pay for e-waste

Some electrical or electronic components contain materials that can be recycled and have commercial value. Most of the respondents perceived e-waste as equipment that still holds a certain amount of value. They felt that the equipment could be sold to interested parties such as scrap dealers, e-waste contractors, assemblers, etc. This is also one of the factors why households tend to store their e-waste; they preferred to wait for someone to buy the e-waste from them. Subsequently, this practice could actually extend the lifespan of the e-waste. However, the results from the survey show that 76% of the respondents were unaware of the existence of e-waste contractors licensed by DOE to collect unwanted EEE for recycling. Some of them prefer to sell their e-waste to scrap collectors as they offer a better price for the unwanted equipment. As the findings show in Figure 5, 19% of the respondents prefer to give away the equipment to scrap collectors compared to sending it to the recycling centre. The value of e-waste to the consumer is obvious. A majority of the respondents in the study was aware that some of it could be profitably recycled. The amount of money offered by the scrap collectors has indicated that 13% of the respondents sold their unwanted equipment at 10–20% of their purchase price. The price offered by the recyclers usually depends on the type of EEE, weight and condition of the waste rather than based on the market price.

Most of the households in Shah Alam are not willing to pay for their e-waste to be collected and recycled. Several of the respondents asked, 'Why I should pay if it can be sold?'. Many of them argue that it is not practical to pay for equipment that they don't want anymore and to waste money just to compensate for something that can give them income. It is assumed that the respondents are waiting for the collector to buy the items rather than paying for someone to collect the waste. They are unwilling to pay as proved in a study conducted in China where the citizens traditionally regard their obsolete electronic appliances as valuable goods and would prefer to sell them to get some money back rather than to pay for the treatment of the

waste [27]. However, 76% of the respondents are willing to give away their e-waste for free. Moreover, the respondents were also willing to give away their unwanted equipment on condition that free pickup services are provided. The relevant authorities should ensure proper disposal of e-waste by setting up convenient collection centres and coming up with campaigns to increase the recycling of e-waste.

Since there is no appropriate regulation on enforcing the public to pay for their disposed wastes in Malaysia, it is difficult for the local community to participate in e-waste recycling. Even if a campaign is launched, it would not necessarily be successful when cash is part of the equation. One conclusion reached in this survey is that domestic consumers prefer to get paid for getting rid of their e-waste, rather than for them to pay other parties to do so. On the other hand, households are willing to pay for the unwanted equipment to be taken away when the waste takes up space in their homes and becomes a visual disturbance to them. It seems that they are also concerned about whom they should sell the equipment to. The households would not mind paying as long as the amount involved is reasonable, it can minimize wastage and help improve the environment. This shows that the respondents do have concerns or awareness on the environmental consequences of improper disposal of e-waste.

#### 4.3 Awareness on social and environmental consequences of e-waste disposal

The respondents' awareness on the consequences of EEE disposal to the environment is higher compared to their awareness on the social consequences. Table 4 shows the feedback from the respondents on both social consequences and environmental consequences of EEE disposal. The feedback indicates that the respondents' awareness on environmental issues is higher compared to their awareness on social issues related to e-waste management. Some of them answered in the positive when asked whether e-waste could create job opportunities for people. As e-waste falls under a new category of scheduled wastes and contains 97–98% recyclable materials [28], it creates a new industry on e-waste recycling, opens up prospects for research and development (R & D) and at the same times provides income to the recyclers. Even though the respondents are aware of the environmental consequences of the disposal of e-waste, most of them do not know or are unsure of the actual consequences.

**Table 4:** Social and environmental consequences of the disposal of electrical and electronic equipment

Social consequences	Environmental consequences
<ul style="list-style-type: none"> <li>• Don't know/Not sure</li> <li>• Increase the amount of waste in the waste stream</li> <li>• Visual pollution (dirty environment is an eyesore)</li> <li>• Government burdened with high cost of disposing e-waste in proper ways</li> <li>• Increase wastage (price of raw materials to produce new products becomes higher)</li> <li>• Community exposed to health hazards</li> <li>• Increased income for recyclers</li> </ul>	<ul style="list-style-type: none"> <li>• Don't know/Not sure</li> <li>• Results in negative effects to the environment</li> <li>• Hazardous substances leach into the environment</li> <li>• Takes up land space/increase land for landfill</li> <li>• E-waste pile up</li> <li>• Improper disposal method which leads to pollution</li> </ul>

<ul style="list-style-type: none"> <li>• Increase in activities where people resort to modifying e-waste via hazardous ways</li> <li>• Social problems (crime rate increases as e-waste has its own value)</li> <li>• Provide job opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Dirty disposal area</li> <li>• Depleting natural resources</li> </ul>
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## 5. Conclusion and recommendation

Although Malaysia has a specific law governing both municipal wastes and scheduled wastes, the related regulations and guidelines that deal with e-waste are not yet well established. Two types of e-waste generators stated in the guidelines include the public as they are also the users of electrical and electronic equipment. However, the focus is mostly on the practices of e-waste management by industries especially large electrical and electronic manufacturing industries. Only from the industrial management perspective that awareness on e-waste has increased and this can be seen from 2005 when e-waste was first introduced in EQSWR 2005. However, the level of public awareness is still low as people are still disposing e-waste with other household wastes, storing e-waste in their premises, and giving e-waste to scrap collectors. This is due to the value of the materials that can generate income for the interested parties.

The current regulations (EQSWR 2005) do not deal with e-waste from households. This is because there is no structured mechanism on proper segregation, collection infrastructure and service providers that collect e-waste generated from households. Most of the individual consumers or households do not know where and how to dispose of e-waste in a proper manner. Consequently, they resort to discarding e-waste outside their premises together with other household wastes. As a result, this has invited illegal collectors to collect the waste without handling it using proper methods. This is because there is no appropriate regulation in place to compel the public to segregate and send e-waste to recycling facilities. The government needs to improve collaboration among stakeholders in order to enhance public awareness on e-waste. Furthermore, enforcement and monitoring by responsible agencies are crucial in order to improve e-waste management at present as well as in the future.

E-waste management in Malaysia is at an early stage; therefore, there are many challenges in managing e-waste in Malaysia. The responsible authority should work together with the local authority to increase public awareness and to promote the recycling of wastes, including e-waste, among the public. This is because local authority officers are the representatives who are closer to the communities under their jurisdiction. In terms of e-waste guidelines, the focus is more on industrial practices but not on the public. Although the initiatives taken may have involved the public, there is no regulation enforced on the public with regard to e-waste management. There is a definite need for sound management of e-waste to ensure better human health and to sustain the environment for future generations.

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