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SUSTAINABLE E-WASTE MANAGEMENT IN MALAYSIA: LESSONS FROM SELECTED COUNTRIES

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ABSTRACT

The seriousness of electrical and electronic equipment waste (E-waste/WEEE) problem is currently haunting both developed and developing nations around the world. WEEE in layman's term can be defined as discarded components of electrical and electronic equipment that have no reuse value. Improper disposal of WEEE can bring about catastrophic effects to mankind and the environment. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1992 categorises WEEE as hazardous waste due to the presence of toxic materials. Currently, the production of WEEE is expanding at a significant rate and is expected to touch 52.2 million Mt tonnes globally by 2021. The nations around the world have taken initiatives such as introducing new laws, regulations and policies. Malaysia is also similarly affected by the increasing volume of WEEE and it has been reported that its WEEE would reach an aggregate of 762.507 million units by 2020. In response, the Malaysian government has drafted a new regulation, the Environmental Quality (Household Scheduled Waste) Regulation, which is currently under review by the Attorney General's Chambers. Using the library-based research methodology, this legal research aims to provide a comprehensive overview of WEEE management from a global as well as the Malaysian perspective. A brief discussion on the classification of e-waste and analysis of key initiatives taken worldwide is provided and examined. The article concludes with a recommendation for the necessary actions that can be adopted to enhance best WEEE management practices in

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Malaysia, to ensure the threat imposed by WEEE on mankind and the environment is curtailed.

Keywords: electrical and electronic Equipment, E-waste management, malaysian legal framework, hazardous impact, recycling.

KELESTARIAN PENGURUSAN E-SISA DI MALAYSIA: PENGAJARAN DARI NEGARA-NEGARA TERPILIH

ABSTRAK

Pelupusan sisa elektrik dan elektronik (E-Sisa) merupakan masalah serius yang sedang menghantui negara yang maju mahupun negara yang masih membangun. E-sisa didefinisikan sebagai komponen peranti elektrik dan elektronik yang tidak bernilai. Pelupusan E-sisa yang tidak mampan boleh membawa impak yang negatif kepada manusia dan juga alam sekitar. Mengikut Konvention Basel Mengenai Kawalan Pergerakan Buangan Berbahaya Merentasi Sempadan dan Pelupusanya yang berlangsung pada tahun 1992, E-sisa diklasifikasikan sebagai bahan berbahaya kerana mempunyai kandungan bahan toksik. Kini, penghasilan E-sisa semakin meningkat dan dijangka akan mencapai 52.2 juta tan di seluruh dunia pada tahun 2021. Sebagai usaha mengurangkan sisa elektronik, pelbagai usaha memperkenalkan undang- undang, peraturan dan akta baru sedang diambil diseluruh dunia. Malaysia juga turut terjejas dengan peningkatan penjanaan E-sisa dimana penjanaan E-sisa dianggarkan akan mencapai sebanyak 762.507 juta unit menjelang tahun 2020. Malaysia telah merangka peraturan baru iaitu Peraturan Kualiti Alam Sekeliling (Buangan Isi Rumah) yang masih dikaji oleh Jabatan Peguam Negara. Dengan menggunakan metodologi penyelidikan berasaskan perpustakaan, kajian undang-undang ini ingin memberikan gambaran yang menyeluruh mengenai pelupusan E-sisa dari perspektif global dan Malaysia. Perbincangan yang ringkas mengenai klasifikasi E-sisa serta analisis inisiatif utama yang diambil diseluruh dunia turut dibincangkan. Artikel ini memberi cadangan yang boleh digunakan untuk pengurusan pelupusan E-sisa yang mampan bagi memastikan implikasi yang lebih parah akibat pelupusan E-sisa tidak mampan terhadap manusia dan alam sekitar dapat dikurangkan.

Kata Kunci: peranti elektrik dan elektronik, pengurusan E-sisa, kerangka perundangan malaysia, kesan berbahaya, kitar semula.

INTRODUCTION

The reckless growth of innovative technological instruments and enormous marketing tactics of electrical and electronic equipment (EEE) suppliers worldwide have multiplied the accessibility and usage of electrical appliances.[1] A survey held by the Global E-waste Statistics Partnership 2017[2], highlighted a continuous upsurge in global e-waste up to 50 million metric tonnes per annum or equal of 6.1 kg/inch. In 2021, a voluminous growth is expected in e-waste which can be reached up to 6.8 kg/inch or 52.2 million Mt.[3] WEEE is an emerging waste stream on a global level.[4] The high demand for advance EEEs has shortened its life cycle also which is resulted in a huge volume of outdated and discarded EEEs.[5] Unfortunately, a small portion of generated e-waste is being reported and recycled which is 20%.[6] It is important to mention that in developed countries nearly 1.7 Mt of WEEE is discarded which is incinerated or landfilled. Internationally, approximately 8.9 Mt of WEEE is landfilled and/or incinerated. Surprisingly, only 20% of Global WEEE is recycled and reported.[7]

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1 Nayaka G. P. et al, "Recovery of valuable metal ions from the spent lithium-ion battery using aqueous mixture of mild organic acids as alternative to mineral acids," *Hydrometallurgy* 151 (2015): 73-77.

2 Zoeteman Bastiaan CJ, Harold R. Krikke, and Jan Venselaar, "Handling WEEE waste flows: on the effectiveness of producer responsibility in a globalizing world," *The International Journal of Advanced Manufacturing Technology* 47, no. 5-8 (2010): 415-436.

3 Baldé Cornelis P. et al., "The global e-waste monitor 2017: Quantities, flows and resources," United Nations University, International Telecommunication Union, and International Solid Waste Association.

4 Dias Pablo, Andréa Moura Bernardes, and Nazmul Huda, "Waste electrical and electronic equipment (WEEE) management: An analysis on the Australian e-waste recycling scheme," *Journal of cleaner production* 197 (2018): 750-764.

5 Wong Ming Hung et al., "Export of toxic chemicals–a review of the case of uncontrolled electronic-waste recycling," *Environmental Pollution 149*, no. 2 (2007): 131-140.

6 Forti Vanessa, Kees Baldé, and Ruediger Kuehr, "*E-waste Statistics: Guidelines on Classifications, Reporting and Indicators*," (2nd Ed.) (Bonn: United Nations University, ViE – SCYCLE, 2018).

7 Baldé Cornelis P. et al., *The global e-waste monitor 2017: Quantities, flows and resources.* (Bonn: United Nations University, International Telecommunication Union, and International Solid Waste Association, 2017).

Moreover, there is a lack of WEEE collection mechanism in most countries. For instance, global inattention can be seen by the fact that the statistics for WEEE is officially reported by only 41 countries.[8] The major volume of WEEE which is 34.1 Mt is still undocumented and unreported.

Subsequently, the documentation and collection of WEEE are complicated and challenging.[9] WEEE contains a variety of toxins and materials i.e. cadmium, flame retardants, mercury, arsenic and lead. This untreated WEEE caused huge contamination in water, atmosphere and land. Aside from that, the workers who are entrusted for dismantling this WEEE suffer severe health diseases.[10] The researchers also affirm that lack of a formal mechanism for disposing and dismantling WEEE increases health issues for the community. This negligence is affecting the functionalities of thyroids and lungs, enhance the temperature and also increase the risk for premature babies, spontaneous abortions in women.[11] This research also found evidence of Deoxyribonucleic acid (DNA) damage on populations in the recycling area and labourers who worked in recycling facilities, as well as health impacts on children[12] such as that of urinary metabolites and skin diseases.[13] There is a lack of specific laws which deals with e-

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8 Forti Vanessa, Kees Baldé, and Ruediger Kuehr, "*E-waste Statistics: Guidelines on Classifications, Reporting and Indicators*," (2nd Ed.) (Bonn: United Nations University, ViE – SCYCLE, 2018).

9 Nayaka, G. P. et al., "Recovery of cobalt as cobalt oxalate from spent lithium ion batteries by using glycine as leaching agent," *Journal of environmental chemical engineering* 4, no. 2 (2016): 2378-2383.

10 Anna Kučírková, "E-Waste: A Big Problem Needing Bigger Solutions," accessed October 29, 2018, https://goodelectronics.org/e-waste-a-big-problem-needing-bigger-solutions/.

11 Grant Kristen et al., "Health consequences of exposure to e-waste: a systematic review," *The lancet global health* 1, no. 6 (2013): e350-e361.

12 Ibid.

13 Lu Shao-you et al., "Effect of e-waste recycling on urinary metabolites of organophosphate flame retardants and plasticizers and their association with oxidative stress," *Environmental science & technology* 51, no. 4 (2017): 2427-2437; Lin Xinjiang et al., "Decreased vaccine antibody titers following exposure to multiple metals and metalloids in e-waste-exposed preschool children," *Environmental pollution* 220 (2017): 354-363; Liu Xiaotu et al., "Estimation of human exposure to halogenated flame retardants through dermal adsorption by skin wipe," *Chemosphere* 168 (2017): 272-278.

waste disposal in most countries. In these countries that do not have provisions for recycling, the e-waste management is to recycle with other metal or plastic waste.[14]

Mostly, informal recycling is being used in developing countries to recover precious metals from discarded WEE which may damage the health of workers.[15] On the other hand, the formal recycling facilities are secure and equipped with advance technology which protects workers from harmful health effects of harmful substances. But such advanced and secure facilities require a huge amount of finance and it is challenging to build such facilities in developing countries. Due to this reason, the recycling of WEEE is done in informal ways in most of the developing economies and this may cause severe threat to human beings as well as to the environment.[16] According to a non-governmental organization (NGOs) such as the Basel Action Network (BAN) and the Silicon Valley Toxics Coalition, the US exported 50% to 80% of e-waste to developing countries.[17] Similarly, illegal export of e-waste from Canada to developing countries is also reported by BAN, where Global Positioning System (GPS) trackers were used to locate WEEE and the export of WEEE from Canada to Hong Kong was traced due to GPS tracker.[18] Further, illegal export of e-waste from Australia is also reported by BAN which led to a letter being written by the coordinator of BAN, Jim Puckett in 2006 to the Australian Minister for Environment and Heritage which stated that:

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14 Baldé, Cornelis P. et al., *The global e-waste monitor 2017: Quantities, flows and resources*, (Bonn: United Nations University, International Telecommunication Union, and International Solid Waste Association, 2017).

15 Renee Cho, "What can we do about the growing e-waste problem?," *State the planet*, accessed August 27, 2018, https://blogs.ei.columbia.edu/2018/08/27/growing-e-waste-problem/.

16 Ilyas Sadia, Jae-chun Lee, and Ru-an Chi, "Bioleaching of metals from electronic scrap and its potential for commercial exploitation," *Hydrometallurgy* 131 (2013): 138-143.

17 Puckett, J. et al., "Exporting Harm: The High-Tech Trashing of Asia. Basel Action Network and Silicon Valley Toxics Coalition," *Toxic link India scope green piece China*, 1 (2002): 1-48.

18 Jim Puckett, Chris Brandt, Hayley Palmer, *Export of e-waste from Canada, a story as told by GPS Trackers.* 2018. (Seattle: A Report from the e-Trash Transparency Project, Basel Action Network).

> We sincerely hope, consistent with the Hazardous Waste Management Act of Australia, which implements the Basel Convention, that the Minister will take the far wiser and legally correct approach to this crisis and will deny in this case, the export of hazardous waste for disposal and rather move to solve the problem at home.[19]

The WEEE management is challenging in Malaysia because the small volume of generated WEEE is being reported and recycled which only makes up 25% whilist major volume which makes up 75% are being treated in informal ways which are not secure or safe.[20] Due to the contemporary issue of WEEE management and the frightening figures reported by BAN, it is crucial for further research in this area to understand firstly, the adverse consequences of improper management of WEEE. In light of the matter, this paper aims to elaborate on some key global measures taken to deal with challenges caused by WEEE. Secondly, the paper aims to analyse Malaysia's compliance with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (the Basel Convention) specifically towards e-waste management. The primary objective is to recommend some best practices that can be adopted in Malaysia to encourage efficient e-waste management.

DEFINITION AND CLASSIFICATION OF E-WASTE

Before analyzing the key global initiatives to overcome WEEE problems and Malaysia's compliance of the Basel Convention, it is crucial to understand the meaning of the term e-waste. In a White Paper, Solving the E-Waste Problem (StEP) has defined the term e-waste in the following words[21]:

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19 1800Ewaste, "Exporting Electronic Waste - The question is…. to where?," accessed August 24, 2019, https://www.ewaste.com.au/exporting-electronic-waste-where/.

20 Balqis Lim, "Reducing the impact of e-waste," *New Straits Times*. September 27, 2019.

21 StEP Initiative. "*Solving the E-Waste Problem*" White Paper: One Global Definition of E-waste. Bonn, Germany. StEP (2014), 3576. StEP Initiative is a membership organization that is part of United Nations University which envisions to be agents and stewards of change, uniquely

> E-waste is a term used to cover all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of reuse.[22]

Though this definition is recommended by the StEP Initiative, it is not endorsed by the Basel Convention, or the International Telecommunication Union (ITU), which are both StEP members. The Basel Convention categorised WEEE as harmful waste due to its hazardous and poisonous material.[23] The term waste is defined in Article 2 of the Basel Convention as "substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law." Moreover, the fourth paragraph of the aforementioned article defines disposal as "any operation specified in Annex IV" of the Convention.[24] According to the Basel Convention, WEEE is listed in Annex VIII as A1180 (hazardous waste: WEEE having components i.e. contaminated with cadmium, lead, mercury switches, polychlorinated biphenyl, accumulators) and Annex IX as B1110 (non-hazardous waste: electronics assemblies containing alloys or metals, circuit boards as per Basel Convention.[25]

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leading global thinking, knowledge, awareness and innovation in the management and development of environmentally, economically and ethically-sound e-waste resource recovery, re-use and prevention. This is website of StEP Initiative; https://step-initiative.org/.

22 StEP Initiative, "*Solving the E-Waste Problem*". White Paper: One Global Definition of E-waste. Bonn, Germany. StEP (2014), *3576.*

23 "Annex VIII," The Basel Convention, accessed August 25, 2019, http://www.basel.int/Implementation/Ewaste/Overview/tabid/4063/Default.aspx.

24 "Text of the Basel Convention," accessed August 26, 2019, http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx.

25 "Waste Classification and Control Procedures," Annex VIII & Annex IX of the Basel Convention, accessed August 25, 2019, http://www.basel.int/Implementation/Controllingtransboundarymovements/WasteClassificationandControlProcedures/tabid/2384/Default.aspx; The technical guidelines on transboundary movements of electrical and electronic waste and used electrical and electronic equipment, in particular regarding the distinction between waste and non-waste under the Basel Convention, accessed August 26, 2019,

For a better understanding of WEEE, it is important to comprehend how WEEE is classified. The European Union's Directives introduced the most comprehensive classification which divides WEEE into ten main categories as described in Table 1.[26]

Table 1. E-waste Categories according to Directive 2012/19/EU European Parliament and Council

No	Main Categories	Waste Description
1	Large household appliance	Refrigerators, freezers, washing machines, clothes dryers, dishwashers, electric cooking stoves and hot plates, microwaves, electric fans, and air conditioners etc.
2	Small household appliance	Vacuum cleaners, toasters, grinders, coffee machines, appliances for haircutting and drying, toothbrushing, and shaving etc.
3	IT and telecommunication equipment	Mainframes, minicomputers, personal computers, laptops, notebooks, printers, telephones, and cell phones etc.
4	Consumer equipment	Radios, televisions, video cameras, video recorders, stereo recorders, audio amplifiers, and musical instruments etc.
5	Lighting equipment	Straight and compact fluorescent lamps and high-intensity discharge lamps etc.
6	Electrical and electronic tools	Drills, saws, sewing machines, soldering irons, equipment for turning, milling, grinding, drilling, making holes, folding, bending, or similar processing of wood and metal etc.

http://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/Ewaste/tabid/2377/Default.aspx.

[26] Directive 2012/19/EU of the European Parliament and of the Council.; Jagran Josh, "*Types of e-waste,"* accessed August 27, 2019, https://www.jagranjosh.com/general-knowledge/types-of-e-waste-1440681505-1.

7	Toys, leisure and sports equipment	Electric trains or racing car sets, video games, and sports equipment with electric elements etc.
8	Medical devices	Radiotherapy equipment, cardiology, dialysis, pulmonary ventilators, and nuclear medicines etc.
9	Monitoring and controlled instruments	smoke detectors, heating regulators, and thermostats etc.
10	Automatic dispensers	For hot drinks, hot or cold bottles etc.

(Source: Directive 2012/19/EU of the European Parliament and the Council)[27]

As indicated in Table 1, there are ten main categories of WEEE. The Directive has also given the detail of the items which fall under each category. In the next section, the researchers provide a detailed discussion about the e-waste concerns from a global perspective.

E-WASTE CONCERNS: A GLOBAL PERSPECTIVE

The developed countries are following the trend of transporting their WEEE to developing or less developed countries. One of the reasons is the lack of a proper management system and an expensive recycling process of WEEE in the developed countries tend not to recycle e-waste. It is either landfilled or shipped to developing or less developed countries where it might be recycled utilizing informal recycling facilities.[28] It is worth mentioning here that approximately 60-90 % cent of WEEE, worth approximately 19 billion US dollar is illegally shipped into developing countries.[29] According to BAN, approximately 352,474 Mt of WEEE is shipped from EU countries to developing or

[27] "Directive 2012/19/EU of the European Parliament and the Council," accessed December 17, 2020, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0019&from=EN.

[28] Park, J. K. et al., "Effects of electronic waste on developing countries," *Advances in Recycling & Waste Management* 2, no. 2 (2017): 1-6.

[29] Kamal Baher Kamal, "Where Do 50 Million Tonnes a Year of Toxic E-Waste Go?," *Inter Press Service News Agency*, September 27, 2017, http://www.ipsnews.net/2017/09/50-million-tonnes-year-toxic-e-waste-go/.

less developed countries every year.[30] Mainly African and some Asian countries have become a destination for the huge volume of WEEE from developed countries. Similarly, in Asian countries, for example, Malaysia, Indonesia, Singapore, India, China and Pakistan, illegal dumping of WEEE exits because of unlawful trade of e-waste.[31]

United States' Environmental Protection Agency (EPA)[32] acknowledged that WEEE is rapidly growing in the USA. In the United States, illegal WEEE centres absorb about 90 % of WEEE dumped per year. Approximately 70 % of the hazardous material sullying in US landfills are the result of WEEE disposal.[33] The quantum of WEEE disposed of is expanding at a rate of 3 - 5 % per year. After the USA, China comes next in producing e-wastes with a rate of 2.3 million tonnes.[34] The massive generation of WEEE in China is a direct result of the enormous demand for electronic items in the private and public sector. Additionally, illegal imports of WEEE further worsen its generation rate in China. It seems that 80 % of WEEE generated by the USA is exported to Asian countries and a huge volume of that e-waste around 90% is hosted by China.[35] African countries, for example, Ghana and Nigeria are ranked as major e-waste dumping sites in the African continent. Even though the utilisation of EEE is less in the two referred countries, the huge volume of imports increases their WEEE

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30 Alice Tidey, "EU e-waste 'illegally' exported to developing countries: Report," *Euronews*, February 7, 2019.

31 Will Nichols, "Up to 90% of world's electronic waste is illegally dumped, says UN," *The Guardian*, May 12, 2015, https://www.theguardian.com/environment/2015/may/12/up-to-90-of-worlds-electronic-waste-is-illegally-dumped-says-un.

32 U.S. Environmental Protection Agency, "National Overview: Facts and Figures on Materials, Wastes and Recycling," accessed August 27, 2019, https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials.

33 Ibid.

34 Research Unit Larrdis, "*E-Waste in India,"* (Delhi: Rajya Sabha Secretariat New, 2011).

35 Ni Hong-Gang et al., "Environmental and human exposure to persistent halogenated compounds derived from e-waste in China," *Environmental Toxicology and Chemistry* 29, no. 6 (2010): 1237-1247.

material.[36] Kevin McElvaney, pointed out that Ghana became a dump destination of world's huge volume of WEEE, he further stated:

> Boys and young men smash devices to get the metals, especially copper. Injuries such as burns, untreated wounds, eye damage, lung and back problems, go hand in hand with chronic nausea, anorexia, debilitating headaches and respiratory problems. Most workers die from cancer in their 20s.[37]

Similarly, Dr Christian Nellemann, the head of the Rapid Response Unit at the Rhipto-Norwegian Center for Global Analyses and author of UNEP's e-waste report stated: "It is illegal to export e-waste, but widespread smuggling networks classify the waste as second-hand goods and dump it in places like Ghana, India, Pakistan and Brazil".[38]

From the foregoing discussion, it can be concluded that e-waste generated is increasing worldwide day by day and it seems unstoppable. Furthermore, this huge volume of WEEE even worsens the situation in developing countries because of challenges such as the absence of proper legal framework, weak implementation of laws, lack of treatment plants, illegal dumping, illegal trade and illegal shipment of e-waste from the developed countries to the developing countries. Now is the time for the international community to return to the traditional method of repairing broken items instead of simply discarding them. The next section is a discussion on some key initiatives taken globally to deal with the issues of WEEE.

Key Initiatives Taken Worldwide to Address WEEE

In line with the Basel Convention, a few prominent initiatives have been taken by the international, regional conventions and European Union to deal with the fast-paced challenge of safe and secure e-waste

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36 Schluep Mathias et al., "Where are WEEE in Africa?" In 2012 *Electronics Goes Green 2012+*, pp. 1-6. IEEE, 2012.

37 Kevin McElvaney, "Agbogbloshie: the world's largest e-waste dump – in pictures," *The Guardian*, February 27, 2014.

38 Tatenda Gwaambuka, "Revealed: The West Is Dumping Electronic Waste in Africa," *The African Exponent*, October 3, 2017.

management. These are listed in Table 2 alongside brief descriptions of the initiatives.

Table 2. Key Initiatives are taken by the International Community to address the issue of E-Waste

No.	International Community	Brief Description of Initiatives
1	Basel Convention	• Basel Convention declares WEEE as hazardous waste because it contains toxic materials such as mercury, lead and brominated flame retardants. The Basel Convention started to address e-waste issues since 2002. • Prevention of illegal traffic to developing countries. • Building capacity around the globe to better manage e-waste. • Extended producer responsibility (EPR) • The Mobile Phone Partnership Initiative (MPPI) 2002 by COP6. • The Nairobi Declaration on the Environmentally Sound Management of Electrical and Electronic Waste and decision IX/6 adopted by COP9; (i) Programmes of activities for the environmentally sound management of e-waste in Africa, in the Asia Pacific and in South America; (ii) Partnership for Action on Computing Equipment (PACE) (iii) Preparation of technical guidelines on transboundary movements of e-waste.
2	Basel Action Network (BAN), Silicon Valley Toxic Coalition (SVTC), Electronics	• These three acts together for workable national e-waste collection and recycling programs. The internationally promote the 'Basel Ban' a more restrictive waste export amendment to the Basel Convention. BAN has produced documentaries and research.

No.	International Community	Brief Description of Initiatives
	TakeBack Coalition (ETBC)	
3	Bamako Convention	• Entered into force in 1998 in African Union countries. Total 29 Signatories and 25 parties. • Sets more stringent waste import limits than the Basel Convention, and sets penalties.
4	EU WEEE Directives & EU Restriction of Hazardous Substances Directive (RoHS)	• The first WEEE Directive (Directive 2002/96/EC) entered into force in February 2003 and introduced collection schemes where consumers return their WEEE free of charge. • Revised Directive 2012/19/EU came into force on 13 August 2012 to address the rapidly increasing e-waste stream. • Directive 2002/96/EC entered into force in February 2003. It requires heavy metals such as lead, mercury, cadmium, and hexavalent chromium and flame retardants such as polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE) to be substituted by safer alternatives. • Revised the RoHS recast Directive 2011/65/EU became effective on 3 January 2013. • The 2017 RoHS 2 scope review proposal. • Commission Implementing Regulation (EU) 2019/290 of 19 February 2019 establishing the format for registration and reporting of producers of electrical and electronic equipment to the register.
5	Solving the E-waste Problem (StEP)	• Instituted formally in 2007 by UN agencies, StEP partners with prominent academic and government organisations (e.g., MIT, USEPA) on promoting reuse of recycled materials and control of e-waste contaminants.

(Source: Michelle Heacock et al, 2016; Rolf Widmer et al., 2005)[39]

As mentioned in Table 2, the Basel Convention is the most prominent international platform to deal with hazardous wastes including WEEE. It came into force in 1992 to keep hazardous waste within producer countries, or ones able to safely process. Currently, it has 178 signatory nations but it is yet to be ratified by the US and it also does not specify penalties.[40] The Basel Convention also bans the export of hazardous materials to developing countries except with written prior informed consent (PIC) from the receiving country. Extended Producer Responsibility (EPR) is a key policy instrument for financing environmentally sound management (ESM) of WEEE as required by the Basel Convention.[41] EPR makes producers and importers of electronic products responsible for the collection and end-of-life treatment of the products. This can be seen as an approach taken to set up formal WEEE take-back systems in the developed countries. The Basel Convention also paved the way for the Mobile Phone Partnership Initiative (MPPI) and the Nairobi Declaration on the environmentally sound management of WEEE. The usage of mobile phones is the fastest growing industry in the world. According to the Global System for Mobile Association (GSMA),[42] approximately 5.15 billion people have mobile devices worldwide. This means that 66.6% of the world's

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39 Michelle Heacock et al., "E-waste and harm to vulnerable populations: a growing global problem." *Environmental health perspectives 124*, no. 5 (2016): 550-555; Rolf Widmer et al. "Global perspectives on e-waste," *Environmental impact assessment review 25*, no. 5 (2005): 436-458.

40 "History of the negotiations of the Basel Convention," accessed August 27, 2019, http://www.basel.int/TheConvention/Overview/History/Overview/tabid/3405/Default.aspx; "Text of the Basel Convention," accessed August 27, 2019, http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx.

41 Open-ended Working Group of the Basel Convention, "Draft practical manuals on Extended Producer Responsibility and on financing systems for environmentally sound management," accessed August 27, 2019, http://www.basel.int/TheConvention/OpenendedWorkingGroup(OEWG)/Meetings/OEWG11/Overview/tabid/6258/Default.aspx.

42 GSMA, "Representing the worldwide mobile communications industry," accessed August 27, 2019, https://www.gsma.com/.

population have mobile devices.[43] Furthermore, there are now over 9.32 billion mobile connections worldwide, which surpasses the current world population of 7.74 billion implied by UN digital analyst estimates.[44] MPPI developed the following guidelines; awareness-raising, design considerations, collection of used and end-of-life mobile phones, transboundary movement of collected mobile phones, refurbishment of used mobile phones, and material recovery/recycling of end-of-life mobile phones were developed to combat the issue of WEEE.[45] The Basel Convention gave the final guidance document on the environmentally sound management of used and end-of-life mobile phones in 2011.[46]

Further, as indicated in Table 2, the European Commission adopted Implementing Regulation (EU) 2019/290[47] which aims to harmonize the practices applied by member states for the registration and reporting of producers of EEE under Directive 2012/19/EU[48] on WEEE to reduce the administrative burden for producers operating at Union level. The format for registration and reporting should be used by all producers including producers supplying EEE using distance communication or, where appointed, by authorised representatives, and by all registers drawn up in the member states pursuant to Article 16(1) of Directive 2012/19/EU. This regulation will apply from 2020,

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43 Bankmycell.com, "How Many Phones Are in the World?," accessed August 27, 2019, https://www.bankmycell.com/blog/how-many-phones-are-in-the-world.

44 Ibid.

45 Basel Convention, "MPPI," accessed August 29, 2019, http://www.basel.int/Implementation/TechnicalAssistance/Partnerships/MPPI/Overview/tabid/3268/Default.aspx.

46 Basel Convention, "Guidance document on the environmentally sound management of used and end-of-life mobile phones," accessed August 29, 2019, http://www.basel.int/Implementation/TechnicalAssistance/Partnerships/MPPI/MPPIGuidanceDocument/tabid/3250/Default.aspx.

47 EUR-Lex, "Regulation (EU) 2019/290," accessed August 29, 2019, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.048.01.0006.01.ENG&toc=OJ:L:2019:048:TOC%20.

48 "Directive 2012/19/EU," accessed August 29, 2019, https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:197:0038:0071:en:PDF.

January 1.[49] On the other hand, the situation in African countries is more challenging because Africa is known as a major destination of WEEE from developed countries. Albeit, the Bamako Convention imposed a ban on the import of all forms of hazardous waste into the continent of Africa and also controls transboundary movement and management of hazardous wastes within Africa.[50] It must be noted that Article 1 of the Bamako Convention presents a definition of hazardous waste that is comprehensive with a wide range than that of the Basel Convention and includes any wastes containing any of the constituents of Annex I, or exhibiting the hazardous characteristics found in Annex II.[51] Despite the ban on imports of hazardous wastes the issue of WEEE in Africa remains severe and threatening.[52] There is a need to do more not only by the African countries but also by the developed countries to assist them in addressing the issue caused by WEEE.

StEP Initiative is an independent, multi-stakeholder platform for developing strategies that address all dimensions of EEEs in a high demand digitised world.[53] The StEP applies an integrated approach to develop multiple solutions to the world about WEEE. and electronics life cycle.[54] In this regard, StEP adopts UN Sustainable Development Goals 12 on responsible consumption and production.[55]

Furthermore, Table 3 is listed as significant initiatives taken by some developed and developing countries to enhance the management of e-waste. Initiatives taken by the following countries such as the U.S.,

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49 SGS, "EU Establishes the Format for Registration and Reporting under the WEEE Directive," accessed August 29, 2019, https://www.sgs.com/en/news/2019/05/safeguards-06019-eu-establishes-the-format-for-registration-and-reporting-under-the-weee-directive.

50 Article 4.1, Text of the Bamako Convention.

51 Article 2, Text of the Bamako Convention.

52 InforMEA, "Prevention of Hazardous e- Waste and Near End-of-Life Importation and Dumping in Africa," accessed August 29, 2019, https://www.informea.org/en/decision/prevention-hazardous-e-waste-and-near-end-life-importation-and-dumping-africa.

53 StEP, "Solving the E-waste Problem," accessed August 29, 2019, http://www.step-initiative.org/.

54 Ibid.

55 Sustainable Development Goals, "Goal 12: Ensure sustainable consumption and production patterns," https://www.un.org/sustainabledevelopment/sustainable-consumption-production/.

Canada, Switzerland, Australia, New Zealand, Japan, China, India and Pakistan have been discussed in Table 3.

Table 3. Key Initiatives are taken by some Developed and Developing Countries to address the issue of E-Waste

No	Country	Brief Description of Initiatives
1	U.S. State laws & Responsible Electronic Recycling Act (HR2284)	• Twenty-five states and the District of Columbia have enacted legislation establishing a statewide electronic waste, or e-waste, recycling program. • Besides, Colorado passed legislation in 2012 (SB 133) prohibiting the disposal of electronic devices at solid waste landfills. • HR2284 is a proposed national law to control e-waste export and certify used electronic goods for export.
2	Canada	• There is no federal legislation specifically at e-waste management. • E-waste legislation in Canada has been set mainly at the provincial level and has primarily taken the form of regulations requiring extended producer responsibility (ERP) or product stewardship for designated electrical and electronic products.

No	Country	Brief Description of Initiatives
		• Canada is developing systems based on Japan's "Reuse, Recycling and Recovery" system. • National Model for E-waste Stewardship developed by Electronics Product Stewardship Canada endorsed by the Canadian Council of Ministers of the Environment (CCME).
3	Switzerland's E-Waste Management System under the Ordinance the Return, Take-Back and Disposal of Electrical & Electronic Equipment (ORDEE) 1998	•. Switzerland credited with establishing the first comprehensive e-waste management system, covering collection to disposal. Under this ordinance, retailers, manufacturers and importers are required to take back, at no charge. • The Ordinance covers all sorts of EEE. • The purchase price of all appliances covered by the ORDEE includes a prepaid disposal charge based on voluntary sectoral agreements. • The collection and disposal managed by the Swiss Foundation for the Disposal of Wastes (SENS) and the Swiss Association for Information, Communication and Organisational Technology (SWICO).
4	Australia	• There is no legislation at the federal level, specifically at e-waste management. • Australia is adopting "Reuse, Recycling and Recovery" system. • National Waste Policy Less Waste, More Resources 2018; It provides a framework for collective action by businesses, governments, communities and individuals until 2030. • National Television and Computer Recycling Scheme 2011. The scheme is funded and run by industry and regulated by the Australian Government under the Product Stewardship

No	Country	Brief Description of Initiatives
		Act 2011 and the Product Stewardship (Televisions and Computers) Regulations 2011
5	New Zealand	• E-waste recycling standard New Zealand (AS/NZS 5377). • Zealand is the only OECD country without national e-waste regulations, UN report. • eDay was a nationwide collection programme for e-waste which ran from 2006 to 2010. • Product Stewardship Schemes. • TechCollect is New Zealand's first free dedicated e-waste recycling service which provides the public with access to convenient, secure, responsible and free recycling of e-waste.
6	Japan's Reduce, Reuse, Recycle (3Rs)	• June 2004, Japan's Prime Minister Koizumi proposed the "3R Initiatives" aimed at building a sound material-cycle society through the 3Rs (reduce, reuse, and recycle). • Objective to prevent the creation of waste, and to further cooperation on recovering with developing countries. Allows waste export for remanufacturing. • October 2008, the establishment of "Regional 3R Forum in Asia. • The Law for the Promotion of Effective Utilisation of Resources (LPUR) 2015. • The Law for Recycling Specified Kinds of Home Appliances (LRHA) 2001.

No	Country	Brief Description of Initiatives
7	China	• China banned the import of 24 kinds of solid waste, including e-waste. No longer be the world's lap sap haven (lap sap means rubbish in Cantonese) 2018. • Launched a scheme to create 'waste-free cities' and is building hundreds of 'comprehensive recycling bases' across the country. • China began to offer subsidies for e-waste recycling with funds from manufacturers in 2012. • China aims for zero waste imports by 2020. • The Management Measure for the Prevention of Pollution from Electronic Products 2015. It is also known as China's RoHS. • The Regulations for the Administration of the Recovery and Disposal of [i.e., recycling] of Waste Electric and Electronic Products (Order No. 551) 2009. • China recently enacted the Cleaner Production Promotion Law, the Solid Waste Pollution Prevention Law (Amendment), and the Circular Economy Promotion Law.
8	India	• The E-Waste (Management) Rules, 2016 were enacted in supersession of the 2011 Rules • In 2018 the E-Waste Management Rules 2016 amended for the effective and efficient environmentally sound management of e-waste in India. To apply Extended Producer Responsibility (EPR).
9	Pakistan	• There is no law at federal law at e-waste management. • E-waste comes under Section 13 of the Pakistan Environmental Protection Act 1997,

No	Country	Brief Description of Initiatives
		prohibits the import of hazardous waste and Section 14 disallows handling of hazardous elements.

(Source: Ilankoon et al., 2018; Ikhlayel Mahdi, 2018; Waleed Al-Rahmi et al., 2018)[56]

As mentioned in Table 3 approximately twenty-six states of the US have enacted e-waste laws but there is no e-waste law at the federal level.[57] Similarly, in Canada, there is no federal legislation on WEEE management. However, there are laws and regulations at the provincial and district level.[58] In Canada, EPR programme has emerged as an effective stewardship approach to promote and ensure the proper and formal management of a wide range of post-consumer products as an important policy tool for shifting the responsibility either physical or financial for the management of discarded EEEs towards producers and consumers. Canada is keen to develop the '3R System'. Further, Canada also has National Model for WEEE Stewardship developed by

[56] Ilankoon I. M. S. K. et al., "E-waste in the international context–A review of trade flows, regulations, hazards, waste management strategies and technologies for value recovery," *Waste Management 82* (2018): 258-275; Ikhlayel Mahdi, "An integrated approach to establish e-waste management systems for developing countries," *Journal of Cleaner Production 170* (2018): 119-130; Waleed Al-Rahmi et al., "Strategies to manage electronic waste approaches: an overview in east Asia," *International Journal of Engineering & Technology 7*, no. 4 (2018): 3268-3275.

[57] Jennifer Namias. *"The future of electronic waste recycling in the United States: Obstacles and Domestic Solutions"* (Master dissertation, Columbia University, 2013).

[58] OECD, "Global Forum on Environment: Promoting Sustainable Materials Management through Extended Producer Responsibility," accessed August 29, 2019, https://www.oecd.org/environment/gfenv-extendedproducerresponsibility-june2014.htm.

'Electronics Product Stewardship Canada' endorsed by the 'Canadian Council of Ministers of the Environment' (CCME).[59]

Switzerland has the Ordinance Return, Take-Back and Disposal of Electrical & Electronic Equipment (ORDEE) 1998[60] which is known as the leading and comprehensive e-waste management system. According to the Ordinance, retailers, manufacturers and importers are required to take back electrical and electronic equipment at no charge. ORDEE also covers the purchase cost of all appliances.[61] Whereas Australia and New Zealand also do not have laws to deal with WEEE but they do have recycling standards and both countries run campaigns for collection and recycling of WEEE.[62] Australia is also planning to adopt '3R System' like Japan. Australia also introduced the National Waste Policy 2018 intending to create waste more resources.[63]

Japan has the Law for the Promotion of Effective Utilisation of Resources 2001[64] and the Home Appliance Recycling Law 2001.[65] The objectives of aforesaid laws are to enhance measures for recycling materials and efficient use of resources by implementing collection and formal recycling of EEEs by companies, minimise waste generation by taking necessary initiatives for durable EEEs as well as by

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59 Schroeder and Schroeder, "E-waste Management in Canada," accessed August 29, 2019, https://www.schroeder-inc.com/2016/03/19/e-waste-management-in-canada/.

60 FOEN, "The Return, Take-Back and Disposal of Electrical and Electronic Equipment (ORDEE)," accessed August 29, 2019, http://www.rezagos.com/descargas/ORDEE.pdf.

61 Chaudhary Karishma and Prem Vrat, "Case study analysis of e-waste management systems in Germany, Switzerland, Japan and India: A RADAR chart approach," *Benchmarking: An International Journal* 25, no. 9 (2018): 3519-3540.

62 Myles Gough. "Australian laws lag on electronic waste management". *Newsroom UNSW*, July 12, 2016; Stuart Corner, "Government moves to deal with e-waste: again, and again," *Computerworld*, August 12, 2019.

63 Sally Capp and Cathy Oke, "Waste and Resource Recovery Strategy 2030," accessed August 29, 2019, https://www.melbourne.vic.gov.au/SiteCollectionDocuments/waste-resource-recovery-strategy.pdf.

64 "Law for Promotion of Effective Utilisation of Resources," accessed August 29, 2019, https://www.env.go.jp/en/laws/recycle/06.pdf.

65 "The Home Appliance Recycling Law," accessed August 29, 2019, https://www.env.go.jp/en/laws/recycle/08.pdf.

implementing measures to enhance reusing parts recovered from collected used EEEs. The laws also introduce a new framework of recycling whose principle is to place an obligation on manufacturers and retailers of home appliances. Japan also introduced the '3R Initiatives' (reduce reuse and recycle) to build a sound material-cycle society.[66]

China implemented the Regulations for the Administration of the Recovery and Disposal of [i.e., recycling] of Waste Electric and Electronic Products (Order No. 551) 2009.[67] Further, China also enacted three laws for WEEE which are the Cleaner Production Promotion Law, the Solid Waste Pollution Prevention Law (Amendment), and the Circular Economy Promotion Law. Based on these laws, the relevant authorities have enacted 12 laws and regulations to manage the recycling and treatment of WEEE.[68] China also aims for zero waste imports by 2020[69] and to achieve this objective, China imposed a ban on the import of 24 kinds of solid waste including e-waste.[70] In other words, China is no longer the world's *lap sap* (*lap sap* means rubbish in Cantonese). China is also encouraging

66 MOE, "3 R Initiatives," accessed August 29, 2019, http://www.env.go.jp/recycle/3r/initiative/en/index.html.

67 State Council Decree of the People's Republic of China, "Regulations on Recovery Processing of Waste Electrical and Electronic Products," accessed August 29, 2019, http://www.chinarohs.com/chinaweee-decree551.pdf.

68 Shevchenko Tetiana, Kirsi Laitala, and Yuriy Danko, "Understanding Consumer E-Waste Recycling Behavior: Introducing a New Economic Incentive to Increase the Collection Rates," *Sustainability* 11, no. 9 (2019): 2656.

69 Muyu Xu and David Stanway, "China plans to cut waste imports to zero by next year: official," *Reuters*. March 28, 2019, https://www.reuters.com/article/us-china-waste-imports/china-plans-to-cut-waste-imports-to-zero-by-next-year-official-idUSKCN1R90AQ.

70 David Dodwell, "More than a year after China's ban on waste imports, the world is still learning to clean up after itself," *South China Morning Post*, June 8, 2019, https://www.scmp.com/comment/opinion/article/3013546/more-year-after-chinas-ban-waste-imports-world-still-learning-clean.

e-waste recycling by initiating waste-free cities campaigns and offering subsidy for e-waste recycling.[71]

India implemented E-Waste Management Rules 2016 and amended it in 2018 for the effective and efficient environmentally sound management of e-waste and to apply the Extended Producer Responsibility (EPR).[72] In Pakistan, there is no e-waste law at the federal level and WEEE comes under Section 13 of the Pakistan Environmental Protection Act 1997 (PEPA 1997).[73] According to Section 14 of PEPA 1997[74], the import of hazardous waste is prohibited. However, informal recycling of e-waste exists in Pakistan which is harmful to human health and the environment.[75]

The initiatives taken by the various countries as discussed indicate a positive development where different kinds of laws, regulations and policies are being developed with the sole objective of managing e-waste efficiently which is a serious issue faced by both developed and developing nations around the world. The next section of this paper is about e-waste management in Malaysia.

E-WASTE CONCERNS: A MALAYSIAN PERSPECTIVE

71 Renee Cho, "What Can We Do About the Growing E-waste Problem?," *State of the Planet*, August, 27, 2018, https://blogs.ei.columbia.edu/2018/08/27/growing-e-waste-problem/; Liqiang, Hou, "E-waste leads the way in China's recycling progress," *The Nation Thailand*. May 9, 2018, https://www.nationthailand.com/opinion/30344996.

72 Rupali Sharma and Shahzar Hussain, "India: E-Waste Management in India," *Kochhar & Co*, April 26, 2018; Shreya Mishra, "Extended Producer Responsibility: Possibilities in Indian context," *SCC Online*, March 31, 2019.

73 Iqbal Mehreen et al., "Emerging issue of e-waste in Pakistan: a review of status, research needs and data gaps." *Environmental pollution* 207 (2015): 308-318.318.

74 "Pakistan Environmental Protection Act 1997," accessed August 29, 2019, https://www.elaw.org/system/files/Law-PEPA-1997.pdf.

75 Umair Shakila, Stefan Anderberg, and José Potting, "Informal Electronic Waste Recycling in Pakistan," *The Journal of Solid Waste Technology and Management* 42, no. 3 (2016): 222-235.

Malaysia is an emerging Southeast Asian economy having 32.63 million population as per the reported statistics of 2019[76]. It is mentioned in a survey held by Global E-Waste Monitor 2017 that the generation of WEEE per person was reported 8.8 kg per person in 2016 totalling to 280,000 tonnes.[77] The e-waste inventory project also reported that the generation of WEEE is projected to increase by 1.1 million Mt in the year 2020 which can be reported14 % increase per annum.[78] The Department of Environment (DOE) has classified all the discarded parts of EEEs as e-waste. Table 4 elaborates description of used or discarded electric and electronic equipment which are considered as e-waste in Malaysia.

Table 4. EEE considered as E-Waste in Malaysia

No.	Waste Description
1	Waste metal, contaminated with heavy metals such as cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, or manganese.
2	Wastes or products processed out of the partial recovery facilities
3	Printers including accessories
4	Audio amplifier & radio
5	Integrated circuit & microwave/ oven
6	Ink cartridges & facsimile machine
7	Printed circuit board & video recorder
8	Patterned wafer & photocopy machine
9	Lead-frame & telephone

[76] Department of Statistics Malaysia, "Demographic Statistics Third Quarter 2019, Malaysia," accessed August 29, 2019, https://www.dosm.gov.my/v1/index.php?r=column/ctwoByCat&parent_id=115&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09.

[77] Sim Leoi, "DOE gets tough on e-waste," *The Star Online*, May 30, 2019, https://www.thestar.com.my/news/nation/2019/05/30/doe-gets-tough-on-ewaste.

[78] Perunding Good Earth, "The e-waste inventory project in Malaysia," accessed August 29, 2019, https://www.env.go.jp/en/recycle/basel_conv/Internationa_Cooperation/E-wasteProject/06.pdf .

10	Hard disk drive & washing machine
11	Motherboard & refrigerator
12	Computers & mobile phones
13	Cathode ray tube & television
14	Electric cable & air-conditioner

(Source: Forti, Baldé & Kuehr, 2018)[79]

Unfortunately, Malaysia does not have any particular legislation for WEEE management and it is being managed as a general category of waste. The DOE[80] has highlighted some main obstacles for safe and secure management of household e-waste in Malaysia such as most of the recyclers use informal recovery method for precious metals, collection and transportation is challenging, formal methods for the treatment of WEEE is expensive and it entails advance technology which is lacking in developing countries.

E-Waste Recovery and Collection Procedures in Malaysia

The WEEE collection is a cost-effective business in economically weak countries. EEEs contain a different type of precious metals which can be recovered and recycled through formal and informal ways.[81] Safe and secure method to recover precious metals from WEEE is a formal method which requires well equipped and modern technology and unfortunately, this is lacking. The role of social associations, manufacturers and retailers is important for formal management of WEEE as it is being practised in developed countries.[82] For instance, public awareness campaigns are effective and useful for social

79 Forti Vanessa, Kees Baldé, and Ruediger Kuehr, "E-waste Statistics: Guidelines on Classifications, Reporting and Indicators." (2nd Ed.) (Bonn: United Nations University, ViE – SCYCLE, 2018).

80 DOE, Issues and challenges, <http://www.doe.gov.my/hhew/household-e-waste-collection-recycling-2/>.

81 Suja Fatihah et al., "E-waste management scenarios in Malaysia," *Journal of Waste Management* 2014, (2014).

82 Alam Md, and Chamhuri Siwar, "Waste recycling in Malaysia: Transition from developing to developed country," *Jereme, IA, Alam, MM, and Siwar, C* (2015): 1-14.

association activities in Europe and indeed such campaigns are being organised in Malaysia. The DOE collaborate with Japan International Cooperation Agency (JICA) to develop an efficient mechanism for the collection of WEEE in Penang.[83] It was expected that the experience with the model would be utilised to make a nationwide drive in the future. However, up to this point in time, no such drive has been implemented and until today could not develop an effective mechanism to monitor WEEE.[84]

Formal and Informal E-Waste Management Sectors in Malaysia

Currently, the recycling of WEEE in Malaysia is being handled by both formal and informal ways. Generally, licensed recycling firms operate to recover and recycle WEEE and follow the guidelines issued by the DOE.[85] Generally, informal recycling and recovery methods of WEEE use unsafe and traditional ways in the recovery of precious metals which can be harmful to human as well as for the environment.[86] Furthermore, the significant portion of WEEE is dismantled at backyard offices or warehouses using risky and dangerous processes.[87] The substantial volume of WEEE ends up in informal processing backyard because of cost-cutting, gaps in guidelines and ineffective implementation of laws.[88] Indeed, it is a challenge for policymakers to

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83 Final Report Asia Region, "*Data Collection Survey on E-waste Management in Malaysia and Surrounding Countries,"* Japan International Cooperation Agency & EX Research Institute Ltd. 2014.

84 Balqis Lim, "Reducing the impact of e-waste," *New Straits Times*. September 27, 2019, https://www.nst.com.my/lifestyle/bots/2019/09/525027/reducing-impact-e-waste.

85 Williams Eric, "International activities on E-waste and guidelines for future work," in *Proceedings of the Third Workshop on Material Cycles and Waste Management in Asia*, National Institute of Environmental Sciences: Tsukuba, Japan. 2005.

86 Ibid.

87 Chi Xinwen et al., "Informal electronic waste recycling: a sector review with special focus on China," *Waste Management* 31, no. 4 (2011): 731-742.

88 Kojima Michikazu, "Transboundary movement of recyclable resources in Southeast Asia," *International Trade of Recyclable Resources in Asia 29* (2005): 85.

control and regulate informal WEEE recycling practices to protect mankind and the environment form its hazardous impacts.[89] The DOE has issued a list of 121 collection centres for WEEE in Malaysia as mentioned in Table 5.

Table.5 Collection Points for Household E-Waste over States in Malaysia

No	States Name	Collection Points
1	Kuala Lumpur	12
2	Johor Bahru	15
3	Pahang	4
4	Melaka	6
5	Kelantan	5
6	Perlis	3
7	Perak	11
8	Kedah	4
9	Penang	14
10	Negeri Sembilan	6
11	Terengganu	3
12	Selangor	30
13	Sarawak	5
14	Sabah	3

(Source: Department of Environment Malaysia, 2019)[90]

The DOE has also listed approximately 35 licensed companies for recovery of WEEE.[91] Most of the recovery facilities are privately

[89] Soo Vi Kie, Charles Featherston, and Matthew Doolan, "E-waste Assessment in Malaysia," in *20th CIRP International Conference on Life Cycle Engineering, Singapor, 2013*.

[90] DOE, "Collection Points by State," accessed August 29, 2019, //www.doe.gov.my/hhew/collection-points/.

[91] DOE, "Recovery Facilities," accessed August 29, 2019, http://www.doe.gov.my/hhew/recovery-facility/.

owned companies. The DOE initiated the Alam Alliance Malaysia in 2013[92] to manage household e-waste efficiently. Following were key objectives such as to develop an effective mechanism to collect, segregate and transport the WEEE, run effective campaigns to enhance public knowledge, the awareness of relevant stakeholders about the WEEE is vital. Further, it is also important to motivate all stakeholders involved in the production and distribution of EEEs to enhance cooperation for the efficient administration of WEEE.

Legal Framework of E-Waste Management in Malaysia

It is important to highlight that the right to have an eco-friendly environment is not mentioned in the Federal Constitution of Malaysia, 1957. However, the Court of Appeal emphasised in the historic judgement of *Tan Tek Seng v Suruhanjaya Perkhidmatan Pendidikan & Another [1996] 2 CLJ 771* that right to live in a clean and eco-friendly environment is implied in the right to life which is protected in Article 5 of the Federal Constitution.[93] Furthermore, the Environment Quality Act, 1974 (Act 127) was legislated for sustainable development and protection of the environment and the shared benefits of present and future generations.

The Environmental Quality (Scheduled Wastes) Regulations 2005 has categorised the WEEE as a scheduled waste under the code SW110[94], further, it also provides specific coding, for example, SW102 presents discarded lead-acid batteries, SW103 covers batteries containing heavy metals and SW109 for fluorescent lamps. It is mentioned that only licensed facilities are authorized to treat WEEE. The parties are legally bound to dispose and treat WEEE at the approved integrated facilities such as Kualiti Alam Sdn. Bhd. Being a party to the Basel Convention, Malaysia is liable to follow the guidelines provided by the Basel Convention and according to that the

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92 DOE, "E-Waste Alam Alliance," accessed August 29, 2019, http://www.doe.gov.my/hhew/e-waste-alam-alliance/.

93 *Tak Tek Seng v. Suruhanjaya Perkhidmatan Pendidikan & Anor* [1996] 2 CLJ 771.

94 Forti Vanessa, Kees Baldé, and Ruediger Kuehr, "E-waste Statistics: Guidelines on Classifications, Reporting and Indicators," (2nd Ed.) (Bonn: United Nations University, ViE – SCYCLE, 2018).

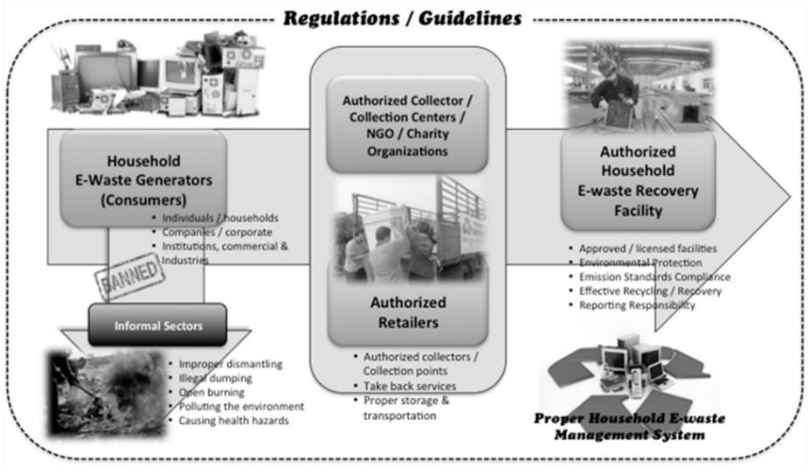
transboundary movements of WEEE is precisely illegal as mentioned in Article 4, Paragraph 1(a) and 1(b) of the Basel Convention:

a) "Parties (refer to the country) exercising their right to prohibit the import of hazardous waste or other waste for disposal shall inform the other Parties of their decision pursuant to Article 13 (Transmission of Information)"

b) "Parties shall prohibit or shall not permit the export of hazardous waste and other wastes to the Parties that have prohibited the import of such waste when notified pursuant to subparagraph (a) above."

Article 1, Paragraph 1(a) of the Basel Convention defines hazardous waste as stated: "Waste that belongs to any category contained in Annex I unless they do not possess any of the characteristics provided in Annex III."

The new proposed regulation titled '*the Environmental Quality (Household Scheduled Waste) Regulation'* to manage household hazardous e-waste in Malaysia is under review in the Attorney General's Chambers.[95] Figure 1 describes the guidelines for the upcoming regulations for household scheduled waste.



95 DOE, "Regulations, Scheduled E-Waste Management in Malaysia," accessed August 29, 2019, http://www.doe.gov.my/hhew/.

Figure 1. Guidelines for Household E-waste Management[96]

As indicated in Figure 1, there are a series of steps to be followed in the household e-waste management. It begins with the responsibility of the household e-waste generators comprising of individuals/households, companies/corporate as well as institutions, commercial and industries. Further, the guideline also prohibits all stakeholders to use the informal ways of WEEE treatment that can harm human beings as well as the environment. It is also highlighted in the figure that authorised retailers, collectors and collection centres will be appointed under the regulation. The authorised retailers will be liable to collect and transport WEEE to a licensed household e-waste recovery facilities for safe and secure treatment. The above-mentioned mechanism is a constituent of the effective Household E-Waste Management System of the upcoming regulation. It can be argued that the forthcoming Environmental Quality (Household Scheduled Waste) Regulation will bring a considerable change in Malaysia to enhance the formal and environment-friendly management of WEEE. Further, it also can be hoped that producers and retailers of electronics products will be responsible for the collection and disposal of discarded products and this will be a new start to enhance and develop formal e-waste management system in Malaysia. Last but not the least, the 3R mechanism and EPR approach are missing in the new proposed law which shall consider being added in the draft of the new law.

CONCLUSION

Indeed, there is an enormous increase in the generation of WEEE in the world and recycling alone might not be sufficient to manage the massive volume of WEEE efficiently. There is a need to promote other possible solutions to manage WEEE. For instance, product development, promoting the habits of using repaired products, recycling plans by manufacturer, EPR and developing environmentally sound recycling infrastructure can also be effective and efficient techniques to manage WEEE. Further, WEEE requires to be competently managed and recycled rather than by way of informal

[96] DOE, "Responsibilities of Stakeholders," accessed August 29, 2019, http://www.doe.gov.my/hhew/responsibilities-of-stakeholders-2/.

dismantling. When recycling is impossible, WEEE ought to be disassembled through formal ways and well adept efficient technology to initiate reusing facilities in developing countries like Malaysia.

There are a few central standards from which WEEE guidelines ought to be founded on, for example, setting satisfactory hazard limits for unsafe treatment. The spreading of harmful segments in WEEE is life-threatening and destructive in the long run both to mankind and nature. Despite the fact that there is a hard-pressing need for further research, enlightening and recognition programmes on the prospective risks of WEEE reusing need to be organised. These projects are of indispensable significance in developing countries. The inadequate and untimely actions by the relevant authorities and financial limitations attenuate the process of essential preparations to restrict the trans-boundary movement of WEEE. Thus, a comprehensive WEEE management system should be implemented to constrain illegal transfer of WEEE across the borders and to enhance formal recycling in Malaysia. Further, Malaysia shall also take into consideration to implement Extended producer responsibility (EPR) programmes like Canada for shifting the responsibility, either physical and/or financial, for the management of end-of-life products towards producers and consumers. The researchers advocate that endeavours need to emerge towards the appropriate implementation of the 3Rs approach for WEEE manufacturing in Malaysia. However, it must be noted that Malaysia has already taken a positive step in this concern by drafting the new regulation for ensuring environmental quality.

From the above discussion, the following are some key recommendations for policymakers which will enhance informal and efficient e-waste management Malaysia:

- Unauthorized and unlicensed collection of WEEE should be discouraged in forthcoming law and violators should be penalised.
- The enforcement of law and monitoring shall be stringent to control illegal informal recycling facilities of WEEE in Malaysia.
- The DOE shall build new and advanced facilities for WEEE management.
- The manufacturers of EEEs shall be legally bound to submit a 3R plan (re-use, reduce and recycle) in Malaysia. The 3R plan

must contain all relevant information and the violators must be charged with fines, imprisonment or both.

- Last but not the least, the extended producer responsibility approach is recommended to be introduced in the new regulation. The EPR approach will be helpful to promote and ensure the proper and formal management of EEEs as an important policy tool for shifting the responsibility either physically or financially for the efficient management of WEEE in Malaysia. Further, under EPR, manufacturers will be liable to conduct workshops or campaigns to enhance public awareness of e-waste management.