WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (E-WASTE) ASSESSMENT REPORT FOR THE CO-OPERATIVE REPUBLIC OF GUYANA

Developed under the project:
RG-T3726: Management of E-Waste in Guyana, Suriname and Trinidad and Tobago

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LIST OF ABBREVIATIONS/ACRONYMS

Abbreviation/Acronym	Detailed Name
BCRC-Caribbean	The Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean Region
BOKU	University of Natural Resources and Life Sciences, Vienna
CARICOM	Caribbean Community
EEC	Environmental Economics Consultant
EEE	Electrical and electronic equipment
EoL	End-of-Life
EPA	Environmental Protection Agency
EPR	Extended Producer Responsibility
ESM	Environmentally Sound Management
EU	European Union
GEF	Global Environment Facility
GRA	Guyana Revenue Authority
HS	Harmonized Commodity Description and Coding System
ICT	Information and communication technology
IDB	Inter-American Development Bank
LC	Legal Consultant
MEA	Multilateral Environmental Agreement
MFA	Mass Flow Assessment
MSW	Municipal solid waste
Mt	Metric Tons
NDC	Neighbourhood Democratic Council
NGO	Nongovernmental Organisation
NPA	National Project Assistant
NWG	National Working Group
PACE	Partnership for Action on Computing Equipment
PDBE	Polybrominated Diphenyl Ether
SDGs	Sustainable Development Goals
SIDS	Small Island Developing States
UNU	United Nations University
UN Comtrade	United Nations Commodity Trade Statistics Database
WEEE	Waste electrical and electronic equipment / e-waste
WHO	World Health Organization

GLOSSARY

Circular economy	An alternative concept that seeks to slow down the rate of resource consumption by circulating them in the society for longest time possible, and to eliminate waste by smarter product design and business models
Collector	Individual or entity that physically removes waste from an area.
Distributor	An intermediary entity between the manufacturer or producer of a product and another entity in the supply chain (wholesaler, retailer or end user)
Dismantling	The process of disassembling or taking apart equipment for the purpose of component separation or segregation, to remove the hazardous components and recover reusable material.
EEE	Electrical and electronic equipment according to the 10 categories as listed in the European Union WEEE Directive
E-waste	An electrically powered appliance that has reached its end-of-life, and therefore no longer satisfies the current owner for its originally purpose
E-waste generator	An individual or entity that creates e-waste in the process of using or consuming EEE
Harmonized Commodity Description and Coding System	Also known as the Harmonized System (HS) Codes, it is a standardised coding system used to identify goods traded internationally.
Hazardous wastes	Wastes with properties that make them dangerous or potentially harmful to human health and/or the environment
Lifetime	The period from EEE POM to e-waste: this includes the lifespan of the equipment, the second-hand use and the stock time
Processing	The application of manual or automated technology to crush, separate or sort waste, typically to obtain high value materials.
Put on Market (POM)	The quantity of a material put on the market or present in-country, determined as POM = Imports - Exports in the context of this report
Recycling	Process by which waste is reprocessed so as to obtain a product or material suitable for use whether for the original or other purposes
Repair	Fixing a fault in equipment to make the equipment a fully functional product to be used for its originally intended

	purpose.
Reuse	Extension of the end of life of equipment or component parts to be used for the same purpose
Stock	EEE in use or storage in a household or corporate entity
Treatment	The treatment process typically involves dismantling, processing, and end processing (end processing deals with where the materials obtained in processing ends up, such as steel scraps at steel mills to be re-melted).

1 EXECUTIVE SUMMARY

The project entitled *Management of E-Waste in Guyana, Suriname and Trinidad and Tobago* was funded by the Inter-American Development Bank (IDB) and co-executed by the University of Natural Resources and Life Sciences, Vienna (BOKU) and Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean (BCRC-Caribbean). This report provides a rapid assessment of management of the electrical and electronic equipment (EEE) waste stream (e-waste) in the Co-operative Republic of Guyana, hereafter referred to as *Guyana*. This study attempted to:

1. Identify the local stakeholders involved in the national e-waste generation and management
2. Estimate quantities of e-waste generated, and their associated economic values
3. Map existing e-waste-related management practices and/or regulations
4. Examine the extent of stakeholder knowledge relative to e-waste generation, management, and the economic value of this existing or potential sector.

Being the first such assessment for Guyana, the study sought to collect adequate baseline data to fulfil the objectives of the project, set the foundation for responsive action, and build on previous and ongoing related projects, including the 2008 National Inventory of Hazardous Wastes conducted by the Environmental Protection Agency (EPA) of Guyana, the Global Environment Facility's (GEF) Implementing Sustainable Low and Non-Chemical Development in Small Islands Developing States (ISLANDS) project, and the GEF Review and Update of the National Implementation Plan for Guyana under the Stockholm Convention on Persistent Organic Pollutants (POPs). In the latter document, an inventory of polybrominated diphenyl ethers (PBDEs), compounds contained in casings of e-waste, will also be developed, and can complement the findings of this report.

At this time of writing this report, although not explicitly mentioned, e-waste may be classified as *hazardous waste*[1] under the Environmental Protection (Hazardous Wastes Management) Regulations 2000. The most relevant legislations include the Environmental Protection Act of 1996, the Environmental Protection (Hazardous Wastes Management) Regulations of 2000, and Environmental Protection (Litter Enforcement) Regulations of 2013. Some of the gaps and/or barriers to e-waste management in Guyana include the lack of e-waste-specific legislation, inadequate mechanisms to combat the exponential growth of EEE, and lack of considerations for the management of EEE and e-waste in existing national policies and strategies.

Although a formal national system of categorisation, quantification and lifecycle treatment of EEE has not yet been implemented, the recent efforts of the EPA to develop a database on types and quantities of wastes generated and managed in Guyana must be recognised as a mechanism that will support the country's future decisions on the lifecycle management of EEE (among other products that generate hazardous waste) and ensure the maintenance of records on the EEE imported, put on market and the e-waste generated in Guyana.

Since this inventory is considered a first-generation inventory, the categories of EEE contained in the ***Draft Practical Guidance for the Development of Inventories of Waste Electrical and Electronic Equipment*** (**"the Guidance"**), developed by the Secretariat of the Basel, Rotterdam and Stockholm Conventions were utilised. In the execution of this assessment, data on import and export of EEE, generation and management of e-waste locally, and handling and export of e-waste were gathered through interviews, questionnaire administration, and review of secondary data sources. It must be noted, however, that the limited availability of local data resulted in the

[1] '"Hazardous waste" means a waste or combination of wastes which, because of its quantity, concentration or physical, chemical or infectious characteristics, may pose a substantial hazard to human health and belong to any category contained in Schedule I unless they do not contain any of characteristics contained in Schedule II and includes waste that is (i) hazardous industrial waste; (ii) acute hazardous waste chemical; (iii) hazardous waste chemical; (iv) severely toxic waste; (v) flammable waste; (vi) corrosive waste; (vii) reactive waste; (viii) radioactive waste; (ix) clinical waste; or (x) leachate toxic waste, or polychlorinated biphenyl waste'. - Environmental Protection (Hazardous Wastes Management) Regulations 2000.

reliance on data from the UN Comtrade Database, to calculate the national e-waste inventory.

The key respondents included the Guyana Revenue Authority (GRA), Ministry of Local Government and Regional Development (MLGRD), the Environmental Protection Agency (EPA), Ministry of Natural Resources (MNR), domestic waste generators and waste handlers (collectors and the sole exporter). The findings have been presented under three sections: e-waste inventory, legislative considerations, and economic evaluation and considerations for e-waste management. Additionally, relevant recommendations have been proposed to support the advancement of environmentally sound e-waste management in Guyana.

The average annual e-waste generation for the period 2019-2021 is estimated to be 7,232 metric tons (Mt), which translates to an estimated e-waste generation rate of 9 kg per capita annually. While the per capita e-waste generation for Guyana estimated in these findings is higher than the 2019 global average (7.3 kg per capita), only a very small proportion of this is exported for environmentally sound management (ESM).

Transboundary movements of e-waste destined for Asian markets are undertaken by the sole authorized e-waste exporter, Eternity Investment Inc. Compliance with all necessary procedures under the Basel Convention and other statutory requirements are ensured through cooperation with the national competent authority for the Basel Convention, the Environmental Protection Agency. The average annual quantity of e-waste exported for ESM during the period 2019-2021 was 47.5 Mt, which represents less than 1% of the average e-waste generation during the same period. Although this suggests the approximately 99% of the e-waste generated (7,160 Mt) remains in Guyana,. Further, while valuable metals are exported, plastic casings and other components which are not profitable in Guyana's waste trade, are disposed of in the landfill/dumpsites. As previously mentioned, these plastics may be treated with brominated flame retardants (e.g. HBBs, HBCD,PBDEs), and so their final disposal without treatment is a concern for human health and the environment.

Through the strengthening of technical and institutional capacity for e-waste management, creation of economic incentives for proper e-waste management, and

establishment of local e-waste material recovery, marketing, and disposal programmes, the e-waste sector can contribute further to the national gross domestic product (GDP).

An economic model for setting up a dismantling facility at Guyana was developed aimed to be helpful for policy makers to understand the economic framework conditions for e-waste treatment in their country and the sub-region. In addition, the model brings advantages to decision makers as it gives detailed background data which is useful when designing an e-waste policy framework. Further, it can be used as guidance for entrepreneurs who want to become involved in Guyana's e-waste industry as provides an overview of the expected costs and revenues. For established facilities, on the other hand, this tool is helpful for identifying options for improving in their current process and optimizing their dismantling operations.

The economic assessment provides different scenarios based on collection rates. It estimates incomes from selling recovered materials. Associated human resources, equipment and operational costs have also been considered, including transboundary movements of e-waste among the project countries. From studying the model, it was concluded that regardless the collection scenario, the economic result of the treatment facility is negative. Options for generating other sources of revenue or reducing some costs to make the operation economically viable were presented.

An assessment to ascertain the economic feasibility (incentives/disincentives) of the current scenario was developed. In addition, an assessment on gaps, barriers, and opportunities to e-waste management operations based on the current situation is presented. However, it must be noted that due to time limitations and challenges in data availability, as well as with low response rates from stakeholders on their current practices, there were challenges in gathering comprehensive information on the quantities, methods and destinations of E-waste and materials handled through existing private initiatives which limited the development of the economic assessment in the current situation.

The feasibility of setting up a sub-regional dismantling facility was assessed through the model. The first alternative was to locate it in Trinidad and Tobago, due to the high e-waste generation and level of industrialization of the country, in comparison to Guyana

and Suriname. The second alternative was to locate it in Suriname, due to the lower labour and rental costs. Positive economic results are achieved when the sub-regional facility is located in Suriname. To make any sub-regional approach possible, user agreements must be in place among countries so that e-waste can move among them. The political and social impact of such measures should be taken into consideration as well.

Recommendations

1. Establishment of a comprehensive e-waste policy, legislation, standards and an action plan that implements an integrated e-waste management system
2. Establishment of an interagency committee
3. Development of national data collection system
4. Introduction of extended producer responsibility (EPR) schemes
5. Forging of public-private-people partnerships
6. Careful examination of the role of the informal sector
7. Dissemination of information to increase public awareness on the ESM of e-waste

These recommendations, in addition to the findings of this study, can provide a foundation on which a national e-waste management system can be developed and implemented to achieve environmentally sound e-waste management and allow for the harnessing resources from e-waste.

2 INTRODUCTION AND BACKGROUND

2.1 Introduction and Project Overview

Waste electrical and electronic equipment (WEEE or e-waste) has been identified as one of the fastest growing waste streams in the world in relation to volume and environmental impact (Forti et al., 2020; Kumar et al., 2017). In 2019, 53.6 million Mt of e-waste was generated globally, increasing by 21 % in just 5 years. This figure is expected to reach 74 Mt by 2030 (Forti, et al, 2020). The recent pandemic caused by the novel SARS-CoV-2 (COVID-19) virus, during which persons across the globe were compelled to obtain and use of personal devices to continue their work or education, where possible, may have led to exponential increases in forecasts of rates of e-waste generation for future years. Furthermore, attitudes of consumers and businesses wishing to remain up to date with advances in technology result in shorter lifespans of electrical and electronic equipment (EEE), thereby contributing to increasing generation of e-waste[2].

In cases where hazardous constituents such as mercury, lead and brominated flame retardants are present in its components, e-waste will be considered as hazardous waste under the Basel Convention due to their associated health and environmental impacts. However, regardless of its classification as hazardous or non-hazardous, its mismanagement has the potential to negatively impact human health and the environment. As a Party to the Basel Convention on the Transboundary Movement of Hazardous Wastes and their Disposal (Basel Convention), Guyana is required to ensure that environmentally sound management (ESM) practices are implemented nationally.

Given that e-waste may also contain metals such as gold, copper, nickel and rare materials of value such as indium and palladium, its sound management is not only a matter of environmental importance, but also of economic significance. However,

[2] There is no standard definition of e-waste. The Organisation for Economic Co-operation and Development (OECD) defines e-waste as “any appliance using an electric power supply that has reached its end-of-life” (UNEP, DTIE, 2007a). The most widely accepted definition of e-waste is as per European Commission Directive 2002/96/EC: “electrical or electronic equipment, which is waste…including all components, subassemblies and consumables, which are part of the product at the time of discarding”. – *The Global Impact of E-waste: Addressing the Challenge* (2012).

monopolising on the true economic potential of e-waste is yet to be realised since, according to the Global E-Waste Monitor, 2020, only 17.4% of e-waste was collected and recycled globally in 2019.

In their study of the circular economy potential of e-waste in five (5) Caribbean Islands, Mohammadi et al. (2021) projected that between the years 2020 and 2025, more than 317 kilo tons (kt) of valuable resources can be recovered from e-waste. This represents an estimated economic value of US $546 million in just these five (5) islands, which possess only 11% of the Caribbean population. Should this potential be realised from the entire Caribbean e-waste industry, it is estimated that a total of US $6 billion in revenue can be generated.

All Caribbean Community (CARICOM) Member States have waste management laws and regulations; however, there is no overarching regional directive or guidance on e-waste management. Therefore, the e-waste industry and the flow of materials to same have not reached their full potential on a regional scale.

The Inter-American Development Bank (IDB) funded project 'Management of E-Waste in Guyana, Suriname and Trinidad and Tobago' seeks to first develop an assessment on the management of e-waste in the project countries, which will include an inventory of e-waste generated, and then the development of a sub-regional solution for the management of e-waste. This solution has the potential to be scaled up regionally. The project is co-executed by the University of Natural Resources and Life Sciences, Vienna (BOKU) and the Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean (BCRC-Caribbean).

This report presents the findings of the e-waste management practices in Guyana.

2.2 Project Scope and Objectives

2.2.1 International Scenario

Approximately 50 million Mt of e-waste is generated globally per year, with an average of more than 6 kilograms (kg) per person (Parajuly et al., 2019). There is great disparity in e-waste generation rates between wealthy, industrialised, developed nations and

economies in transition or the least developed countries. For example, Norway produces 28.5 kg e-waste per person per year, compared to an average of less than 2 kg per person in African countries (Parajuly et al., 2019). Arguably, the fastest growing component of solid waste[3], e-waste is estimated to increase in volume exponentially because of technological revolution, increased demand, and digitisation in global education given the effects on the education sector by the COVID-19 pandemic.

While the mismanagement of e-waste can lead to significant environmental threats, the management of this waste stream, via formal or informal means, also presents economic opportunities. While industrialised countries may have more advanced e-waste management capacities and treatment technologies as compared to economies in transition and developing countries, these wealthy nations contribute disproportionately to the e-waste-induced environmental challenges facing the planet (Lungren, 2012). Much of these problems are even exported by industrialised countries to small, developing countries. The balancing act between increased e-waste generation and waste minimisation through resource recovery, recycling and material reuse remains a challenge for wealthy nations, let alone small islands developing states (SIDS). The Basel Convention is an international treaty for the global regulation of hazardous wastes and its transboundary movement. E-waste which is subject to transboundary movements may be categorized as either hazardous (A1180) or non-hazardous (B1110) based in its constituents.

2.2.2 Regional Scenario

The United Nations Industrial Development Organization (UNIDO) posits that approximately 7% of the 50 million Mt of e-waste produces globally per year is generated in the Latin American and Caribbean (LAC) region. The United Nations Environment Programme (UNEP) Waste Management Outlook for Latin America and the Caribbean (2018) proposes that 1kg of waste is generated by per inhabitant daily (UN Environment, 2018). Approximately, 541,000 Mt of municipal waste is generated

[3] https://www.weforum.org/agenda/2018/02/how-do-we-tackle-the-fastest-growing-waste-stream-on-the-planet/

per day in the region—50% of which is inorganic waste—and this is estimated to increase by at least 25% by 2050. As it pertains to the e-waste stream, the report estimates that approximately 6.3 kg of e-waste per capita—per inhabitant per year—would be generated. An interesting statistic proffered by this finding is that,

> *despite the fact that Brazil and Mexico are the largest generators of this type of waste in the region, the countries with the highest rates, considering the volume generated per inhabitant, are Chile (9.9 kg/inhabitant) and Uruguay (9.5 kg/inhabitant)–the countries with the highest income levels in Latin America–followed by smaller countries such as Suriname (8.5 kg/inhabitant) and Panama (8.2 kg/inhabitant).*

The UN Environment study reiterates that the most significant challenges the region faces in pursuit of effective e-waste management include the lack of legal and regulatory management systems, the lack of sustainable lifecycle management for e-waste, lack of requisite recycling and resource-recovery technologies and sustainable economic models to mitigate financial difficulties associated with e-waste management.

2.2.3 Local Scenario

The Environmental Protection (Hazardous Wastes Management) Regulations, 2000, implemented by the Environmental Protection Agency (EPA), is Guyana's overarching legislation governing the management of hazardous wastes. Although the Regulations are written broadly enough to cover e-waste by virtue of the waste stream, waste constituents and hazardous characteristics outlined in schedules I and II of the Regulations, there is no specific mention of e-waste (**Appendix 1**). Although Guyana is a Party to the Basel Convention the disconnect between local legislation and obligations under the convention, may be attributed to the fact that Guyana acceded to the Convention in 2001-one year after the Environmental Protection (Hazardous Wastes Management) Regulations 2000 was enacted and therefore is unlikely to have considered the obligations of the Basel Convention in its development.

Except for minimal separation of e-waste done by some state agencies before placement for collection, and some dismantling and segregation by informal workers at the Haags Bosch Sanitary Landfill, e-waste is generally comingled with other categories of waste and transported to landfill for disposal.

The lack of sufficient data collection throughout the lifecycle of EEE, makes the quantification of e-waste in Guyana difficult. Estimations on the quantity of EEE on the market represents a mechanism for estimating the total generation of e-waste locally.

Given the progressive rate of industrialization following the recent discoveries of oil and gas in Guyana, as well as the international shift towards more virtual engagements in the wake of the COVID-19 pandemic, national rates of e-waste generation are likely to increase. Improper management of this waste stream directly threatens the country's pristine environment, as well as its social and healthcare sectors. The need to implement effective e-waste management systems and transfer best available technologies for resource recovery and recycling of EEE in Guyana are therefore paramount.

2.2.4 Project Objectives

The project, which is funded by the Inter-American Development Bank (IDB) and co-executed by the BCRC-Caribbean and the BOKU in collaboration with the Governments of Guyana, Suriname and Trinidad and Tobago, comprises of the following four (4) components:

1. Producing updated reports on the current e-waste management practices in Suriname and Trinidad and Tobago and developing a report on the current e-waste management practices in Guyana
2. Development of a proposal on the sub-regional approach to the management of e-waste and development of training material
3. Development of a business plan for the proposed management solution
4. Dissemination of project results and facilitation of knowledge dissemination.

This report has therefore been developed as an output of Component 1 of the project and will inform the development of trainings and a business plan for a sub-regional model for e-waste management. It analyses:

- The current trends and practices in e-waste management in Guyana
- The existing national legislation and institutional framework and legislative and institutional mechanisms to be developed, to enable the implementation of the sub-regional solution
- The current market conditions as it relates to the management of e-waste in Guyana and the requirements for ensuring the economic viability of the sub-regional solution

2.3 Scope of and Approach to E-waste Inventory

The sustainable management of EEE and e-waste is founded on a sound e-waste inventory system which records the sources and quantities of EEE by their classifications, and critical trends. The assessment sought to understand the flow of EEE in Guyana using reliable available data. The types or categories of EEE and e-waste referenced in this assessment are those identified in the Practical Guidance for the Development of Inventories of Waste Electrical and Electronic Equipment (**"*the Guidance*"**), developed by the Secretariat of the Basel, Rotterdam and Stockholm Conventions at the request of the Conference of Parties (COP) to the Basel Convention. Given the lack of data on the lifespan of different categories of e-waste in Guyana, the average lifespan of each category of e-waste was provided by the Environmental Economist, based on the average lifespans in the Caribbean. **Table 1** illustrates the ten (10) categories of EEE (adapted from the EU WEEE Directive), their respective descriptions and their average lifespans.

Table 1: The 10 categories of EEE, their descriptions and average lifespans

Category	Description	Average Lifespan (years)
1: Large Household Appliances (**LHA**)	Refrigerators, freezers, air conditioners, washing machines, clothes dryers, dishwashing machines	9
2: Small Household Appliances (**SHA**)	Vacuum cleaners, irons, blenders, fryers, other household appliances	6
3: IT and Telecommunications Equipment (**ITE**)	Laptops, desktop computers, telephones, mobile phones, typewriters, electronic calculators	5
4: Consumer Equipment (**CE**)	Musical instruments, microphones, earphones, amplifiers, speakers, and other video and audio equipment	6
5: Lighting Equipment (**LE**)	Incandescent light bulbs, fluorescent tubes, gas-discharge lamps, chandeliers	4
6: Electrical and Electronic Tools (**EET**)	Handheld drills, saws, soldering irons and guns, lawn mowers, and other gardening devices	6
7: Toys, Leisure and Sports Equipment (**TLSE**)	Electronic toys such as video games requiring monitors, models, sports equipment	5
8: Medical Devices (**MD**)	Electro-cardiographs, ultrasonic scanning apparatus, electro-diagnostic apparatus, all other medical equipment, with the exception of implants	10
9: Monitoring and Control Instruments (**MCI**)	Detectors, thermostats, laboratory equipment, electric sound or visual signalling apparatus, photogrammetrical surveying instruments	10
10: Automatic Dispensers (**AD**)	Automated vending machines: dispensers of snacks, beverages, lottery tickets	10

The flow of EEE usually follows the path of import, consumption, e-waste collection, and disposal at end-of-life, with little treatment and resource recovery. **Figure 1** shows the typical mass flow of EEE and e-waste.

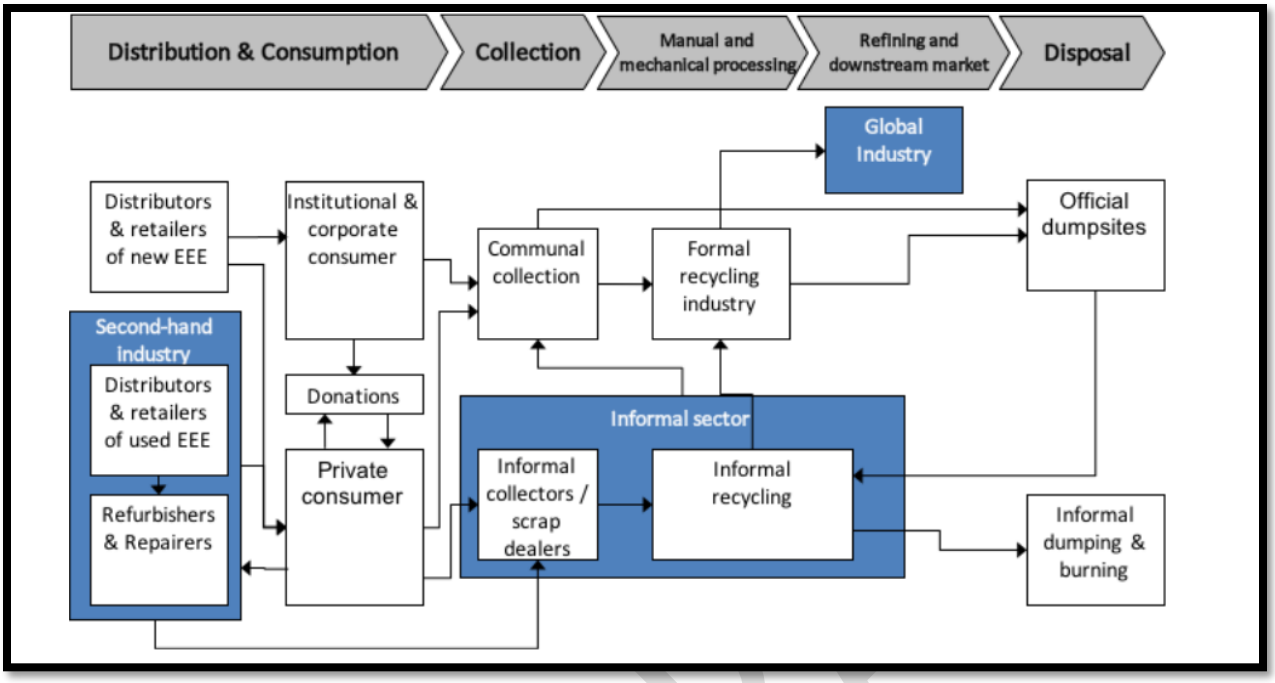


Figure 1: EEE and e-waste mass flow schematic (*Source: Practical Guidance for Inventory Development*)

In Guyana, state agencies, such as government ministries and their agencies, constitutional bodies, and local government organs, are all required to document EEE at procurement and at their end-of-life (e-waste) before disposal. Sections 42 and 43 of the Stores Regulations, 1993, outline the procedures for the disposal and sale of serviceable uneconomical and unserviceable EEE, which require in most cases, disposal by public auction. In some entities, Microsoft Excel is used to collate data sets on e-waste; however, while the number of EEE at end-of-life is documented, the weight is not measured and inventoried. Consequently, there are no comprehensive records on the quantities of e-waste generated by government. Some Government entities also liaise with the EPA to receive guidance on disposal of e-waste.

Although the Stores Regulations, 1993 does not prescribe procedures for private entities, well-structured private organisations follow a similar procedure, primarily for accounting purposes. EEE are considered assets and are therefore required to undergo an asset disposal process, which entails removal of the items from the Company's

assets database when approved for disposal; and finally, being physically damaged prior to selling to scrap metal dealers.

At the household level, EEE may be procured through local distributors or imported via online purchases or during travel. Once at the end of its useful life, e-waste generated by households may be stored or comingled with other solid municipal waste for disposal. As a result, the e-waste that are not stored by households may end up at landfills and dumpsites in Guyana.

In the final stages of the e-waste management system, some of the e-waste in landfills and dumpsites may be recaptured by the informal sector and sold to scrap metal dealers in the formal sector, including Eternity Investments Inc., for onward processing and export.

2.4 Approach to Inventory and Methodology

The approach adopted during this assessment, was adapted from the methodology outlined in the ***"Guidance"***. The approach to the development of the report involved:

I. Identification of key stakeholders involved in EEE and e-waste management in the private and public sectors of Guyana
II. Examination of data sets, from the Guyana Revenue Authority (GRA) and UN Comtrade Database on imports and exports of EEE and subsequent calculation of e-waste generation, recorded quantities by public and private sector entities, disposal, treatment and/or export of e-waste at the national and/or sectoral level
III. Identification or mapping of existing EEE lifecycle management system(s), and assessment of material flow
IV. Identification of e-waste management regulations, and approach and barriers to regularisation of informal sectors involved in e-waste management
V. Identification of market conditions or business viability of material recovery, and economic implications of resource maximisation in the e-waste sector; and

VI. Recommendations for the development of a comprehensive e-waste management strategy for Guyana, considering the sub-regional approach to e-waste management.

The methodology included collection of primary data from key stakeholders and the public through questionnaires and in-depth interview instruments, and secondary data through review of relevant literature and searches of applicable trade databases. Surveys were disseminated via e-mail and social media for households and distributors while interviews were conducted with members of the National Working Group (members in **Appendix 2**), Contractors of the Haags Bosch Landfill Site (Waste Solutions Landfill Inc.) and a member of the GT Recyclers who is the owner of a scrap metal yard.

2.4.1 Data sources for import and export of EEE

The preparation of an e-waste inventory is hinged heavily on the availability of and access to existing baseline data on EEE consumption and the resulting e-waste generation rated. However, since no such data exist in Guyana, it was essential therefore necessary to derive the Put-on-Market (POM) quantities for e-waste using the approach, outlined in the ***"Guidance"*** This required the collection of datasets with historical information on EEE import and export quantities.

As it relates to the collection of secondary data from trade databases, Automated System for Customs Data (ASYCUDA), which is managed by the GRA in its capacity as Guyana's overarching customs regulator, was initially consulted. The data in ASYCUDA is organised according to the Harmonized Commodity Description and Coding System (HS Code). However, since ASYCUDA only became functional in 2018, EEE import, and export data provided was restricted to the period 2019 to 2021. This proved to be a major limitation, since all categories of EEE had a lifespan of between four (4) and ten (10) years, which therefore required data from 2009 to 2017, to at least allow the estimation of e-waste inventories for 2019, 2020 and 2021.

The assessment of e-waste generation rates primarily relied on published trade statistics retrieved from the UN Comtrade database, for the period 2009 to 2021. A total

of 171 HS codes, aggregated into the 10 EEE categories, were provided with the import and export data shared by GRA for 2019-2021. While the values could not be used to estimate e-waste generation, the commodity codes provided by the GRA, (included in **Appendix 3**), were used to retrieve the required data from the UN Comtrade Database.

2.4.2 Determination of EEE POM

The quantity of EEE POM is the difference between the sum of EEE imported and EEE produced locally, and the EEE exported from Guyana. The amount of EEE POM was derived from import and export statistics relative to Guyana, contained in the UN Comtrade Database. This data source was used to produce an estimate of e-waste generation from each category of EEE across their lifespans, for three (3) years (2019-2021). This was calculated by finding the difference import and export quantities, since Guyana is not a manufacturer of EEE.

Although the GRA's data was not used to calculate e-waste generation, the EEE POM from 2019-2021, calculated using GRA's data has been included in **Appendix 4** for comparison.

Upon completion of POM calculations, it was recognised that the POM values for some categories in particular years, were unusually low or high, when the trends for the specific categories were examined. Further scrutiny of the data showed that these anomalies were due to high increases or decreases in import quantities from one year to another, in some cases, more than 30-fold increases. These outliers were therefore eliminated, by finding an average of the POM values recorded in the year preceding and succeeding the year with the outlier value. The POM values calculated using the initial data from UN Comtrade database have been included in **Appendix 5** for reference; however, the adjusted POM values were used to calculate e-waste generation from 2019-2021, which is discussed in the following section.

2.4.3 Determination of E-Waste Generation

The calculations employed for this method were guided by the ***"Guidance"***, which proposed two methods of estimating e-waste generation, one which considers use of EEE and stockpiles of e-waste and the other which considers the EEE placed on the market. In the absence of reliable country data on EEE use and stockpiles of e-waste, this assessment utilised the POM method which also required that the lifespans of the EEE in each category be considered in order to calculate the e-waste generated (EWG) as follows:

EWG(t) = POM (t – average lifespan of equipment).

Where t is the year of the inventory

To further clarify the methodology used to derive the e-waste generation quantities, the POM years of consideration for the 2019-2021 e-waste inventories are outlined in **table 2**.

Table 2: POM Years of Consideration for 2019-2021 E-waste Inventories

EEE Category	Average Lifespan (years)	Consideration Years for 2019 Inventory	Consideration Years for 2020 Inventory	Consideration Years for 2021 Inventory
LHA	9	2010	2011	2012
SHA	6	2013	2014	2015
ITE	5	2014	2015	2016
CE	6	2013	2014	2015
LD	4	2015	2016	2017
EET	6	2013	2014	2015
TLSE	5	2014	2015	2016
MD	10	2009	2010	2011
MCI	10	2009	2010	2011
AD	10	2009	2010	2011

*LHA = Large Household Appliances, SHA = Small Household Appliances, ITE = IT and Telecommunications Equipment, CE – Consumer Equipment, LD = Lighting Devices, EET = Electrical and Electronic Tools, TLSE = Toys, Leisure and Sports Equipment, MD = Medical Devices, MCI = Monitoring and Control Instruments, AD = Automatic Dispensers.

The e-waste generation quantities for 2022 and 2023 were estimated using the data forecast function in Microsoft Excel. Quantitative and qualitative data collected were analysed using descriptive statistics and thematic analysis.

2.4.4 Limitations

During the assessment, the following limitations were noted:

1. While national data is preferred for the calculation of e-waste generation, the information provided by the GRA could not be used for estimations of e-waste quantities. This was because the applicable POM values required for the estimation of e-waste generation needed to be derived from years prior to 2019, since the lifespans of all categories of EEE considered, exceeded 3 years.

2. The data retrieved from both the GRA and UN Comtrade database could not be used to categorise EEE according to its condition, i.e., whether new or used. This therefore resulted in application of the same lifespan to all EEE of the same category. Additionally, the lifespans assigned to the EEE assume that all EEE under consideration were new. Generally, since used EEE will reach its end-of-life much quicker than new EEE, the application of the same lifespan for all EEE in a specific category is likely to have led to an under estimation of EEE POM in any given year.

3. The proportion of collected e-waste, which is exported, could not be accurately estimated since the calculation of e-waste generation considered the weight of all components of the EEE whilst the record of exports only account for the weight of the valuable component exported.

4. The household questionnaire was unable to capture information on lifespans of EEE at the national level since respondents were only asked about their disposal quantities and not the time between acquisition and end-of-life. Further, the low response rate received from the household survey meant that the sample size

was too small to be extrapolated to provide a country-level perspective and sample size too small.

5. Poor record-keeping among all key players in the e-waste management system, made it impossible to completely and confidently track the flow of EEE and e-waste in Guyana.

2.4.5 Assumptions

The aforementioned limitations suggest that gaps in data required to support the preparation of this report still exist. Therefore, the following assumptions were necessary to facilitate the completion of the assessment:

1. The commodity codes provided by the GRA, for each category of EEE were accurately grouped, and there were no misplaced commodity codes.
2. The lifespans of all EEE in a specific category were the same.
3. All EEE of the same category which were POM in the same year, also reached their end-of-life in the same year and are counted in the e-waste stock for the particular year.

3 COUNTRY OVERVIEW

The gross domestic product (GDP) of any country depends not only its natural resources but also the utilization of resource potential, its harnessing of its human capital, and the governance of its environment. As a country transitions toward developed status, it is faced with new environmental challenges. For Guyana, one of those forthcoming challenges is the management of increased volumes e-waste as the country becomes increasingly industrialized. The key characteristics of Guyana are presented within the context of its e-waste management.

3.1 Profile of Guyana

The Co-operative Republic of Guyana, hereafter referred to as *Guyana*, is a country situated on the northern mainland of the South American continent, bordered by the Atlantic Ocean to the north, Brazil to the south-west, Venezuela to the west, and Suriname to the east. The only anglophone country in South America, Guyana—historically, culturally and geopolitically—has been considered a Caribbean country and is a founding member of the Caribbean Community (CARICOM).

Guyana is a high-forest, low-deforestation (HFLD) country, with approximately 84% of its landmass covered by dense tropical rainforest. The country is divided into four natural regions, ten (10) administrative regions, and has ten (10) municipalities, including the capital city of Georgetown. According to the most recent national census conducted in 2012 and estimation to date based on population growth projections, its population is approximately 790,000.

Figure 2: Map of Guyana depicting major municipalities

Guyana is a parliamentary republic. Its Head of State, who is elected by citizens who have attained suffrage at the age of 18, is also the Head of Government and Cabinet. Parliament constitutes 65 seats, and the current Cabinet consists of 25 members.

Guyana, which is the third smallest by area on the continent of South America (215,000 square kilometres), is classified as a middle-income country. Traditionally, the country's economy was heavily dependent on the export of six main commodities: sugar, gold, bauxite, shrimp, timber, and rice. These export commodities represented nearly 60% of the country's GDP.

Guyana is one the recent entrants in the petroleum sector as evidenced by discoveries of commercial quantities of oil offshore, totalling approximately 11 billion barrels since 2015. This has implications for the GDP because revenues from the petroleum industry are estimated to dwarf those earned by the aforementioned traditional industries. This is already evident by the shift of Guyana's balance of trade from red to green since the commencement of export of petroleum. According to an IDB report, the new oil-and-gas sector represented 36 percent of GDP in 2020, followed by services at 25 percent (down from 40 percent), agriculture at 18 per cent (down from 25 percent), and gold production at 7 percent (down from 11 percent) (OilNow, 2021). World Bank statistics show that Guyana's GDP currently stands at 5.47 billion US Dollars (US$), recording an annual growth rate of 43.5% in 2020 (World Bank, 2022).

Aspiring to balance its low-carbon, high-forest profile with emerging industries and the new petroleum sector, Guyana faces many environmental management challenges, with waste management being among the most significant. The country has solid waste management systems, practices and regulations (discussed in subsequent sections in this report). Although the management of e-waste is covered in Hazardous Waste Management Regulations and the National Solid Waste Management Strategy, there are some gaps in the lifecycle management of EEE which needs to be addressed.

3.2 Overview of Relevant Stakeholders

Stakeholders with the most significant stake in the flow and management of EEE and e-waste in Guyana include EEE importers/distributors, consumers/users, waste generators (domestic, commercial and industrial), state agencies, refurbishers/repairers, waste collectors and exporters. Within the context of state agencies, stakeholders include:

- the Ministry of Local Government and Regional Development (MLGRD), which has oversight for local waste management through Regional Democratic Councils (RDCs), Neighbourhood Democratic Councils (NDCs) and City/Town Councils,
- the GRA, which records the EEE imported and exported in Guyana,
- the EPA, which is the principal environmental regulator, focal point and competent authority for the Basel Convention, and
- the Ministry of Tourism, Industry and Commerce, under which the Scrap Metal Unit was formed.

3.2.1 Ministry of Local Government and Regional Development (MLGRD)

The MLGRD is the principal authority on waste management in the country. The mandate of the MLGRD is to provide technical and financial support (through budgetary allocations) to the local democratic organs, i.e., Regional Democratic Councils (RDCs), Neighbourhood Democratic Councils (NDCs), and municipalities, to enable waste management and enhance their capacities, effectively manage and upgrade the landfill sites to reach best environmental standards, and to collect, transport and dispose of waste at designated landfills.

Waste collection and disposal services are provided in every administrative region of Guyana. However, while the cost of waste collection is generally borne by the MLGRD, some private citizens are required to pay a fee to private waste collection companies to obtain this service. Depending on where it is generated, municipal solid waste is collected, transported and disposed at the Haags Bosch Landfill Site, or one (1) of seventeen (17) dumpsites located throughout the country.

The Haags Bosch Sanitary Landfill is Guyana's only engineered landfill and is equipped with a liner and leachate collection system. The landfill was constructed to facilitate the continued disposal of municipal solid waste, after the Mandela Avenue Dumpsite reached capacity and was being prepared for decommissioning and closure. The Haags Bosch Landfill currently receives approximately 160,000 tonnes of waste annually with an annual operating cost of GYD $300 million (US $ 1,392,111).

Households, business places, institutions, and industries place their comingled waste in waste receptacles, where it is collected and loaded onto compactor trucks, open dump trucks, tractors, and, to a lesser extent, skip trucks. Waste is collected once or twice weekly in residential areas and daily in commercial areas. The high cost of transportation can be considered as one of the key factors for the low frequency of collection rates in residential areas by RDCs and NDCs. Waste is transported directly to disposal sites, since there are no transfer stations in the country. Rear-loading compactor trucks, which are typically used to collect waste, are outfitted with mechanisms to minimise the release of leachate from organic waste during the transport of waste. The use of dump trucks and flatbed trucks has also been observed.

At the Haags Bosch Sanitary Landfill, there is an organised group of approximately seventy (70) informal sector workers who salvage e-waste and other metal waste on the landfills for dismantling, and sale to scrap metal dealers.

Currently, the MLGRD is updating the draft National Solid Waste Management Strategy (NSWMS) 2013-2024. The strategy intends to pursue '*establishing an integrated, financially self-sustaining, environmentally-sound, and socially-acceptable waste and resource recovery system for Guyana*'. This outcome of this e-waste assessment is envisaged to contribute to the broadening of the NSWMS. Additionally, the Draft Solid Waste Management Bill, is expected to be updated by August 2022, and enacted by December 2022. Regulations for different types of waste streams, including e-waste are expected to be developed.

3.2.2 Guyana Revenue Authority

In 2000, the Inland Revenue Department and Customs and Excise Department—founded on the Income Tax Act of 1939—were merged to form the Guyana Revenue

Authority (GRA). The mission of this state agency is *to promote compliance with Guyana's Tax, Trade and Border Laws and regulations, through education, quality service and responsible enforcement programmes*. Its mandate, essentially, is the protection of citizens by implementation of systems to seize prohibited items, detain restricted items until requisite licences are produced (licence from Guyana Police Force for import of firearms, for example), revenue collection, and agency functions.

GRA is the country's chief tax administration authority, custodian of the country's trade and border laws, regulator of import and export, and repository of trade data. The agency has been evolving in capacity and capability to meet the growing demands of a nation on the cusp of a petroleum-induced economic boom. One of the ways the agency has built its capacity is by improving its data management system, transitioning from the Total Revenue Integrated Processing Systems (TRIPS) to the currently utilised Automated System for Customs Data (ASYCUDA). This system has increased the pace of data management, facilitated interoperability, and enhanced ease of business.

It should be noted that consumer electronics which are imported through personal travel for use at the household level may not always be documented under the GRA's declaration system. As a result, the total quantity of e-waste generated in Guyana may be higher than reported herein.

3.2.3 Environmental Protection Agency

The principal environmental regulator is the Environmental Protection Agency, Guyana (EPA). This agency was given effect by the Environmental Protection Act of 1996 (the Act) and is mandated 'to provide for the management, conservation, protection and improvement of the environment, the prevention or control of pollution, the assessment of the impact of economic development on the environment, the sustainable use of natural resources.

EPA is the National Focal Point for three multilateral environmental agreements (MEAs): UN Convention on Biological Diversity (UNCBD), Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Area (Cartagena Convention), and Basel Convention.

As it relates to the Basel Convention, EPA takes measures to control the import, transit and export of hazardous waste in Guyana by granting of environmental authorisation based on the Prior Informed Consent Procedure and other principles of the Convention. Therefore, although not stated in legislation, the EPA does not encourage the import of waste, including e-waste, into Guyana.

As it relates to bringing operators in the informal sector into compliance, the EPA also works with the Scrap Metal Unit established under the Ministry of Tourism to identify and engage persons who should become authorised under the Act. Guidance is also provided to operators in order to mitigate negative impacts which their activities may have on human health and the environment.

3.2.4 Scrap Metal Unit, Ministry of Tourism, Industry and Commerce

The Scrap Metal Unit (SMU) appears to have had its origin in the Old Metal Dealers Act, Cap 91:08, first promulgated in 1900 (Ministry of Finance, 2015). The primary objective of the SMU is to "*strengthen the regulatory framework, taking into account international best practices and unique national circumstances, in order to adequately address the problems plaguing the scrap metal industry*" (Ministry of Tourism, Industry and Commerce, nd).

The 2015 forensic audit of the SMU (Ministry of Finance, 2015) revealed that while the functions of the unit are not outlined in legislation, the following functions are executed by the SMU:

1. Conducting daily inspections of scrap metal yards, which include ensuring they are all licensed; all scrap metal acquired is recorded in a register; the yards are appropriately secured; identification of illegally obtained scrap metal and taking note of any shipping containers on site during inspection.
2. Observing the loading process of scrap metal into containers to ensure that there is no illegal materials or substance is stuffed into containers for export.
3. Along with the Guyana Police Force and officials from Guyana Metal Recyclers Association, conducting investigations into vandalism and theft of scrap metal.
4. Verifying the type of metal being exported i.e., Ferrous & Non-Ferrous metals.

5. Checking for suspected vandalised metals e.g., manhole covers, electrical and telephone cables etc.
6. Ensuring containers that are packed in the legally approved yards, under inspection of the scrap metal unit are the ones being shipped.
7. Checking on “collection yards” for any suspected vandalised metals.
8. Observing the movement of scrap metal from collection yards to licensed yards.

3.2.5 EEE Importers/Distributors

Most of the EEE within the country are imported by distributors and retailers. Among the popular EEE importers/distributors are Unicomer Guyana (formerly Courts Guyana), Singer Guyana Inc , Guyana Telephone and Telegraph Company (GTT), Digicel Guyana, and Starr Computers Inc. Most importers/distributors are also retailers, and some are agents of certain brands of EEE.

A significant volume of EEE is imported by smaller electronics retailers, and—with the ease-of-purchase made possible by eCommerce—by individuals (consumers).

3.2.6 Waste Collectors/Dealers

The Ministry of Local Government and Regional Development (MLGRD), through its local government agents: municipalities, Regional Democratic Councils (RDCs) and Neighbourhood Democratic Councils (NDCs), contracts private waste handlers to collect, transport and dispose municipal and household waste at landfills. The largest share of waste collection is the responsibility of the State. The major municipal waste collectors, which are contracted to support the MLGRD are Cevons Waste Management and Puran Brothers Inc. However, other waste collectors are involved in this activity, thereby expanding the reach of waste collection to all ten (10) Administrative Regions in Guyana. Many commercial businesses also utilize State-sponsored waste collection or privately contract the aforementioned companies to support their waste collection. The waste collected is taken to one of the landfills or dumpsites in the relevant region.

As it relates to companies that manage e-waste, there are six (6) in total. Five (5) of these companies collect, transport and dismantle e-waste. Most of them are located on

the East Bank Demerara while one (1) is located in Georgetown. Of the six (6) companies, only one (1) is an exporter of e-waste and scrap metals (Eternity Investment Inc), which also has an office based in Georgetown.

Eternity Investment Inc is a privately owned scrap metal dealer established and has been operating in Guyana for thirteen (13) years. Having secured an Environmental Authorisation from the EPA, the entity is the only authorized local operator with the authority to handle, store and export ferrous and nonferrous metals and e-waste. Equipped with, *inter alia*, storage bond, equipment to compact scrap metal, forklifts, telehandlers, truck scale, and an office, the establishment occupies 4.33 acres of land at Madewini of the Linden-Soesdyke Highway. The Company has received duty free concession from the Guyana Revenue Authority for a number of equipment relevant to their business.

E-waste generators, such as the GRA, the University of Guyana (UG) and government agencies, place in storage for pickup by the company. Additionally, Eternity purchases e-waste and metals from scrap metal dealers in the formal and informal sector. Eternity uses trucks and shipping containers to transport e-waste (along with scrap metals). E-waste is shipped in 20 ft containers, each with the capacity to accommodate 20-28 Mt of e-waste. The major distinction between waste delivered by other scrap metal dealers and Government entities, is the level of dismantling done. E-waste received from other scrap metal dealers are already dismantled and materials of value are sold in a manner that is ready to be exported. On the other hand, e-waste received from Government entities need to be dismantled to remove materials of value. Further, no payment is made to Government entities for e-waste received.

Eternity exports scrap metals and e-waste to South Korea, Pakistan, Thailand, Taiwan, Malaysia, Vietnam, Spain, Belgium and other countries with the demand and feasible logistics to make the business viable. Based on the information provided for this project, it is estimated that approximately 2 shipments of e-waste occur annually. The transboundary movement of e-waste by Eternity is conducted in accordance with Basel Convention provisions. Prior Informed Consent (PIC), plus relevant importation approvals from importing countries, for instance, are honoured.

Data on export of different categories of e-waste and corresponding trade values was provided by Eternity Investment Inc., whose proprietor is a key stakeholder and a serving member of the National Working Group (NWG)[4] for this project.

3.2.7 Waste Generators/Disposers

These are, essentially, general consumers of EEE and e-waste generators: households, commercial entities, and industries.

Waste generators generally place commingled waste outside residences, business places, institutions, organisations and industries for collection by waste disposal companies. In some instances, and scrap metal collectors from the informal sector periodically traverse through residential areas using horse-drawn carts, to announce their interest in collecting e-waste.

Apart from GRA, which has bonds to hold its e-waste for collection, most state agencies generally stock e-waste in their yards or rooms until disposal is approved by their institutional arrangements, or simply put them out for disposal commingled with other types of waste. There is no standardised storage and separation system for recycling, resource recovery or treatment.

3.2.8 EEE Refurbishers/Repairers

These include persons and establishments that service, repair and upgrade EEE: small to large household appliances, and electronic devices (computers, tablets, mobile phones, wristwatches). Several refurbishers/repairers of EEE operate particularly in the capital city and in other municipalities, servicing individuals and establishments. They operate in clusters for the most part, and most of them are unregulated, operating without special certifications and even business registration.

3.2.9 Informal Actors

In the context of this project, informal actors refer to unregulated scrap metal dealers and operators, as well as persons who scavenge e-waste and scrap metals from landfills. While the Ministry of Tourism, Industry and Commerce has a Scrap Metal Unit

[4] The NWG was established to provide oversight and support to this e-waste assessment project. Members include the EPA, GRA, GNBS, MLGRD and Eternity Investments Inc.

for the purpose of regulating scrap metal export and there is an organised group of waste pickers at the Haags Bosch Sanitary Landfill, it is possible that some actors of this stakeholder grouping remain unregulated. Consequently, although there is no precise data on the total number of actors in the informal sector, and the share of e-waste export their operations represent, approximately seventy (70) recyclers (waste pickers), specifically operate from the Haags Bosch Landfill Site.

4 RESULTS OF E-WASTE INVENTORY AND MASS FLOW ANALYSIS FOR GUYANA & E-WASTE MANAGEMENT PRACTICES IN GUYANA

4.1 Estimation of EEE put on the Market (imports and exports)

A mass flow assessment (MFA), also referred to as materials flow analysis, is a systematic assessment of materials flows and stocks from source to final disposal, based on the mass balance principle, defined within space and time boundaries (Mohammadi et al., 2020). The MFA for EEE, attempted to trace the flow of these materials from import, through distribution, use, refurbishing, disposal, recovery, and export.

Since Guyana is not a producer of EEE, the estimation of e-waste quantities in Guyana, determined by the Market Supply (Put on Market) method, was therefore only dependent on import and export statistics for EEE published in the UN Comtrade database.

4.1.1 Import of EEE

The data retrieved from the UN Comtrade database showed that large household appliances accounted for the largest proportion of imports during the 13 years period. The total quantities of EEE from each category, imported during the period 2009-2021, is presented in **figure 3** below.

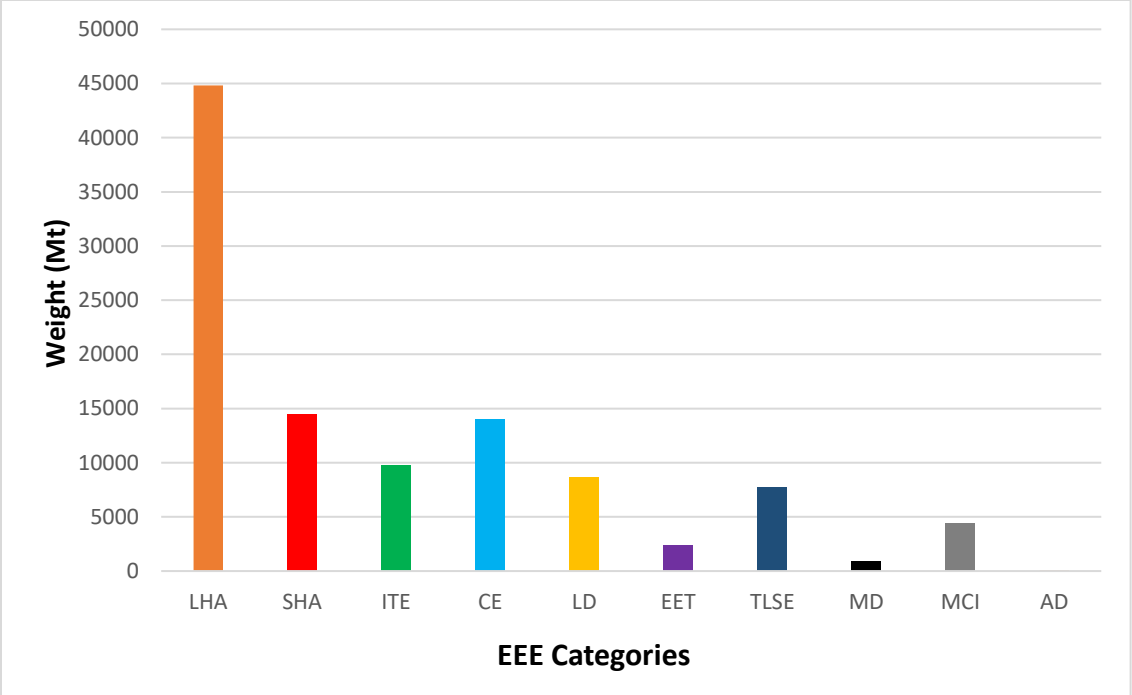


Figure 3: Total EEE by category imported into Guyana (2009-2021)

Large household appliances attributed the greatest portion of EEE imported accounting for approximately 42% of total imports. Small household appliances accounted for approximately 14% of all EEE imported, and was closely followed by consumer equipment, which accounted for approximately 13%. This finding is expected, since large household appliances are generally heavier than small household appliances. As such, even if a larger quantity of any other category of EEE was imported, the overall mass is not expected to be sufficient to replace large household appliances as the number one imported EEE on a mass basis.

On the other hand, the least imported EEE were automatic dispensers and medical devices, which collectively accounted for less than 1% of total EEE imported. This finding suggests that in the case of automatic dispensers, it is likely that a small quantity was imported, since the equipment contained in this category generally weigh more than EEE in other categories, which exceeded the quantity of automatic dispensers imported.

4.1.2 Export of EEE

Records of EEE exported from Guyana were also retrieved from the UN Comtrade database. As outlined in **table 3**, the total mass of EEE exported from 2009-2021 was 3,938 Mt. IT and Telecommunications Equipment represented the largest quantity of EEE exported, accounting for approximately 47 % of total exports from 2009-2021. This was followed by large household appliances (LHA) and monitoring and control instruments (MCI) which accounted for 26 % and 17 % respectively.

Table 3: Total Export of EEE by Categories (2009-2021)

Category of EEE*	Quantity Exported (Mt)
LHA	1,012
SHA	34
ITE	1,838
CE	200
LD	54
EET	84
TLSE	51
MD	1
MCI	664
AD	0

*LHA = Large Household Appliances, SHA = Small Household Appliances, ITE = IT and Telecommunications Equipment, CE – Consumer Equipment, LD = Lighting Devices, EET = Electrical and Electronic Tools, TLSE = Toys, Leisure and Sports Equipment, MD = Medical Devices, MCI = Monitoring and Control Instruments, AD = Automatic Dispensers.

Further analysis of export data showed that the largest quantity of exports was recorded in 2010, where the export of IT and telecommunications equipment accounted for 1,506 Mt, representing 38% of the total export of EEE from 2009-2021. This would have contributed to the IT and telecommunications equipment being the EEE category with the largest export quantity.

In general, no consistent trend is observed from export data since there have been fluctuations in the quantities of EEE exported in each category.

Since Guyana is not a manufacturer of EEE, enquires were made regarding the export of EEE, more specifically, seeking to determine what situations may have warranted exports of EEE from Guyana, such that both the GRA's ASYCUDA system and the UN Comtrade database were able to produce EEE export statistics.

The first observation was that the customs declaration documents for the export of e-waste from Eternity Investment Inc (Guyana's lone e-waste exporter), categorised a shipment using the commodity code 84485900 (machines; parts and accessories of machines; or auxiliary machines), although commodity codes with the series 8459 (electrical and electronic waste and scrap) could have been utilised instead. It is therefore possible that in many instances, e-waste shipments may have been assigned incorrect commodity codes that have caused them to be documented as EEE exports rather than e-waste exports.

Additionally, stakeholder consultations with the GRA revealed that there are no known cases of Guyana exporting EEE, as it is not a manufacturer of EEE. Therefore, the values recorded as exports were not a result of a direct shipment of new EEE from Guyana to other countries. In some cases, used EEE such as instruments requiring calibration and EEE imported for temporary use, such as and medical and mining equipment rented for specific, short-term activities, are categorised as exports when being re-exported to manufacturers or distributers; however, information concerning the condition of the EEE (new or used) and the purpose of export, cannot be extracted from ASYCUDA or UN Comtrade.

Considering that the export statistics are necessary to deduce the amount of EEE that remains in Guyana until its end of life, the grouping of transit, re-exported, misrouted and rejected shipments of EEE under the exports category, is likely to have resulted in an inaccurate representation of the quantity of EEE exported and an underestimation of the EEE POM.

4.1.3 EEE Put on Market (POM)

The supply of EEE for distribution, consumption and use on the market, describes the EEE POM (Mohammadi et al., 2020). The quantity of EEE POM is the difference between the sum of EEE imported and EEE produced locally, and the EEE exported from Guyana, i.e.,

$$POM = Import_{(t)} + Domestic\ Production_{(t)} - Export_{(t)}.$$

Since domestic production of EEE is non-existent in Guyana, the EEE POM is approximately equal to the physical trade balance. Therefore, in this instance:

$$POM = Import – Export$$

Table 4 shows the POM quantities for each category of EEE from 2009-2021.

Table 4: EEE POM in Guyana (2009-2021)

EEE Category*	EEE POM (Mt)													
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	TOTAL
LHA	1,704	2,433	2,964	3,481	2,885	2,877	3,287	3,362	3,432	3,975	3,980	4,132	5,301	**43,813**
SHA	764	623	816	874	1,016	1,011	1,023	1,144	1,261	1,587	1,451	1,250	1,608	**14,428**
ITE	750	-739	991	1,032	872	699	658	722	817	606	576	473	438	**7,895**
CE	729	862	1,129	1,199	993	826	896	1,120	1,373	1,316	946	1,026	1,395	**13,810**
LD	373	460	610	567	633	790	635	850	754	867	799	577	684	**8,599**
EET	93	120	165	167	174	120	114	178	83	141	278	261	420	**2,314**
TLSE	405	433	588	631	664	530	540	628	784	940	766	639	871	**8,419**
MD	6	19	65	624	75	85	156	118	104	73	61	2	44	**1,432**
MCI	88	106	84	71	243	105	130	596	515	916	1,133	146	159	**4,292**
AD	0	1	5	4	0	1	2	3	1	1	2	0	5	**25**
TOTAL	**4,912**	**4,318**	**7,417**	**8,650**	**7,555**	**7,044**	**7,441**	**8,721**	**9,124**	**10,422**	**9,992**	**8,506**	**10,925**	

*LHA = Large Household Appliances, SHA = Small Household Appliances, ITE = IT and Telecommunications Equipment, CE – Consumer Equipment, LD = Lighting Devices, EET = Electrical and Electronic Tools, TLSE = Toys, Leisure and Sports Equipment, MD = Medical Devices, MCI = Monitoring and Control Instruments, AD = Automatic Dispensers.

Large household appliances, accounted for the largest share of EEE, placed on Guyana's market. This accounted for approximately 42% of the total EEE POM from 2009 to 2021. Small household appliances and consumer equipment were responsible for 14 % and 13 % of EEE POM respectively.

On the other hand, automatic dispensers accounted for the smallest quantity of EEE, by weight, POM, accounting for 0.02% of EEE POM.

In 2010, the quantity of IT & Telecommunications Equipment POM, was -739 Mt, indicating that for this particular year the export of this category of EEE exceeded its import. It is possible that this occurrence may have been the result of a large transit, misrouted, or rejected shipment of IT & Telecommunications Equipment in 2010, or a combination of these.

Figure 4 shows that there were fluctuations in the quantity of EEE POM, until 2014, where there was a steady increase until 2019.

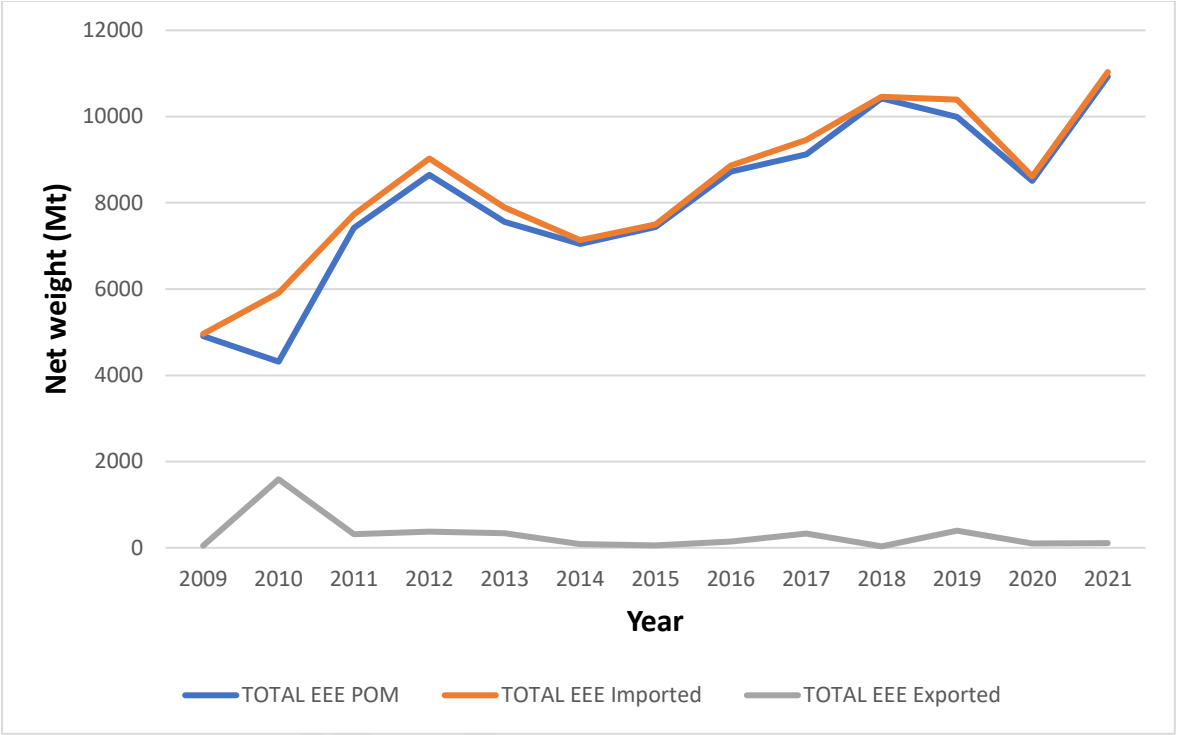


Figure 4: A comparison of total EEE Imported, Exported and POM in Guyana (2009-2021)

In 2019, there was a decrease in total EEE POM, as a result of a corresponding decrease in total imports and exports of EEE. This observed change may be attributed to the COVID-19 pandemic, which saw restrictions to shipping and general disruptions in the shipping industry, including the prioritisation of shipments of critical health and safety equipment and materials.

4.2 E-waste Generation Practices

The rate of e-waste generation involves many players, and is greatly influenced by factors such as gloablisation, advancement in technology, affordable pricing even with additional features and decreased lifespan of equipment (Vats & Singh, 2014). The rise in e-waste generation globally has been attributed to factors such as swift evolution in technology, increased purchasing power and an elevated rate of planned obsolescence (Luhar & Luhar 2019; Mohammadi et al., 2020).

4.2.1 Generation of E-waste by Public Sector

All public sector/ government agencies are required to procure EEE in accordance with the Procurement Act, 2003 and dispose them at their end of life in accordance with the provisions of the Stores Regulations, 1993.

At the end of life of the EEE, the Ministry of Natural Resources (MNR), for example, stores the e-waste until it can be collected for disposal. Disposal is guided by a Standing Board of Survey and is disposed at the Haags Bosch Sanitary Landfill.

The GRA follows a similar procedure for disposal. E-waste is stored at a bonded area until it can be collected for environmentally sound management. As of 2021, the EPA requires that ministries and statutory agencies submit a list of items to be disposed of, so that guidance can be provided on the environmentally sound management and disposal of the different waste streams. GRA has complied with this requirement.

The GRA, as the customs authority sometimes have unclaimed EEE in its possession. After one month, the unclaimed EEE are not disposed as e-waste, but rather through donations to charitable organisations and via public auction.

The procedures outlined by the aforementioned state agencies, are similar to that required under local law, for the disposal of serviceable uneconomical and unserviceable assets.

Government agencies usually store e-waste in designated rooms or open areas before they can be collected for disposal. However, this practice may result in e-waste being

stored by for indefinite periods. The EPA, for example, provided a list of disposed assets, which had accumulated and was awaiting disposal since 2010. The GRA, however, has dedicated storage facilities and liaises with the EPA for guidance on how items are to be disposed. GRA also indicated that e-waste is usually collected by Eternity Investment Inc for management.

Due to inadequacies in record-keeping, the specific types and quantities of e-waste generated by all government entities engaged for this project, could not be provided. For example, while the EPA was able to produce a list of assets disposed in 2019, there were no records of their weight, or how long they were used prior to their end of life. Nevertheless, GRA and the MNR, were able to provide insight into the quantity of e-waste generated in 2021 and average quantity generated from 2019-2021, respectively (**table 5**).

Table 5: E-waste generated by MNR (2019-2021) and GRA (2021)

Category of EEE*	Average Annual Quantity of E-waste Generated by MNR (Mt)	Quantity of E-waste Generated by GRA in 2021 (Mt)
LHA	0.3	0
SHA	0.05	0.3
ITE	0.1	0.07
CE	0.1	0
LD	0.05	0
EET	0.2	0
TLSE	0.1	0
MD	0.1	0
MCI	0.5	0.1
AD	0	0.02
Total	**1.5**	**0.4**

*LHA = Large Household Appliances, SHA = Small Household Appliances, ITE = IT and Telecommunications Equipment, CE – Consumer Equipment, LD = Lighting Devices, EET = Electrical and Electronic Tools, TLSE = Toys, Leisure and Sports Equipment, MD = Medical Devices, MCI = Monitoring and Control Instruments, AD = Automatic Dispensers.

The quantities of e-waste generated at government entities are expected to vary based on the size and nature of operations. While it appears that the e-waste generation rate for MNR exceeded the GRA's, this may not be a true representation of the e-waste generation rates, since the GRA is a much larger organisation and is more likely to generate more e-waste annually. Additionally, the GRA's data represents e-waste generation in a single year, while MNR's represents an average over three years. A conclusion on which entity generates more e-waste would have required comparison of data over the same period.

Furthermore, data provided by GRA and MNR was not statistically representative of the public sector in Guyana and could not be extrapolated to produce reliable data on e-waste generation in the country's public sector.

4.2.2 Generation of E-waste by Households

Electronic surveys were distributed to gather information on consumption and use from commercial entities and per household as part of the mass flow of EEE. However, although more than 100 electronic surveys were distributed directly and placed on social media platforms, only 43 responses were returned, and all respondents were representatives of households. The low response rate meant that extrapolation could not be achieved, even if additional census data was also utilised. Nevertheless, the survey provided insight into, among other things, the respondents' view of e-waste and their willingness to be involved in its recycling.

As depicted in **figure 5**, more than 80% of the respondents, reside in region 4, in which the capital city, Georgetown is located, while the remaining 20% of the respondents resided in three (3) of Guyana's ten (10) administrative regions. This therefore means, the conclusions drawn from this survey, may not be an accurate representation of the national perspective, since feedback and opinions of consumers in six (6) of the country's administrative region were not considered.

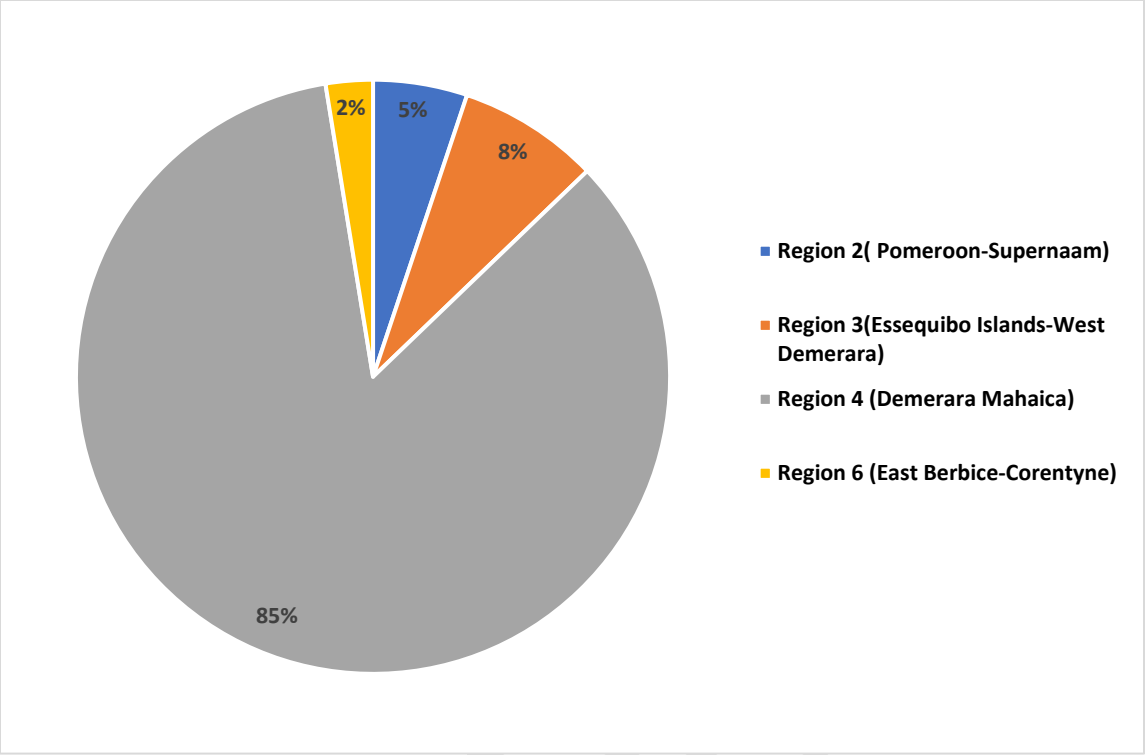


Figure 5: Distribution of respondents by administrative region

As it relates to the collection of waste, 86% of the respondents were beneficiaries of weekly waste collection services, while for 12%, waste was collected fortnightly. Although waste collection and disposal services are provided by four (4) entities (Puran Brothers Disposal Services, Cevons Waste Management, the Mayor and City Council and C& N Trucking Services), Puran Brothers Disposal Services and Cevons Waste Management were identified as the primary service providers for twenty-one (21) and fourteen (14) households respectively. In some cases, fees were charged by Puran Brothers Disposal Services, based on the volume of waste collected for disposal. The respondents who were not required to pay a fee for collection, are likely to be residents of communities which receive waste collection services, paid for by the Government of Guyana, through the Mayor and City Council and the NDCs.

Source segregation of household food waste was only practiced among 5 % of the households. No other type of waste was separated at source. This is an important factor to note, since it suggests that most household e-wastes are comingled with municipal waste, and according to 91% of the respondents, taken to the Haags Bosch Landfill Site

for disposal. **Figure 6** below presents an illustration of the reasons why waste is not segregated at source, the primary one being that there are insufficient waste receptacles to do so. Other reasons included the fact that it was not a requirement, lack of public awareness and absence of incentives for sorting waste.

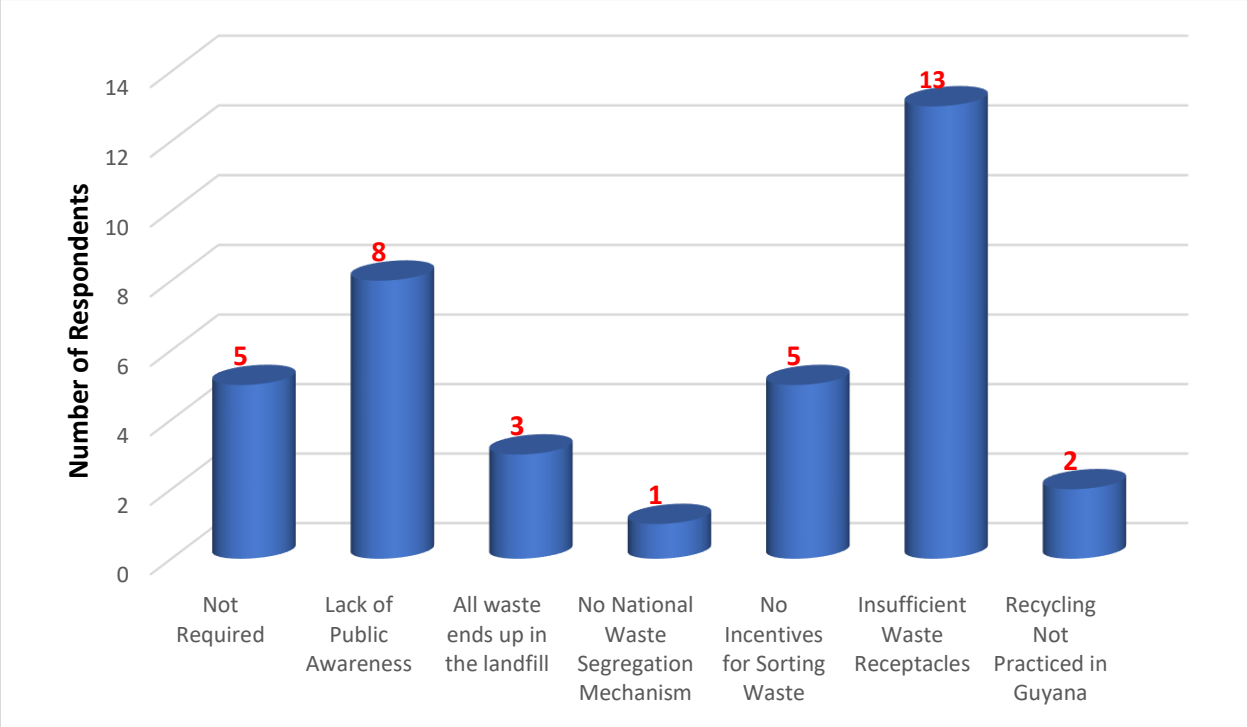


Figure 6: Reasons for the absence of waste segregation at source

Respondents were asked to provide information concerning the quantity of each category of EEE disposed over the last 3 years (2019-2021). While this information could not provide insight into the lifespan of these EEE due to the absence of critical information such as the date of acquisition and condition when acquired (new versus used), a cursory comparison of the e-waste generation quantities among the ten categories of EEE was made and the result of this is depicted in **figure 7**.

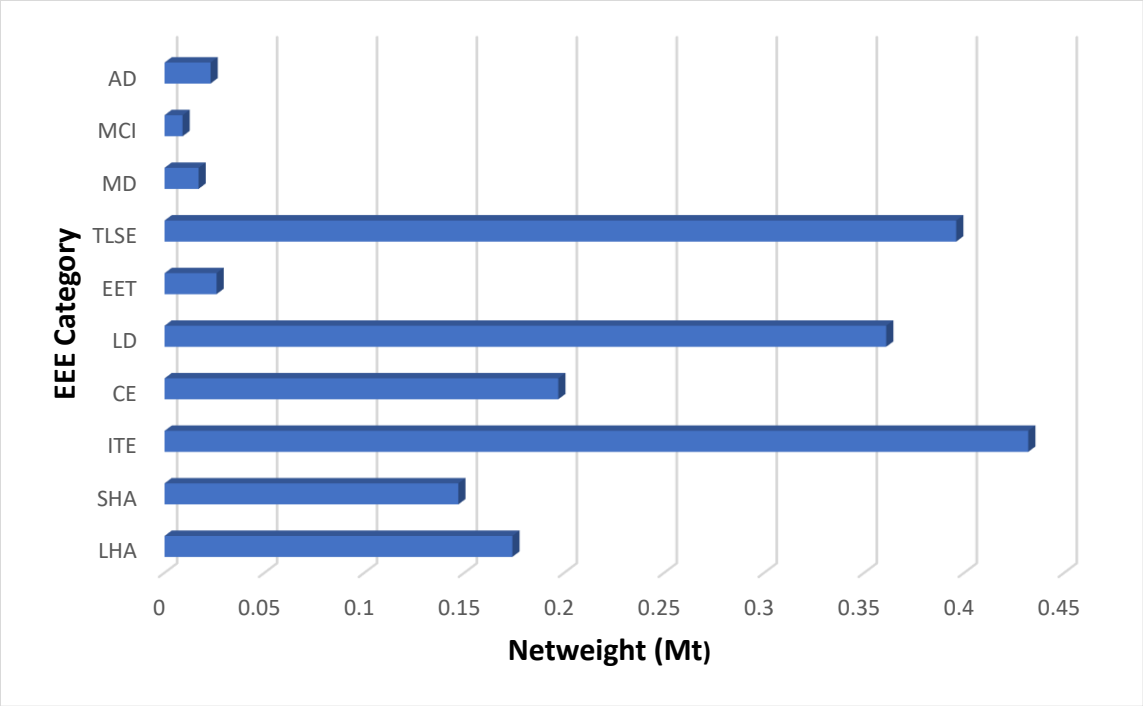


Figure 7: Average annual household e-waste generation (2019-2021)

Unlike the previous trends observed, where large and small household appliances were the most predominant category of EEE imported or POM, the household survey showed that IT and telecommunications equipment, toys, leisure and sports equipment and lighting devices were the major categories of EEE disposed over the last three (3) years, accounting for 24%, 22% and 20% of total e-waste generated from the households surveyed. Apart from user habits, the lifespans of these three (3) categories of EEE could have resulted in the observed trend since these EEE are the ones with the shortest lifespans, and respondents were asked about EEE disposed over the last three (3) years. As would be expected from a household survey, medical devices and monitoring and control instruments were the least generated e-waste type and collectively represented only 2% of e-waste disposal from the households.

Approximately 95% of respondents believed that there was a potential for e-waste recycling in Guyana. In an effort to promote the reuse/recycling of e-waste, 34% respondents indicated that they would be willing to coordinate with collection companies for pickup of e-waste and 24% indicated their willingness to sort e-waste. An equal

number of respondents (17%) expressed their willingness to take e-waste to a recycling facility and to pay a fee for e-waste recycling. The least preferred areas of involvement were participation in awareness and youth campaigns and seeking passage of legislation and receiving incentives for recycling of e-waste, which collectively documents the responses of 5% of the respondents.

Recommendations for improvements in Guyana's e-waste management sector were suggested by ten (10) respondents. Some of these included strengthening and enforcement of legislation (**3**); improved education and awareness (**3**); building a recycling plant (**2**) and prescribing penalties for improper management of e-waste (**2**).

4.2.3 E-waste Generation by the Private Sector

Although specific information was not collected for the private sector in terms of quantity of e-waste generated, information on the general e-waste disposal practices which are similar to government agencies, has been documented in section 2.3. It may be important therefore to consider a special project to gain more specific feedback on this matter of e-waste management from the private sector to determine whether there are any distinct peculiarities governing them.

4.3 E-waste Management Practices

In Guyana, there are no facilities which conduct environmentally sound recycling and recovery of metals and the hazardous chemicals found in e-waste. However, pre-recycling activities, primarily dismantling and sorting, are undertaken by scrap metal dealers, waste pickers and waste management facilities in both the formal and informal sectors. One company is currently authorised for the export of e-waste, which is the main mechanism via which environmentally sound management of e-waste occurs in Guyana. Useful materials captured through dismantling are therefore traded through this company.

As denoted by the household survey, e-waste may also be comingled with municipal waste and as a result, ends up at the Haags Bosch Landfill Site, and other dumpsites across the country. The sections below discuss the local e-waste management practices among key players in the sector.

4.3.1 Management of E-waste by the Informal Sector

In many developing countries, collectors of recyclable materials are commonly referred to as 'waste pickers' and are grouped as members of the informal recycling sector. In Guyana, waste pickers operate at the Haags Bosch Sanitary Landfill Site and dumpsites located in Lusignan and Esplanade, New Amsterdam. The informal recycling sector is the term generally used to describe recycling activities which are unregulated by government. In the context of solid waste management, the informal sector refers to individuals, families, and micro-enterprises working in waste management services, such as recycling, whose activities are neither organised, sponsored, financed, contracted, recognised, managed, taxed, nor reported upon by the formal solid waste authorities (Scheinberg et al, 2010). By virtue of Scheinberg's 2010 definition of the informal sector, those operating out of the Haags Bosch Landfill Site, which are discussed below, should not be considered as part of the informal sector, since they are recognised by government and operate within an organised structure. However, given that many of the actors in this group are not regulated by the EPA or the Scrap Metal Unit, their operations are being discussed in this section.

The GT Recyclers Cooperative Society Limited (also referred to as GT Recyclers), a group comprising approximately seventy (70) recyclers, is a formal organisation which operates at the Haags Bosch Landfill Site. The group functions as a third-party operator at the landfill, approved by the MLGRD. The Contractor of the site, Waste Solution Landfill Inc, is responsible for landfill management, and has also been given general oversight for the group. The Contractor is required to enforce site rules, settle disputes and implement disciplinary action; however, GT Recylers is governed by a management

committee comprised of recyclers from the group. This management committee includes designations such as a President, Secretary and Treasurer.

Waste picking at dumpsites in Guyana existed well before the establishment of the Haags Bosch Landfill Site. Prior to its closure in 2011, recyclers operated at the Mandela Avenue Dumpsite in the city. Recognising that the closure of the Mandela Dumpsite would create socioeconomic impacts, the Government of Guyana was tasked with deciding whether the recyclers were going to be compensated for lost earnings or be allowed to operate from the newly developed landfill site. Government decided on the latter and the group was formally initiated as part of a process which saw the transition of waste disposal from the Mandela Avenue Dumpsite to the Haags Bosch Sanitary Landfill Site. During this transition, basic biodata was collected for recyclers as part of a registration process, and the recyclers were issued with identification cards.

While e-waste recycling can be a lucrative endeavour, the health hazards associated with illegal or improper e-waste management, especially in the informal sector, continues to be a cause for concern due to the direct and indirect health and environmental impacts that may result (Mohammadi et al., 2020; Patil & Ramakrishna, 2019). As such, stringent operational and occupational health and safety mechanisms are implemented at the Haags Bosch Landfill Site. For example, recyclers are only allowed to operate during the landfill's official hours of operation (07:00 -18:00 h); are required to be fully covered, attired in reflective vests and safety boots, and are prohibited from entering areas of the site apart from the landfill's tipping face and pickers' shed and its immediate environs. Photographs of the pickers' shed and area used to store recovered recyclables are presented in **figures 8 and 9** respectively.

Figure 8: Pickers' shed at Haags Bosch Landfill

Figure 9: Designated area for storage of recovered recyclables

Prior to the onset of COVID-19, the recyclers were assigned medical cards through the Ministry of Health and were afforded monthly medical check-ups.

The GT Recyclers are critical players in the management of e-waste. In fact, one of the members of the group, the proprietor of N&S Enterprise, is an authorised operator of a scrap metal yard. This company has been identified in the past as one of the suppliers of e-waste to Eternity Investment Inc. The members of the group sort and dismantle e-waste and used EEE using simple tools such as other pieces of scrap metal, screw drivers and hammers when available. The e-waste recovered is sold to N&S Enterprise and other recyclers. N&S Enterprise has designated a particular area on site where scrap metal, including e-waste waste purchased from the recyclers, are stored until it accumulates enough for offsite transport to their scrap metal yard.

The GT Recyclers also sell e-waste to EEE repair technicians, who may be seeking a specific part of the disposed items, to facilitate repair and refurbishment of damaged EEE. Materials remaining after dismantling and removal of valuable materials from discarded EEE, such as those depicted in **figure 10** are disposed at the landfill.

Figure 10: Waste materials destined for disposal at the landfill after dismantling

As observed in other entities engaged on this project, little to no records specific to e-waste generation are kept. While the contractors record of the amount of waste entering the landfill site, this measurement is conducted for an entire load of waste and does not apportion the contribution of e-waste in the usually mixed load. In rare cases, documentation of discarded EEE entering the landfill is done when a single load of these discarded materials originates from private sector or government entities. Nevertheless, efforts are made to record the quantity of recyclable materials leaving the site; however, this is categorised generally (e.g., ferrous, nonferrous, wood, bottles) without specific mention of e-waste. **Table 6** below shows the categories of recyclable materials commonly retrieved from the municipal solid waste stream and the prices at which the recyclers at the Haags Bosch Landfill Site sell them.

Table 6: Selling price (per ton) of recyclable materials retrieved from the landfill

Recyclables	Cost per pound (GY $)	Cost per ton (GY $)	Cost per ton (US $)
Ferrous Metals	6	13,228	61
Copper	200	440,925	2,046
Aluminium	40	88,185	409
Brass	100	220,462	1,023
Motors	25	55,116	256
Batteries	40	88,185	409

Although no specific information in terms of quantities have been provided, the GT Recyclers evidently play a critical role in the e-waste mass flow. In addition to providing a source of full-time employment for most of its members, which comprises approximately 50% male and 50% female, the group has been key in essentially diverting valuable waste from the landfill, which is expected to reach capacity sooner

than expected, due to the rapid development Guyana is currently experiencing, and the commensurate increase in waste generation from the oil and gas sector.

It is clear that the GT Recyclers play a critical role in the e-waste management system; therefore, policies and legislation must, in addition to highlighting the risks associated with the informal sector, be cognisant of their socioeconomic and environmental contributions.

4.3.2 Management of E-waste by Authorised Scrap Metal Dealers

The EPA is legislatively required to authorise facilities that engage in activities with potential human health and environmental risks and are therefore responsible for issuing permits to all operators of scrap metal yards. On the other hand, the SMU is responsible for registering both scrap metal yards and dealers/exporters of scrap metal (images of application forms have been included in Appendix 6). Therefore, it is possible that some persons involved in the trade, may only be registered as a dealer/exporter without being the proprietor of a scrap metal yard. However, proprietors of scrap metal yards must also be registered as a dealer and/or exporter whichever is applicable.

The distinction in registration requirements is one of the reasons why the EPA only has 6 authorised scrap metal dealers in its database. An official list of scrap metal operators, registered with the SMU was requested; however, while this information was not provided by SMU, the GRA shared a 2021 list of scrap metal yards and temporary loading sites, which comprised a total of seventeen (17) records. Therefore, a disparity in registrants exists at the EPA compared to the SMU, since scrap metal collection is not an activity currently authorised by the EPA.

A total of five (5) authorised scrap metal dealers were contacted first via telephone, and subsequently email, to provide information such as the quantities of e-waste collected, dismantled, in storage and sold. N&S Enterprise was responsive and agreed to a telephone interview. Since this company was identified as a major purchaser of the e-waste generated at the Haags Bosch Landfill Site, this interview was seen as crucial to

possibly understanding the role of scrap metal dealers in the e-waste management system.

N&S Enterprise receives approximately 70% of their e-waste, which is comprised primarily of central processing units (CPUs), from the Haags Bosch Landfill Site, while the remaining 30% is received from a combination of other sources, including residents.

While the company could not estimate what proportion of the stockpiled scrap metal was e-waste, approximately 25 Mt of scrap metal (inclusive of e-waste and the valuable components) have been purchased over the last five (5) years and continues to be stockpiled at the scrap metal yard as the company awaits an opportunity for export. N&S Enterprise has had some difficulty securing buyers overseas, since many prefer to purchase one (1) type of e-waste in a single container as opposed to purchasing a container of mixed e-waste. In addition, some shipping lines have discontinued the export of scrap metal since some countries, e.g., Panama, have disallowed the transit of scrap metal shipments.

It was clarified that the main component of e-waste sold to Eternity Investment Inc a few years ago, was circuit boards from television and computer monitors. The decision to make this sale to Eternity Investment Inc was triggered by the fact that a buyer required a specific type of circuit board, but the quantities stored at N&S Enterprise and Eternity Investment Inc was only able to meet the buyer's demand when combined. Locally, circuit boards are sold at approximately US $ 312 per ton.

During the dismantling process, waste is generated and disposed at the Haags Bosch Landfill Site, since there is no market for materials such as plastics and rubber which are recovered from the dismantling process. The largest volume of waste destined for the landfill is generated from appliances such as refrigerators, since 70-80% of the item requires disposal as only the motor and aluminium tubing are considered valuable to the e-waste sector. On the other hand, there is a market for approximately 95% of air conditioning unit parts, such as copper, the iron frame, radiator, and motor. The mesh and rubber parts of air conditioning units account for the 5% of waste materials which are disposed at the landfill after dismantling.

4.4 Estimated E-waste Inventory

The lack of sound data management systems in Guyana, particularly as it relates to keeping records of EEE used and e-waste generated, meant that reliance on local data for the estimation of e-waste generation was almost impossible. Notwithstanding, e-waste generation was estimated using the Put On Market (POM) method.

4.4.1 Put on Market (POM) Method

While national data on EEE POM and their lifespans is preferred, the paucity of available data meant that EEE POM was calculated from an international database (UN Comtrade), and the lifespans for each category was provided by the Environmental Economist, based on the average lifespan of each category of EEE for the Caribbean. The amount of EEE POM in Guyana was presented in Section 4.1.3, and was used to determine the quantity of e-waste generated for each EEE category from 2019-2021, as presented in **table 7**

Table 7: E-waste Generated from 2019-2021

Category	E-Waste Inventory (Mt)		
	2019	**2020**	**2021**
LHA	2,433	2,964	3,481
SHA	1,016	1,011	1,023
ITE	699	658	722
CE	993	826	896
LD	635	850	754
EET	174	120	114
TLSE	540	628	784
MD	6	19	65
MCI	88	106	84
AD	0	1	5
TOTAL	**6,584**	**7,183**	**7,928**

*LHA = Large Household Appliances, SHA = Small Household Appliances, ITE = IT and Telecommunications Equipment, CE – Consumer Equipment, LD = Lighting Devices, EET = Electrical

and Electronic Tools, TLSE = Toys, Leisure and Sports Equipment, MD = Medical Devices, MCI = Monitoring and Control Instruments, AD = Automatic Dispensers.

The total e-waste generated over the three (3) years period increased steadily, with a 9 % and 10 % increase from 2019-2020 and 2020-2021 respectively. Large household appliances contributed the highest proportion of e-waste generated, with 37% apportioned in 2019 and 44% in 2021. Small household appliances accounted overall for 19% of total e-waste generated over the three (3) years. Automatic dispensers and medical devices were the lowest contributors to e-waste generation accounting for 0.03 % and 0.4 % respectively.

Projections for e-wate generation in 2022 and 2023 are depicted in **figure 11**. This shows that e-waste generation continues to increase, with quantities reaching 9,247 Mt in 2023.

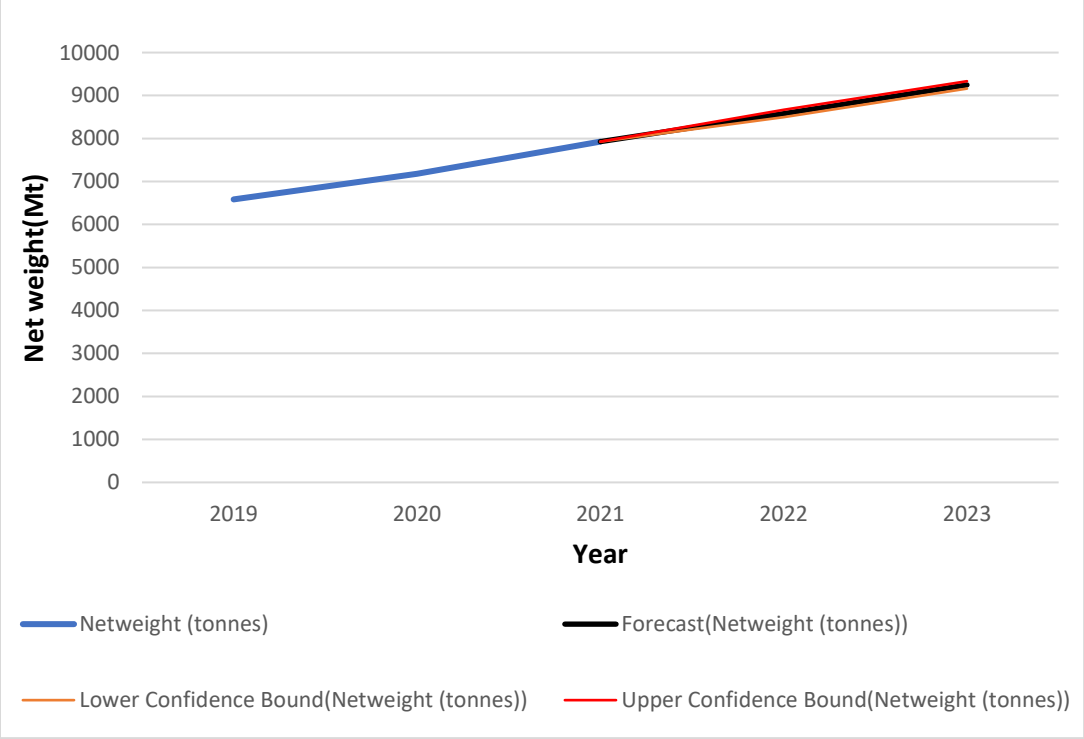


Figure 11: E-waste estimates for 2019-2021 and forecasted estimates for 2022 and 2023.

The Global E-waste Monitor 2020 estimated that in 2019, e-waste was generated globally at a rate of 7.4 kg per capita (Forti, et al 2020). Further, Mohammadi et al. in their study, forecasted the e-waste generation rate in five (5) Caribbean countries in 2025. Aruba was identified as having the highest e-waste generation rate with an estimated 30 kg per capita. This was followed by Barbados, Trinidad and Tobago and Grenada with an e-waste generation rate of 20, 18 and 17 kg per capita. Jamaica was forecasted to have the lowest e-waste generation rate with an estimated 7 kg er capita by the end of 2025. The population size and level of affluence were factors which accounted for differences in e-waste generation in the countries studied (Mohammadi et al., 2020).

Considering Guyana's population over the last three (3) years, the e-waste generation rate was estimated to be 8, 9 and 10 kg per capita in 2019, 2020 and 2021 respectively. Guyana's population for 2019 and 2020 were taken from the World Bank's global population data, while the population for 2021 was estimated using a 0.5 % growth rate recorded in 2020 (World Bank, 2022).

Some of the assumptions made in the estimation of e-waste generation were that all EEE becomes e-waste at the end of the suggested lifespan and that all commodities within a specific category will come to its end-of-life after being in use for the same number of years. In reality, different types of EEE in each category are likely to have different lifespans.

One of the concerns of Guyana's trade in EEE is that the country has no prohibition on importation of used EEE. Consequently, the lifespan of EEE in Guyana can be expected to be considerably shorter than in countries that produce EEE, and those that prohibit import of used EEE. The importation of used EEE such as IT and telecommunications equipment and lighting devices with inherently short lifespans, would shorten their lifespan in Guyana even further. Therefore, such devices could become e-waste in a shorter time than originally estimated. Consequently, the generalisation of the lifespan of an entire category will contain some inaccuracies

4.5 Export of E-waste by Eternity Investment Inc

Eternity Investment Inc is the country's only EPA-authorised exporter of e-waste, and one of the more organised scrap metal operations. This company has been involved in the scrap metal recycling industry for thirteen (13) years and has been able to generate sufficient income and create employment opportunities. There are currently twelve (12) members of staff, excluding the proprietor, with academic qualifications ranging from secondary education to Bachelor's Degrees.

Approximately 70% of e-waste comes from urban areas, with an even split between residential sources and commercial/industrial sources. E-waste is also received from as far as region 9, located approximately 422 km from the capital city. Although some e-waste is picked-up from disposers, most of the e-waste is received by drop off method apart from those collected from some government agencies. In instances where e-waste is picked up from an entity, dismantling would usually occur at the collection site, and only the valuable components are transported to Eternity's scrap metal yard. These companies therefore have the responsibility of disposing the unwanted parts of dismantled EEE, which is primarily taken to the Haags Bosch Landfill Site.

A report examining the informal recycling sector in developing countries, noted that due to the large volumes of processed e-waste demanded by industry, there is generally no direct purchase of e-waste from waste pickers. Instead, middlemen purchase from waste pickers, and after some sorting, cleaning and processing, sell the materials to scrap metal dealers, who in turn sell to industry. The report further highlighted, that due to the way the sector is structured, the middlemen usually earn large profits, and waste pickers are paid very little (Medina, 2008).

While the sector is organised similarly in Guyana, and the waste pickers are the lowest paid in the recycling chain, an examination of the selling and purchasing prices of e-waste components contained in this report will show that the earnings of middlemen, do not far exceed the earnings of waste pickers at the landfill. This may be because the group is well-structured and recognised by the Government of Guyana.

Eternity Investment Inc has no direct interaction with the GT Recyclers; however, e-waste is received from scrap metal collectors and dealers, who purchase scrap metal from the GT Recyclers, at the landfill. Eternity Investment purchases scrap metal (inclusive of e-waste) from dealers, who are most times exporters, in instances where they are unable to accumulate enough valuable components to meet a buyer's demand. On the other hand, collectors are those individuals who use purchase e-waste from the GT Recyclers, and also go house to house with horse carts and canters to collect obsolete EEE from residents. These are delivered to Eternity Investment Inc for sale.

While information was not provided on the purchase price of specific types of e-waste, it was estimated to be 80% of the selling price of ferrous and non-ferrous metals. As such, ferrous and non-ferrous metals are purchased at a rate of USD $96-320 per ton and USD $ 240-1200 per ton respectively.

All the e-waste recovered from end-of-life EEE, is exported to countries such as South Korea, Pakistan, Thailand, Taiwan, and India for recycling/recovery. However, waste is usually stockpiled until enough has accumulated to meet quantities agreed contractually by both the exporter and importer. Since the buyers of the e-waste are usually third parties in the importing countries, no certificate of destruction or recovery is provided to Eternity Investment as proof of environmentally sound disposal of the e-waste.

The quantities and corresponding values of five (5) categories of e-waste exported by Eternity from 2019 to 2021, is depicted in **table 8**.

Table 8: Quantity of e-waste exported form Eternity Investment Inc (2019-2021)

Category	E-Waste Exported (Mt)		
	2019	**2020**	**2021**
LHA	3	2	5
SHA	1	0.5	2
ITE	2	3	2

CE	0.2	0.5	1.5
LD	0	0	0
EET	40	30	50
TLSE	0	0	0
MD	0	0	0
MCI	0	0	0
AD	0	0	0

*LHA = Large Household Appliances, SHA = Small Household Appliances, ITE = IT and Telecommunications Equipment, CE – Consumer Equipment, LD = Lighting Devices, EET = Electrical and Electronic Tools, TLSE = Toys, Leisure and Sports Equipment, MD = Medical Devices, MCI = Monitoring and Control Instruments, AD = Automatic Dispensers.

Since Eternity Investment Inc does not export second-hand EEE, the figures presented in the table represent the weight of valuable components exported (e.g. motors, radiators, circuit boards, copper and aluminium parts) which were retrieved from each category of EEE, after dismantling.

The largest quantity of materials of value exported, was derived from electrical and electronic tools, which accounted for 84 % of total exports from 2019-2021. E-waste derived from the dismantling of consumer equipment accounted for 2% of e-waste exported during the same period.

A 22% decline in e-waste export was observed in 2019. In addition to the COVID-19 Pandemic, and associated shipping challenges, this decline is likely to have been influenced by a closure of the scrap metal trade in September 2020. In contrast, the 40% increase in e-waste exported in 2021, is most likely the result of the reopening of the scrap metal trade in April 2021, and the fact that scrap metal operators had accumulated more e-waste during the closure of the trade.

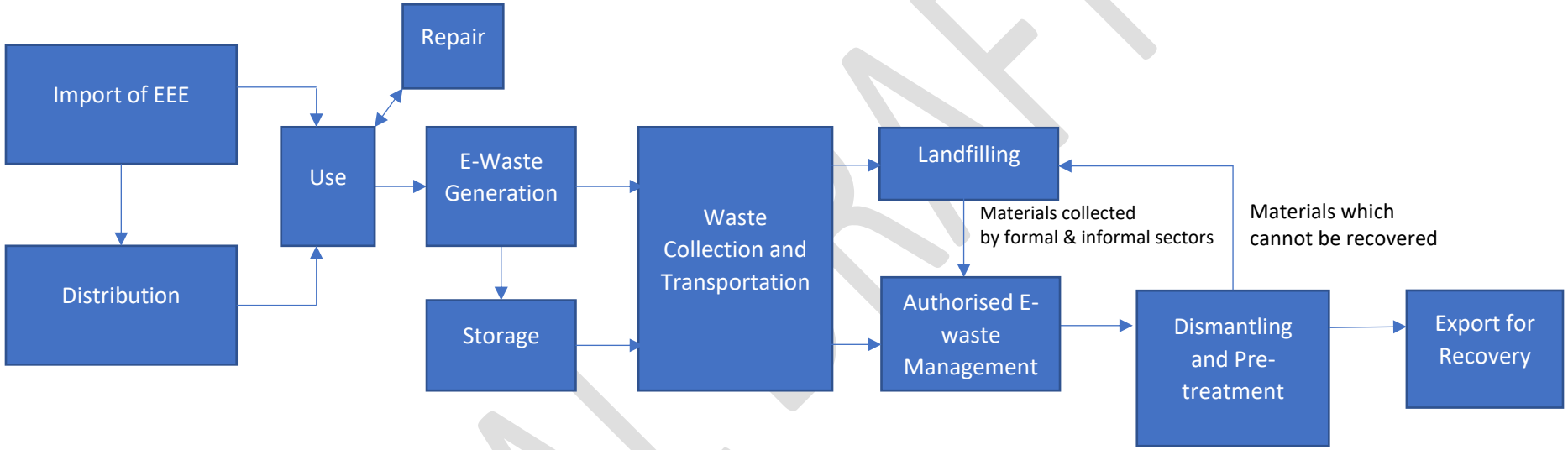
Overall, while it may appear that less than 1 % of Guyana's e-waste was exported, the quantities exported only represent the valuable components of end-of-life EEE and not the entire equipment. The values presented for e-waste generation is a representation

of the entire weight of the EEE and therefore the exports cannot be reasonably compared on a percentage basis. Furthermore, Eternity Investment only records the weight of valuable components for which payment must be issued, and not the entire EEE.

4.6 Final Disposal of E-waste (local practices/solution)

The flow of materials presented in **figure 12** is based on data obtained for the period 2019 to 2021.

Figure 12: Diagram showing Flow of EEE in Guyana



In summary, EEE is imported and distributed for use by consumers. In some cases, EEE may be repaired to extend its lifespan; however, once e-waste is generated, its disposal is dependent on the generator. It may either be stored for long periods before collection and transport to an authorised e-waste management facility, as is usually done in the public sector, or it may be comingled with other waste streams and collected and transported to the landfill or a dumpsite. Some of the e-waste reaching the landfill and dumpsites may be salvaged by the formal sector (specifically the GT Recyclers) and informal sector (unregistered waste pickers operating at dumpsites), where e-waste is dismantled to obtain materials of economic value, such as critical metals. These are sold to authorised facilities or dealers and consolidated with other materials of recoverable value which would have already been collected. Materials which are considered to be of no value

are returned to the landfill and dumpsites for final disposal, while materials which can be recovered are usually exported for financial gain.

Table 9 below, documents the average annual quantities of EEE and e-waste at each activity of the e-waste management system for which data was available.

Table 9: Average Annual Quantity of EEE and e-waste generated from each activity in the e-waste management system between 2019 and 2021

Activity	Average Quantity (Mt)
EEE Imported	**8,237**
EEE Distributed/POM	**8,079**
EEE In-use	**No Reliable Data Available**
EEE Refurbished	**No Reliable Data Available**
E-Waste Generated	**7232**
E-Waste Stored	**No Reliable Data Available**
E-Waste of Economic Value Recovered	**No Reliable Data Available**
E-Waste of Economic Value Exported	**47.5**

The inability to provide a value for all activities in the e-waste management system, highlights that there exist severe data gaps. The advancement of the e-waste industry in Guyana would therefore necessitate improved regulation of the formal and informal sectors, in order to allow for increased capture of data on the amounts of different categories of e-waste generated, collected, stockpiled, and exported for recovery.

Further to this, increased training and capacity-building initiatives on best environmental practices and best available technologies for the dismantling and recovery of waste would be beneficial. Efforts to institute extended-producer responsibility schemes can be undertaken in order to maximise the quantity of end-of-life EEE which may be managed in an environmentally sound manner. Nevertheless, careful examination of each solution is necessary to weigh their pros and cons.

5 LEGISLATIVE CONSIDERATIONS FOR E-WASTE MANAGEMENT IN GUYANA

This assessment presents a summary of the results of the E-waste legislative and institutional capacity assessment for Guyana, which reports on the legal aspects of the current E-waste management framework in Guyana (see Annex 1). That report also informed the recommendations for appropriate strategies for a sub- regional E-waste material recovery and disposal programme, the legal considerations for which are presented in Annex 2.

It is expected that the result of this Project will also support Guyana, in strengthening the institutional capacity of local partner agencies and national stakeholders to ensure cohesion and effective management of electrical and electronic equipment (EEE).

Although Guyana has laws and regulations pertaining to solid waste, (inclusive of a Draft 2014 Solid Waste Management Bill); there is still a need for legislation specific to E-waste management, i-n order to mitigate the negative impact on human health and the environment.

In analyzing the legal aspects of e-waste in Guyana, this section assesses the legal aspects of the current e-waste management framework in Guyana, as well the institutional capacity of Guyana in relation to dealing with matters related to E-waste. This includes the role of competent authorities the management and administration of matters related to E-waste, and the effectiveness of that role towards effective mitigation of E-waste risks within Guyana.

Guyana is an independent semi presidential parliamentary republic and member of the Commonwealth of Nations and the Caribbean Community (CARICOM). [5] The head of state in Guyana is the President, a position which is elected indirectly. Executive power is exercised by the government. Legislative power is vested in both the government and

[5] http://www.caribbeanelections.com/gy/education/government_structure.asp

the National Assembly of Guyana; as a result, the legislative power of Guyana rests in a unicameral National Assembly.[6] The justice system is based on English Common Law with elements of Roman–Dutch Law, and is presided over by the Supreme Court.[7]

5.1 International Agreements related to E-waste in Guyana

Guyana's status with regard to applicable international agreements which have applicability to E-waste, is as follows:

Table 10: International Conventions and Agreements

Convention	*Date of Accession (A)/Ratification (R)*
Basel Convention	*April 4, 2001 (A)*
Stockholm Convention	*September 12, 2007 (A)*
Rotterdam Convention	*June 25, 2007*
Minamata Convention	*October 10, 2013 (R)*
Montreal Protocol	*August 12, 1993 (A)*
Trade Facilitation Agreement of the World Trade Organisation	*November 30, 2015 (R)*
International Convention for the Prevention of Pollution from Ships	*February 20, 2019 (A)*
Cartagena Convention	*July 14, 2010 (R)*

[6] Supra
[7] https://www.commonwealthgovernance.org/countries/americas/guyana/judicial-system/#:~:text=Judicial%20System%20of%20Guyana&text=The%20justice%20system%20is%20based,others%20before%20the%20magistrates'%20courts.

The Basel Convention –The **Basel Convention** on The Control of Transboundary Movements of Hazardous Wastes and Their Disposal was acceded to by Guyana on April 4, 2001 and entered into force on July 3, 2001.

According to the website of the Basel Convention's Secretariat, the Basel Convention started to address e-waste issues since 2002 which include, among others, environmentally sound management; prevention of illegal traffic to developing countries and; building capacity around the globe to better manage E-waste.[8]

There may be the presence of toxic materials in E-waste. Examples of such materials, such as mercury, lead and brominated flame retardants are considered as hazardous waste according to the Basel Convention. [9]

On the other hand, all of the components within E-waste may not necessarily be entirely negative. E-waste components may also contain precious metals such as gold, copper and rare materials of strategic value such as indium and palladium.[10]

Because these metals may still have strategic value, the possibility exists that instead of strict disposal, that these elements could be recovered, recycled and used as valuable source of secondary raw materials.

Finally, the Basel Convention Secretariat's website also indicates that it has been documented that e-wastes are shipped to developing countries where it is often not managed in an environmentally sound manner, thus posing a serious threat to both human health and the environment.[11]

[8] http://www.basel.int/Implementation/Ewaste/Overview/tabid/4063/Default.aspx
[9] Supra
[10] SUPRA
[11] Supra

Entry A 1180 of Annex VIII and entry B 1110 of Annex IX to the Basel Convention pertain to electrical and electronic assemblies and include references to disposal operations.[12]

There was also a Nairobi Declaration on the Environmentally Sound Management of Electrical and Electronic Waste and decision IX/6, adopted by the ninth meeting of the Conference of the Parties (COP9). This gave a mandate to the Secretariat to implement a work plan for the environmentally sound management of e-waste. Under the Basel Convention, there is a prior informed consent (PIC) procedure for the movement of hazardous chemicals. This will also apply to the transboundary movement of e-waste compounds that may be classified components of, or containing harmful chemicals.

Guyana submits national reports annually as per the requirements of the Basel Convention. Creating and updating an inventory of e-waste generated, will therefore also support the Competent Authority in the completion of this report.

The Stockholm Convention – The **Stockholm Convention** on Persistent Organic Pollutants is a multilateral environmental agreement to protect human health and the environment from persistent organic pollutants (POPs), a group of chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment.[13]

Adherence to this treaty would bind Parties to ensuring that the management of hazardous waste, inclusive of e-waste, minimises exposure of POPs. POPs may also be found in machinery and electronic equipment. This was illustrated by the Environmental Agency of the United Kingdom, which provided information that

[12] http://www.basel.int/Default.aspx?tabid=6269
[13] https://www.netregs.org.uk/environmental-topics/materials-fuels-and-equipment/more-hazardous-materials-topics/persistent-organic-pollutants/

components of WEEE identified as likely to contain hazardous substances or POPs include: printed circuit boards, plastic casing, cables, insulation foam, cooling agents, flame retardants, cathode ray tubes, capacitors, activated glass and screen phosphors and Ni-Cad batteries. The Agency also forbids the reuse of EEE with POPs.[14]

Guyana acceded to the Stockholm Convention on September 12, 2007. The agreement was ratified and entered into force on December 11, 2007. The first National Implementation Plan (NIP) was developed in March 2013, primarily by the Pesticides and Toxic Chemicals Control Board. The NIP update for Guyana under the Global Environment Facility (GEF) 10154 project, which was given approval in 2019, is still ongoing. [15]

The Rotterdam Convention – The **Rotterdam Convention** on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade helps Parties to protect themselves against unwanted imports of hazardous chemicals. It is a global system open to all countries that allows the exchange of information between countries on trade in hazardous chemicals.

Therefore, its effective implementation protects people from adverse impact of chemicals at the global level. Similar to the Basel Convention, there is a prior informed consent procedure for the movement of hazardous chemicals. This will also apply to the transboundary movement of E-waste compounds that may be classified components of or may contain harmful chemicals.

The Rotterdam Convention expressly excludes waste. Consequently, a chemical that has become waste will fall within the scope of the Basel Convention, not the Rotterdam Convention, except when applicable in light of the chemical characteristics. The

[14] https://www.gov.uk/guidance/dispose-of-waste-containing-persistent-organic-pollutants-pops
[15] https://www.thegef.org/projects-operations/projects/10154

technical guidelines on transboundary movements of electrical and electronic waste and used EEE apply in particular to the distinction between waste and non-waste.

Guyana acceded to this Convention on June 25, 2007 and it entered into force on September 23 2007.

The Minamata Convention – The **Minamata Convention** on Mercury aims to protect human health and the environment from anthropogenic and other releases of mercury and mercury compounds.

Guyana developed its National Action Plan for the reduction, and where feasible, elimination of the use of mercury in artisanal and small-scale gold mining processes under Article 7 of the Convention.

Mercury is critical for most everyday electronic devices, such as smartphones, notebooks, batteries and lighting equipment, but its harmful effects to human health and the environment, even in small concentrations, are of major concern.

As a result, the Minamata Convention also aims to phase-out or take measures to reduce mercury use in certain products such as batteries, switches, lights, cosmetics, pesticides and measuring devices.

In August 2019 deadline, Guyana, through the Ministry of Natural Resources, signed a Memorandum of Understanding (MOU), for the management of the importation of mercury into Guyana.

Guyana is party to the Minamata Convention since signing it on the October 10, 2013, with it entering into force by ratification on September 24 2014. Guyana has also completed its Minamata Initial Assessment (MIA) Report, which was published in October 2016.

Montreal Protocol - The **Montreal Protocol** on Substances that Deplete the Ozone Layer (the Montreal Protocol) is an international agreement made in 1987. It was designed to stop the production and import of ozone depleting substances and reduce their concentration in the atmosphere to help protect the earth's ozone layer.

In terms of WEEE management, the Montreal Protocol is an important instrument because it covers ozone-depleting substances present in refrigerators, freezers and other refrigeration equipment and provides for management and disposal, as well as for reducing production.

The Government of Guyana acceded to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol for the Phase-out of Ozone Depleting Substances (ODS) in August 1993.

WTO Regulatory Trade – Due to to the costs of disposing or recycling e-waste and the limited space available, it has been found that industrialized nations are increasingly exporting their E-waste to developing countries.

Despite the numerous environmental and health risks associated with processing e-waste, some developing countries would have embraced the trade stream as it provides employment opportunities and the potential to recover economic value from precious metals contained in the E-waste.[16]

Guyana is a member of the World Trade Organisation. Guyana ratified the Trade Facilitation Agreement in November 2015, as part of its ongoing efforts to revamp its Customs infrastructure. Although Guyana has no legal prohibitions in terms of the importation of waste, consultations revealed that the country would not recommend the importation of E-waste into Guyana.

[16] Browne (2016) Can a WTO Member Restrict or Regulate the Importation of E-Waste? *Global Trade and Customs Journal* Volume 11, Issue 6 (2016) pp. 280 – 283

If Guyana decided to go the route of an import ban on E-waste, under the WTO General Agreement on Tariffs and Trade (the GATT), an import ban on E-waste is likely to be justified under Article XX(b), which relates to the measures that are 'necessary to protect human, animal, or plant life or health'. This is provided the measure satisfies the two-step requirements of Article XX, particularly the requirements of the 'chapeau'.

Cartagena Convention - The Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region ("Cartagena Convention" or "Convention") was adopted in Cartagena, Colombia on 24 March 1983 and entered into force on 11 October 1986. It was ratified by Guyana on July 14, 2010.

The Convention is also supported by the Protocol Concerning Pollution from Land-Based Sources and Activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region ("LBS Protocol"), also ratified by Guyana in July 2010.

The Cartagena Convention also obligates the Contracting Parties to take all appropriate measures to prevent, reduce, and control pollution caused by discharges from ships, dumping (from ships, aircraft or manmade structures at sea), land-based sources, sea-based activities, and airborne pollution. [17]

As E-waste in Guyana would classify as a source of land-based pollution, it is critical that Guyana has effective E-waste management to attain compliance with its objectives under the Cartagena Convention.

MARPOL Convention - Guyana acceded to the International Convention for the Prevention of Pollution from Ships (MARPOL) Convention on February 20, 2019.

[17] https://iwlearn.net/documents/legal-frameworks/cartagena-convention

Electronic Waste (E-Waste) Building on resolution MEPC.239(65) introduced in May 2013 a new category of "E-waste" to the 2012 Guidelines for the implementation of MARPOL Annex V.

As a result, the Committee adopted revisions of MARPOL Annex V that add "E-waste" as a new category of garbage in the Garbage Record Book (GRB). In light of such, E-waste is defined as any electronic equipment, including its components, sub-assemblies and consumables, when disposed of as a waste.

The recording of this waste using the new format of the GRB was required as of March 1, 2018.

5.2 Domestic Legislation and Policy

Whilst there is some information with regard to the ability of Guyana on the domestic front to deal with matters relating to e-waste management, most of these actions would have to come from interpretative rules.

This a result of there are not many specific references to e-waste management in Guyana. The identification of the relevant documents and rules are produced below:

Policy
Low Carbon Development Strategy

Legislation	Regulations
Environmental Protection Act 1996	*Environmental Protection Act Hazardous Waste Regulations 2000*
Old Metal Dealers Act	*Environnemental Protection (Litter Enforcement) Regulations 2013*
Customs Act Cap 82:01	
Old Metal Dealers (Amendment) Act 2006	
Public Health Act 1934	
Guyana National Bureau of Standards Act 1984	
Municipal and District Councils Act Cap 28:01	

Draft Policy
Draft National Solid Waste Management Strategy 2014-2024
Environmental Guidelines for Management and Export of Electronic Wastes Electronic Wastes

Draft legislation
Draft Solid Waste Management Bill 2014

5.2.1 Low Carbon Development Strategy

The new LCDS 2030, is expected to create a new-low-carbon economy in Guyana by establishing incentives which value the world's ecosystem services, and promoting these as an essential component of a new model of global development with sustainability at its core.

Whilst there is no specific reference to E-waste within the Strategy, it recognizes the need to have effective management of waste in rural and urban areas, as improper solid waste disposal has been quoted as an issue.

Additionally, in terms of the oil and gas sector, the LCDS 2030 indicates that new measures have been introduced to ensure that all waste management is the responsibility of the oil producer, from "cradle to grave".

It is clear, therefore, that the LCDS 2030 needs to have a more direct link to hazardous waste management, as this is not fully elaborated upon within the Strategy.

5.2.2 Environmental Protection Act (EPA Act)

This Act firstly provides for the institutionalization of the Environmental Protection Agency (EPA) by section 3, which is the body tasked with the prevention and control of environmental pollution.

In the *preamble,* it states that the EPA Act is

'*an Act to provide for the management, conservation, protection and improvement of the environment, the protection and improvement of the environment, the prevention or control of pollution, the assessment of the impact of economic development on the environment, the sustainable use of natural resources and for matters incidental thereto or connected therewith'*

Section 3 lists the specific function of the EPA as:

(i) taking such steps as are necessary for the effective management of the natural environment to ensure conservation, protection, and sustainable use of its natural resources;

(ii) co-ordinating the environmental management activities of all persons, organisations and agencies, establish, monitor and enforce environmental regulations;

(iii) preventing or ensuring that any developmental activity which may cause an adverse effect on the natural environment be assessed before such activity is commenced and that such adverse effect be taken into account in deciding whether or not such activity should be authorised;

(iv) co-ordinating and maintaining a programme for the conservation of biological diversity and its sustainable use; and

(v) preventing environmental pollution.

In reference to the management of environmental control, the EPA Act goes further by section 19 in reference to the Prevention and Control of Pollution, by stating that a person shall not—

(a) undertake an activity that causes or is likely to cause pollution of the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting adverse effect;

Part V of the Act seeks for the Agency to prevent pollution by any means, and it provides the legal basis in section 19 to "to prevent and control environmental pollution by through any means that discharges or permits the entry of any contaminant into the environment whether it is solid, liquid or gas".

Additionally, by section 4 (g) of the EPA Act, the Agency may "formulate standards and codes of practice to be observed for the improvement and maintenance of the quality of

the environment and place limits on the release of contaminants into the environment”. [18]

There are also Environmental Protection (Litter Enforcement) Regulations 2013 which Prescribes penalties for littering (including from a motor vehicle), and appoints Litter Prevention Wardens to enforce provisions.

5.2.3 EPA Hazardous Wastes Regulations

The EPA Hazardous Waste Regulations define hazardous waste as any “*waste or combination of wastes which, because of its quantity, concentration or physical, chemical or infectious characteristics, may pose a substantial hazard to human health*”.

These regulations address issues of industrial waste, commercial and any other activity that produces waste, as well as management activities associated with handling, storage, transportation, and disposal of waste at a general level.

Permits are required for the generation of hazardous waste and a requirement exists that such wastes be monitored throughout the production, storage, transport and release phases. Any person who operates or proposes to operate a facility that generates, transports, treats, stores or disposes of hazardous waste, is required to submit a Notification of Activity and an application to the Agency for an Environmental Authorisation.

Whilst ‘*waste having as a constituent mercury or mercury compounds’* is deemed to be hazardous waste and, therefore, subject to the regulations, *Regulation 36* of the *EPA Hazardous Waste Regulations* provides that hazardous waste from oils, gas, mining and mineral processing are not subject to these Regulations.

[18] St. Hill (2020) Legal and Institutional Report - IMPLEMENTING SUSTAINABLE LOW AND NON-CHEMICAL DEVELOPMENT IN SMALL ISLAND DEVELOPING STATES (ISLANDS) PROJECT PREPARATION GRANT PHASE - Extended Producer Responsibility (EPR) ASSESSMENT – Final Report – May 2020

However, e-waste containing mercury (Hg) as a constituent is not excluded; further, management of e-waste containing Hg and other hazardous components will therefore require authorisation under these regulations.

5.2.4 Public Health Act

The Public Health Act, 1934 provides for the protection and promotion of the health of the people of Guyana. This Act allows the Ministry of Health to provide the broad overarching and technical support in relation to the management of the risk associated to the handling of E-waste..

The Public Health Act by sections 95-98 mentions nuisances and offensive trades; however, given the date of the legislation, it does not have specific reference to E-waste in its provisions and is generally in need of update.

5.2.5 Old Metal Dealers Act & Old Metal Dealers (Amendment) Act 2006

This Act regulates the export of old metal (scrap metal) and by section 13, prohibits export without an export licence from the Competent Authority, in this instance, the Ministry responsible for Trade.

The Act requires old metal dealers to be registered and licensed, and by section 6 stated that this had to be done by an application in writing to the Superintendent of Police. There was a temporary six (6) month ban on the scrap metal trade in 2020, which re-opened circa April 2021.[19]

Import and Export forms are facilitated by the Ministry of Tourism, Industry and Commerce, where there is a Scrap Metal Unit, which facilitates the dealing with such matters in conjunction with the Guyana Revenue Authority.

[19] https://newsroom.gy/2021/09/15/burdensome-measures-stifling-scrap-metal-trade-exporters/

The 2006 amendment to the Old Metal Dealers Act (section 13 A) provides a power that enables the Minister with the requisite responsibility to prohibit all old metal from being shipped or otherwise exported from Guyana for a specified period of time not exceeding one year if he considers it necessary in the interest of preventing or curbing any illegal activity.

Section 15 A also provides the Minister with the power to make regulations for the administration of this Act.

This legislation as it currently stands should also be updated to address E-waste issues. The Ministry of Tourism, Industry and Commerce's website indicates that there is a focus on updating the legislation in order to address the scrap metal regime.

The Ministry further states that it sees the development of new legislation in this area, as a chance to introduce new regulatory measures to govern the Industry.

The Ministry further indicated that the new legislation would be expected to provide the framework that will ensure greater compliance with trade requirements, registration and other issues to ensure maintainable development of this Trade.

5.2.6 Guyana National Bureau of Standards Act (1984)

The Guyana National Bureau of Standards (GNBS), which is governed by a National Standards Council, was established through the GNBS Act Cap 90:16 (1984).

The function of the GNBS is to develop and implement National Quality Infrastructure. The framework Act however, does not provide any information related to the management and administration of WEEE.

Through the mandate of the GNBS to provide standards, it may consider that the GNBS may be included with regard to setting the relevant criteria for the evolution of EEE to WEEE, thus providing a role in the lifecycle management of EEE.

This function may also be further bolstered if a testing role in functionality, safety and designation is a possibility.

5.2.7 Municipal and District Councils Act

This Act empowers councils to establish, maintain and carry out sanitary services for the removal and destruction or management of all kinds of refuse and effluent, and to make by-laws.

The Act also prescribes penalties for littering and illegal dumping. In that light, the Municipal and Districts Councils Act provide the powers of various bodies, both at the municipal and district level, to deal with matters related to waste management and disposal.

Although the framework Act does not make specific provisions to E-waste, it is the umbrella Act for the councils that provide most of the day to day work under the Ministry of Regional and Local Development, and in enforcing against littering and illegal dumping, can assist in recognizing E-waste to not only assist in proposal disposal management, but also the recognition of where components of WEEE can be recycled for further use in the EEE lifecycle.

5.2.8 Customs Act

The Customs Act provides the legislative regime for the actions of the Customs Department of the Guyana Revenue Authority (GRA). With regard specifically to the import of E-waste, whilst the Act does not make specific reference to E-waste, it states by section that ‘the goods, the particulars of which are set out in the Second Schedule, are prohibited or restricted to be imported as the case may be, save as thereby excepted’.

Therefore, prohibitions and restrictions on imported items can be placed with the Second Schedule, which provides the scope for specific items and components of E-

waste to be prohibited from entry into Guyana, or at least regulated with restrictions that may include permissions, fees and licensing.

In addition to listed prohibited items, the Second Schedule of the Customs Act also states that additional goods may be prohibited or restricted by the Minister responsible for Finance, as required. It also prohibits/restricts goods which are restricted/prohibited by any other law, thus ensuring synergy with other domestic legislation without having to list restrictions in each instance.

Similarly, the Third Schedule lists prohibited and restricted items for export. By notice on their official website, the GRA in January 2021 informed all Importers and Licence Customhouse Brokers that the EPA has published a list of Hazardous Materials.

Importers are required to have an approval from the EPA, prior to the importation of such materials through the submission of an electronic Single Administrative Document (eSAD) by Importers and Licenced Customhouse Brokers.

With effect from January 18, 2021, the Guyana Revenue Authority (GRA) also advised all Importers and licenced Customhouse Brokers, that when submitting declarations for listed items, such persons must obtain the relevant approvals from the EPA. The listed items include, inter alia, mercury and mercury compounds.

5.2.9 Draft Solid Waste Management Bill 2014

This Bill is expected to establish licencing and permit systems for waste management facilities and waste haulers. The Bill also prescribes penalties for littering, illegal dumping, burning, operating without licences and other infractions.

Further, the Bill, when passed, will establish a Solid Waste Management Authority, and establishes licencing and permit systems for waste management facilities and waste haulers.

It prescribes penalties for littering, illegal dumping, burning, operating without licences and other infractions.

This draft legislation does not reference WEEE and should therefore be reexamined before being promulgated in order to ensure its provisions are in compliance with any WEEE related requirements and best practices.

Consultations provided information that the Ministry of Local Government and Regional Development (MLGR)D, in collaboration with the United Nations Environment, is currently revising the draft Solid Waste Management Bill, and cited the timeliness of this project in identifying the lack of legislations devoted specifically to e-waste management, which is something which can be addressed by the draft Bill under revision.

5.2.10 Draft National Solid Waste Strategy 2014-2034

Whilst this Strategy does not directly identify issues related to WEEE, it has some interesting information in relation to hazardous wastes. It states that a hazardous waste inventory for 2007 (Caribbean Environmental Health Institute, 2009) showed that over 741,780 kilograms of hazardous wastes (or 1.0 kg per person) were generated in Guyana in 2007 (as reported by 569 entities).

Four waste streams accounted for almost 95% of the total hazardous? waste reported as follows:

- Waste oils/water, and hydrocarbons/water mixtures and emulsions = 42.7%
- Waste from the production, formulation and use of organic solvents = 24.3%
- Clinical wastes from medical care in hospitals, medical centres and clinics = 14.4%
- Acidic solutions or acids in solid form = 7.2%

The actual hazardous waste generation was believed to be higher as the inventory/survey did not capture all sectors, such as mining where mercury used in gold extraction was under-reported. As there have been no major hazardous waste reduction interventions in three of the four categories identified above since the completion of the survey, the hazardous waste generation rate in 2014 is likely to be higher than in 2007.

This illustrates that the information within the Strategy at the time was outdated, and therefore in 2022 is likely to be even more so, given the increase in trends related to WEEE in the region, as illustrated by Acosta and Corallo (2020)[20].

DeFreitas (2018) noted that electronic manufacturing and consumption is a booming industry. At the same time the lifespan of electronic gadgets has shortened significantly leading to a rapid cycle of manufacture-purchase-replacement. To compound this issue, the frequency at which newer models are released entices consumers to keep abreast with the latest trends.[21]

5.3 Institutional Framework

Currently the Relevant Authorities in Guyana in relation to the supervision and administration of considerations relating to E-waste are as follows:

Stakeholder	Type of institution	Rationale for inclusion
Environmental Protection Agency (GUYANA)	State agency	Agency tasked with environmental protection
Ministry of Local Government and Regional Development (MLGRD) (GUYANA)	Government/Waste Management	Ministry with responsibility for waste collection and national waste management
Scrap Metal Unit, Ministry of Tourism, Industry and Commerce	Unit within the Ministry responsible for trade of scrap metal	Old and Scrap Metal Export facilitation

[20] Acosta and Corallo - IMPLEMENTING SUSTAINABLE LOW AND NON-CHEMICAL DEVELOPMENT IN SMALL ISLAND DEVELOPING STATES (ISLANDS) PROJECT PREPARATION GRANT PHASE – Trade Flow Assessment – Final Report – April 2020 p 5

[21] Defreitas Penelope (2018) - The Perception of Electronic Waste Management and Disposal Practices in Guyana November 2018 – Accessed January 11 2022 at https://www.researchgate.net/publication/348428823_The_Perception_of_Electronic_Waste_Management_and_Disposal_Practices_in_Guyana

5.3.1 Environmental Protection Agency

The EPA, under the Environmental Protection Act, Chapter 20:05, laws of Guyana, and the Environmental Protection (Hazardous Waste Management) Regulations 2000, is mandated to oversee the management of hazardous waste.

Conscious of the growing volume of E-Wastes generated in our society, the Environmental Protection Agency (EPA) had developed draft Environmental Guidelines for Management and Export of Electronic Wastes Electronic Wastes; which are currently still in the process of being examined.

The EPA is also the competent authority for the Basel Convention and oversees the implementation of the Prior Informed Consent (PIC) procedure, which is adhered to for the export of e-waste

Whilst there is no blanket provision which prohibits the import of waste into Guyana, the EPA advised during consultations that it currently would not advise the Government to import waste, ie e-waste into Guyana, however, there have been some exporting in terms of scrap metal, as well as E-waste using the PIC procedure, under the Basel Convention.

This is done in conjunction with the Scrap Metal Unit of the Ministry of Tourism, Industry of Commerce, as the Unit is the competent authority for the granting of the licence to the relevant person/entity for the export of scrap metal.

5.3.2 Ministry of Local Government and Regional Development

This Ministry is the primary Government Agency which links the various authorities with the Central Government. It facilitates, coordinates and monitors the execution and implementation of a number of projects, programmes and activities in the various local

government arms/organs, inclusive of waste management at the district and national level, primarily as the competent authority for waste disposal..[22]

The Ministry is tasked with ensuring that the successful implementation of the Government plans, policies and programmes in accordance with good governance, facilitating infrastructural and human resource development in the Regions.

The role of the management of the landfill and dumpsites fall under this Ministry as competent authority, and as it also deals with matters at the district level, it falls as the bridge between regulation and interaction with those in the informal sector of waste collection and disposal.

Through the aforementioned, National Solid Waste Management Strategy, the MLGRD seeks to use this strategic framework to guide government's agenda on waste collection, transportation and disposal; improving the waste management infrastructure, enforcing existing legislation and promoting waste- to- energy initiatives.

In terms of regional development in Guyana, the Ministry monitors the growth and development of the Regions, Neighbourhood Democratic Councils and Municipalities through the promotion of good governance, facilitating infrastructure development/maintenance and training. This is achieved by the following Sections:

1. The Local Government Section
2. The Municipal Services Division
3. The Planning and Training Section.

Additionally, several public sector agencies are involved in waste management including the Ministry of Public Health, EPA, Regional Democratic Councils, the Scrap Metal Unit, Neighborhood Democratic Councils, and town councils, with the attendant potential for overlap in roles and responsibilities. These councils have municipal waste

[22] https://mlgrd.gov.gy/about-us/

management responsibility for their areas. The type of waste is not specified in each specific council's mandate however.

At the Validation Workshop, it appeared that the majority of E-waste in Guyana ended up in the landfill, as well as the dumpsites. Further, the MLGRD indicated that that the difficulty in quantifying e-waste that reaches the sanitary landfill is due to the fact that solid waste reaching the site is commingled.

The Validation Workshop also indicated that in some instances, government agencies such as the GRA were responsible in the exercise of the storage of E-waste before dissemination to a private company

5.3.3 Scrap Metal Unit

Although not mentioned specifically in the aforementioned Old Metal Dealers Act and its subsequent amendments, the Scrap Metal Unit is the division tasked with administering the relevant licence for scrap metal, under the competent authority which currently entitled the Ministry of Tourism, Industry and Commerce.

As this involves components that may be considered as hazardous waste, there is a necessity for collaboration between the Scrap Metal Unit and the EPA, as well as other competent authorities such as the GRA divisions of Customs and Excise, as well as the Customs Anti-Narcotics Unit (CANU).

In cases where the Prior Informed Consent procedure is being conducted by the EPA as competent authority, it would be a pre-requisite to have this licence, as it is an offence under the Old Metal Dealers Act to be dealing with old metals without having been licenced as a dealer under section 4.

These licenses are valid for a period of one year, as stated by sections 5 and 6 of the Act.

As a result, it necessary that there be coordination among EPA, Scrap Metal Unit, MLGRD and GRA as it relates to ensuring Basel Convention protocols are observed. An Environmental Authorization from the EPA is required with regard to the handling of

waste in country; as well as the requirements for advanced notice and the PIC procedure, as well as agreements from the exporting and importing country as set out by the Basel Convention.

5.4 RECOGNISED GAPS AND BARRIERS TO E-WASTE MANAGEMENT IN GUYANA

Firstly, there is no specific legislation currently promulgated which deals with E waste Management in Guyana, which is of concern given the volume of WEEE and UEEE which currently pass through the Caribbean region.

It can be said that Electrical and electronic equipment (EEE) have become part of our daily life. They are necessary (and even essential) in areas such as mobility, medicine, security, communications, among other fields.

At the same time, this exponential development has caused negative environmental impact because of the increasing tonnage of Waste Electrical and Electronic Equipment (WEEE) generated year after year in the world: computers, tablets, cell phones, televisions and household appliances of all types and sizes.[23]

Secondly, the examined policies do not have much focus on disposal and management of WEEE and UEEE, thus providing another gap in guiding the drafting and application of any such WEEE and UEEE related legislation.

With regard to the institutional framework, the barriers would be related to the need for guidance to implement any such laws or policies, particularly to the stakeholders. There

[23] Acosta and Corallo - IMPLEMENTING SUSTAINABLE LOW AND NON-CHEMICAL DEVELOPMENT IN SMALL ISLAND DEVELOPING STATES (ISLANDS) PROJECT PREPARATION GRANT PHASE - Extended Producer Responsibility (EPR) ASSESSMENT – Final Report – May 2020 p6

may be a need for various incentives to get private waste disposal further involved in the process.

Some constraints commonly identified in SIDS (such as limited availability of suitable land for treatment and storage facilities, and landfills; dependency on viability of exporting recovered materials and hazardous wastes or low level of consumption rates to facilitate investments) could be addressed through implementing a regional approach where economies of scale would facilitate investments and space requirements would be reduced due to larger collection rates and more frequency of exports.[24]

Finally, failure to handle equipment properly can have negative impacts and often entails disposal when parts are replaced and discarded. There should be clearer guidelines in terms of differentiation on e-waste which is considered hazardous, as opposed to that which is not.

The GRA, in collaboration with the EPA, has the possibility of including the direct components of E-waste which would be prohibited or restricted from imports and exports, thus enabling the average person to have a reference to E-waste management.

Further, there is a gap in terms of a regional approach being taken by the sub-region in terms of a regional approach of E-waste management, particularly with regard to exporting and transportation under the PIC procedure under the Basel Convention.

There is a glaring omission in that, although sister CARICOM Member States, there is no regional synergy in a legislative and institutional framework that supports the advancement of E-waste management in Guyana.

Another gap which is apparent, is for example, whether the Basel Convention would prohibit, for example, the export of E-waste from Guyana to another country in the

[24] Acosta and Corallo, supra

subregion for further treatment, and thus providing a larger economy of scale rather than singularly per country.

One area which needs greater clarification is whether Guyana may consider in being a transit point for E-waste shipments; during consultations, it was stated that Guyana currently does facilitate transiting shipments; however there is no definitive policy position on Guyana using its position as a transit point for E-waste shipments, as well protocols that may be implemented that could allow Guyana to take part in such an initiative that can assist trade facilitation throughout the sub-region for further exports of E-waste, and be lucrative for the jurisdiction in terms of transiting fees and taxes, with the overall benefit of assisting Guyana in disposing of its E-waste in an environmentally and economically sound manner.

The lack of clarity in defining when used equipment is waste and when it is not has led to a number of situations where such equipment is mishandled, or exported to, in particular, developing countries ostensibly for reuse but where a large percentage of the exported equipment is in fact not suitable for further use or is not marketable and must be disposed of as waste in recipient countries.[25]

In having provided an assessment into the legal and institutional capacity of Guyana in relation to E-waste management, the findings of this Report will provide the foundation of a Recommendations Report, which will present a further analysis into the potential barriers and opportunities for the life cycle management of EEE in Guyana.

This Recommendations Report will also contain Legal Strategies towards the Environmentally Sound Management of EEE in the project countries.

[25] Acosta and Corallo - IMPLEMENTING SUSTAINABLE LOW AND NON-CHEMICAL DEVELOPMENT IN SMALL ISLAND DEVELOPING STATES (ISLANDS) PROJECT PREPARATION GRANT PHASE – Trade Flow Assessment – Final Report – April 2020 p 5

5.5 Legislative and Institutional considerations for the improvement of local and/regional E-Waste (EEE lifecycle) management solutions in the context of Guyana

There is a number of legislative and institutional changes which should occur in order to provide Guyana with greater capacity in terms of the management of the EEE lifecycle. These changes are especially critical as one of the primary concerns with respect to the growth of e-waste is that there is almost no in-country capacity to manage/treat and dispose of this waste stream properly.

Of particular concern are the current practices that are being used to extract precious and strategic metals, resulting in the release of Unintentional Persistent Organic Pollutants (UPOPs). In addition, the e-waste stream also includes mercury-containing wastes, regulated by the Minamata Convention on Mercury, such as mercury-containing energy efficient lights and primary batteries. Unfortunately, capacity for the treatment and disposal of mercury containing products is very limited in the Caribbean Region.

6 ECONOMIC EVALUATION AND CONSIDERATIONS FOR E-WASTE MANAGEMENT IN GUYANA

The below represents a summary of the economic valuation and consideration for e-waste management in Guyana.

An economic model was developed for analysis of the economic situation of e-waste management the project countries. This economic model will serve as a tool for policy makers to understand the economic framework conditions for e-waste treatment in their country and in the sub-region and to support the design of appropriate e-waste policy framework(s). It can further provide support to entrepreneurs planning to set-up an e-waste dismantling facility to get a good overview of the expected costs and revenues. For established facilities, this tool is helpful to identify options for improvement in the current process to optimize their dismantling operations.

The economic model focuses only on the treatment portion of an e-waste management system. This means that the following stages of e-waste management are not being considered: collection, transport, export and disposal. Although these stages are not considered, recommendations related to the whole life cycle management of e-waste are provided.

When it comes to treatment, different levels of technology can be applied, and consequently, a higher or lesser recovery rate of valuable materials and export value can be obtained. This model proposes setting up facility for the manual dismantling of e-waste. Still, different depths of dismantling can be achieved. For the project, it is suggested a more superficial dismantling, where only hazardous components and high valuable components, like printed circuit boards, are removed and the remaining parts are destined to landfill or mechanical separation/recycling.

Considering the type of treatment to be given vs. the required one by each e-waste fraction, the model includes only the manual treatment of only the following categories:

- Large Household Appliances (LHA)
- Small Household Appliances (SHA)
- Screens as a sub-category of CE: Flat Screen monitors (FSm) and Flat Screen TVs (FStv). *Originally, CRTs were planned to be included, but when running the model, it was decided that the amount that could be collected did not justify the investment in specific equipment needed for its treatment.*

The model is Excel-based for the calculation on an annual basis of a manual dismantling facility at the project countries and at the sub-regional level.

The core source of the tool is the Business-Plan-Calculation-Tool for Manual Dismantling Facilities developed by The Solving the e-waste problem (StEP) Initiative that has an open-source version.

Within this campaign the composition of output fractions after dismantling 4 selected e-waste streams (LHA, SHA, FSm, and FStv) has been analysed for three different collection rate scenarios (30%, 50%, 80%). The average times for dismantling these appliance groups have been provided by BOKU.

For each output fraction, the destination for further treatment (recycling or disposal) has to be chosen. The model takes into account the cost estimation of output fractions at the dismantling facility.

To use the model, it is essential to have the following data:

- Gross Monthly Minimum Wage in the country – based on the Global Wage Report 2020-21 (ILO, 2020)
- Average rental cost for facility – obtained though web research
- Purchase prices for investment of equipment and infrastructure – obtained though web research
- Achievable revenues or disposal costs for each output fraction - provided by BOKU
- Generation for e-waste fractions at a certain year – provided by NPAs and based on Comtrade[26]
- Average times for dismantling each e-waste fraction- provided by BOKU

Depending on the inputs and the chosen scenario concerning collection, the model automatically calculates the following on an annual basis:

- Quantities of produced output fractions
- Required staff, investments and equipment
- Required space for administration, dismantling, storage, etc.
- Expected revenues and operational costs
- Treatment cost or revenue per ton of input e-waste

The following costs are not included due to lack of information available at the time of running it:

- Utilities and Internet
- Annualized costs for setting up and maintaining the facility: fire extinguisher system, painting, electric wiring, etc.
- External services: H&S, accounting, training, communication, etc.
- Administration/financing costs: fees & taxes, insurances, banks, interests, etc.
- Office and cleaning/sanitary supplies.

The model is designed in such a way that they can be included if or when the information is collected.

[26] https://comtrade.un.org/

The model consists of an Excel file containing 7 sheets:

1. GUY model: The model per se
2. GUY material composition and revenue: Material composition per e-waste stream, revenue expected per output material, estimation of dismantling workers needed according to dismantling times provided by BOKU per e-waste stream
3. Material revenues: average revenues per output materials, provided by BOKU
4. EWG GUY: Calculates 2020 EWG for the selected e-waste streams
5. Comtrade GUY: raw data on imports and export of selected EEE streams
6. GUY equipment and facility rental: estimated costs for equipment and facility rental, gathered through web research. When possible, information was obtained from local suppliers. Otherwise, information was gathered from suppliers abroad.
7. Assumptions: set of assumptions used, namely:
    a. minimum wage,
    b. working hours and days of the facility,
    c. tons loaded in average in a 20´container and freight costs (used only for the sub-regional approach)

Data is marked according to the following criteria of colours:

- To be filled by user
- Used for calculation basis (should be modified by user in case needed)
- Calculation for the Scenario A, depending on other cells.
- Calculation for the Scenario B, depending on other cells.
- Calculation for the Scenario C, depending on other cells.

The model sheet calculates, for each collection scenario (A: 30%, B: 50%, and C: 80%) the following:

- total input quantities and per e-waste stream
- total staff required and staff required at each of the following categories:
    - Skilled dismantling workers
    - Unskilled dismantling workers
    - Forklift drivers
    - Scale operator
    - workers for sorting
    - Department manager
    - General Manager
    - Administrative staff
- Staff costs per year, per staff category and totalized

- Total tons recovered and tons recovered per year of the following material´s categories:
  - Hazardous components
  - Iron and steel
  - Aluminium
  - Copper
  - Cables
  - Plastics
  - Printed Circuit Boards
  - Compounds / mixed materials
  - Other materials
- Revenues per material category and totalized. It is worth mentioning that for some categories, namely hazardous wastes, compounds/mixed materials and other materials, there is a cost associated with its treatments rather than revenue.
- Total space required and space requirements according to the following sectors:
  - Recreation and sanitary room
  - Administrative department
  - Dismantling working station
  - WEEE receiving area
  - Storage
- Total rental costs for the facility
- Total containers required and containers required according to the following categories:
  - Container for LHA
  - Container for SHA
  - Container for screens
  - Container for scrap
- Equipment requirements of the following types:
  - Forklift
  - Pallet jack
  - scale (4500 kg)
  - Pallet
  - Collection box
  - Ventilator
  - Personal protective equipment (shoes, helm, gloves, etc.)
  - Working tools
  - Administrative working place (PC, table, chair)
  - Dismantling working station (table, chair)

  - Containers
- Cleaning, Maintenance and Repair (CMR) costs
- Other costs not included in the present model due to lack of information:
  - Utilities and internet
  - Annualized costs for setting up and maintaining the facility: fire extinguisher system, painting, electric wiring, etc.
  - External services: H&S, accounting, training, communication, etc.
  - Administration/financing costs: fees & taxes, insurances, banks, interests, etc.
  - Office and cleaning/sanitary supplies

The following table 11 shows the results obtained for the three different collection scenarios in United States Dollars (USD) when running the model for Guyana:

Table 11: results obtained when running the economic model for Guyana

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total annualized fixed costs		**-$ 584,142**	**-$ 932,461**	**-$ 1,474,856**
Total Equipment costs		-$ 935,768	-$ 1,533,168	-$ 2,425,644
Total equipment costs annualized according to lifespan		-$ 53,087	-$ 85,668	-$ 134,972
Total rental costs per year		-$ 531,055	-$ 846,793	-$ 1,339,884
Total other fixed costs		$ -	$ -	$ -
Total Variable costs and revenues		**$ 259,307**	**$ 478,020**	**$ 789,099**
Total CMR costs per year		-$ 51,876	-$ 84,290	-$ 134,002
Total staff costs per year		-$ 117,024	-$ 151,368	-$ 218,784
Total materials revenues and costs per year		$ 428,207	$ 713,678	$ 1,141,886
Total Other variable costs		$ -	$ -	$ -
Total input quantities (tons/year)		1337	2228	3565
Annualized economic result (revenues - costs)		-$ 324,835	-$ 454,441	-$ 685,757
Total treatment cost/ton		**-$ 243**	**-$ 204**	**-$ 192**

From studying the model, a set of conclusions can be achieved:

1. Regardless the collection scenario, the economic result of the treatment facility in Guyana is negative. This implies that there will be a need to generate other

sources of revenue or reducing some costs to make the operation economically viable.

2. The costs that are having the biggest impact are: rental and staff costs. The rental costs that were identified through web research are very high in comparison to the ones identified for Suriname and Trinidad and Tobago. Based on market research, a monthly rental for a warehouse in Guyana is USD 10,000-15,000 while in Suriname and Trinidad and Tobago, it is one-fifth and one-sixth of this cost, respectively. It is recommended to revise this value, maybe through reaching out to real state operators. If the rental cost was avoided, for example, through subsidizing it, the economic result for the three scenarios would be as presented in table 12.

Table 12: Results obtained when running the economic model for Guyana considering no rental cost is needed

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		1337	2228	3565
Annualized economic result (revenues - costs)		$ 206,220	$ 392,352	$ 654,128
Total treatment cost/ton		$ 154	$ 176	$ 183

3. When considering new sources of income, an option would be to charge a fee for e-waste treatment. This fee could be paid by generators; however, less than 20% of households surveyed indicated willingness to do this. Therefore, possible diversions of e-waste to informal channels or MSW disposal. On the other hand, collection systems can be focused on businesses and government stakeholders, including but not limited to GRA, with policies in place to ensure the disposal of end-of-life materials. Another option would be for the government or EEE importers and producers to subsidize the operation by paying a fee per ton treated to the dismantling facility operator, equivalent at least to the total treatment cost/ton in each scenario in order to reach economic equilibrium. The implementation of an EPR scheme can support with the latter option.

4. In terms of equipment, the containers needed for storage and transport of output fractions have, by far, the biggest economic impact (about 90% of total equipment costs). Due to the low e-waste quantity, one of the primary goals was to make the facility as flexible as possible, capable of accumulating materials before the threshold value for export is reached. This is why the model considers an amount equivalent to 50% of total containers needed to store a full annual capacity. The remaining 50% of containers are assumed to be owned by scrap

buyers. It is recommended to revise this strategy with scrap buyers and also to evaluate which would be the export thresholds for each fraction, to obtain a more accurate calculation. If the need for containers is reduced, then the storage area required should be revised as well, and consequently, rental costs would be lowered. For example, if only 10% of containers are needed and consequently 40% of storage area required is reduced, the following would be the results achieved:

Table 13: Results obtained when running the economic model for Guyana considering a reduction in containers and storage area needed

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		1337	2228	3565
Annualized economic result (revenues - costs)		-$ 167,156	-$ 191,171	-$ 261,910
Total treatment cost/ton		**-$ 125**	**-$ 86**	**-$ 73**

5. Finally, it should be noted that the model considers the sound treatment of the hazardous wastes obtained. In addition, it is considered a fee equivalent to USD 35/ton for the disposal of materials destined to landfill.

In addition, Tables 14 to 17 show the costs/revenues of treating each of the fractions solely:

Table 14: Results obtained when running the economic model for Guyana considering only the SHA fraction

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		303	506	809
Annualized economic result (revenues - costs)		-$ 161,455	-$ 210,838	-$ 284,422
Total treatment cost/ton		**-$ 532**	**-$ 417**	**-$ 352**

Table 15: Results obtained when running the economic model for Guyana considering only the LHA fraction

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		889	1482	2371
Annualized economic result (revenues - costs)		-$ 192,089	-$ 249,988	-$ 370,640
Total treatment cost/ton		-$ 216	-$ 169	-$ 156

Table 16: Results obtained when running the economic model for Guyana considering only the FSm fraction

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		23	39	62
Annualized economic result (revenues - costs)		-$ 94,682	-$ 92,391	-$ 102,183
Total treatment cost/ton		-$ 4,046	-$ 2,369	-$ 1,637

Table 17: Results obtained when running the economic model for Guyana considering only the FStv fraction

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		121	202	323
Annualized economic result (revenues - costs)		-$ 111,770	-$ 135,943	-$ 156,841
Total treatment cost/ton		-$ 924	-$ 674	-$ 486

It can be concluded that the e-waste fraction with less negative outcomes is LHA, and in second place, SHA; while FSm is the e-waste fraction with higher negative economic outcome. Finally, the best economic result can be achieved when different e-waste streams are treated, achieving thus economies of scale that would justify the investments required.

6.1 Current economic feasibility (incentives/disincentives) that relate to E-Waste management in Guyana

Incentives

As presented previously in the report, the average annual e-waste generation in Guyana for the period 2019-2021 is estimated to be 7,232 metric tons (Mt), which translates to an estimated e-waste generation rate of 9 kg per capita annually, higher than the 2019 global average (7.3 kg per capita). E-waste contains valuable and scarce materials and recovery of these materials as secondary resources can alleviate mining of virgin materials - and is oftentimes much more efficient compared to mining. This is why business opportunities and "green jobs" can be created and enabled (Cyrcle Consulting, 2015). According to UNEP (2007), using averages, it was estimated that e-waste produced annually is worth over $62.5 billion (WEF and PACE 2019). In their study of the circular economy potential of e-waste in five (5) Caribbean Islands, Mohammadi et al. (2021) projected that between the years 2020 and 2025, more than 317 kilo tons (kt) of valuable resources can be recovered from e-waste. This represents an estimated economic value of US $546 million in just these five (5) islands, which possess only 11% of the Caribbean population. Should this potential be realised from the entire Caribbean e-waste industry, it is estimated that a total of US $6 billion in revenue can be generated. According to the economic model, if a 100 % of e-waste generated were treated in the dismantling facility (equivalent to 4,278 ton in 2020), the value of the output materials, considering the disposal costs of the non-recyclable-fractions, would be approximately USD 1,360,000.

If a proper formal system is put in place for the collection and treatment of e-waste, the potential amount of revenue from material recovery would be an incentive to set up the necessary businesses and infrastructure to ensure environmentally sound management. In the current situation, without high collection rates or government subsidies, six authorized e-waste related businesses are already up and running in Guyana, which is indicative of lucrative business potential. These private initiatives identified that they currently conduct activities related to e-waste management are a source of information and experience that can be helpful in the design of a wider e-waste management system.

A major incentive is that current practices (unregulated private initiatives and informal activities, e.g. waste pickers) used to extract precious and strategic metals result in the release of, among other contaminants, Unintentional Persistent Organic Pollutants (UPOPs), regulated by the Stockholm Convention on Persistent Organic Pollutants, such as Polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF); Polybrominated diphenyl ethers (PBDEs) contained as flame retardants in plastics of TV and computer casings; and, Polychlorinated Biphenyl (PCBs). It is estimated that brominated flame retardant-containing plastics make up approximately 20% of the total plastics contained in the e-waste stream. Electronic goods also contain a wide variety of other hazardous substances (arsenic, cadmium, mercury, bromides, lead, phosphorus pentachloride; among others) which can potentially be released during unsafe

dismantling, recovery, and recycling practices. Through the implementation of the sound management of e-waste, these releases could be prevented or mitigated.

Another incentive would be to implement a regional approach for e-waste management and thus generate economies of scale that would facilitate investments and reduce space requirements due to larger collection rates and more frequency of exports.

Disincentives

One of the major disincentives is that there is almost no in-country capacity to manage/treat, recycle and dispose of this waste stream properly. Almost all e-waste generated ends up in dumpsites or in landfills, which are not properly equipped to receive this waste stream. The Haags Bosch Sanitary Landfill is Guyana's only landfill equipped with a liner and leachate collection system. However, this landfill is projected to reach capacity sooner than initially anticipated, due to Guyana's rapid development and the commensurate increase in waste generation from the oil and gas sector.

As mentioned, at the Haags Bosch Sanitary Landfill there is an organized group of approximately seventy (70) informal sector workers who salvage e-waste and other metal waste on the landfill for sale to scrap metal dealers. In addition to this practice, informal sector workers periodically collect scrap metal and e-waste in residential areas. From an economic point of view, the informal sector represents the weakest link in achieving a system following ESM practices, as they might be paid four times less than the international market value and their working conditions are bad in many respects: waste pickers generally work and live in highly polluted environments, without any form of protection, and have no access to social benefits (Bisschop, L. & Coletto, 2017). Integrating them in the formal system represents several challenges that must be faced with a multidisciplinary approach, considering social, economic, labour, health and education aspects, and that usually there is reluctance from the "formalized" private sector to integrate them. The expert working group on environmentally sound management under the Basel Convention has developed several case studies on promoting ESM in the informal sector, which provide practical examples of measures that can be used to enhance ESM in the informal sector.

Except for some separation of e-waste done by state agencies and private companies and some dismantling and segregation by informal workers at the Haags Bosch Sanitary Landfill, e-waste is generally comingled with other categories of waste and transported to landfill for disposal. This is a major disincentive since a minimum and consistent inflow of material is required to ensure the economic feasibility of a

dismantling facility. Otherwise, it is difficult to justify investments in equipment and infrastructure as the volumes needed for export are difficult to achieve, causing a direct impact on cash flow.

Other constraints identified, characteristic to SIDS, are limited availability of suitable land for treatment and storage facilities and landfills and dependency on the viability of exporting recovered materials and hazardous wastes. As mentioned by N&S Enterprise, they have approximately 25 Mt of scrap metal stockpiled (inclusive of e-waste and the valuable components) which they purchased over the course of the last five (5), which is indicative of the inconsistent flow of materials. Further, at the time of writing this report, the company was still awaiting an opportunity to export at an economically feasible rate. Specifically, N&S Enterprise stated that they are having difficulty securing buyers overseas since many prefer to purchase one (1) type of e-waste in a single container as opposed to purchasing a container of mixed e-waste.

In terms of promoting investment and creating a confident environment for businesses to conduct their activities properly, the lack of specific legislation and enforcement related to e-waste management and the absence of legal definitions of EEE, used EEE and e-waste are considered disincentives. A clear legal framework is a basic requirement to promote an economically feasible ESM of e-waste. On one hand, it has to be clear whether an object is used is EEE or E-waste (distinguishing if it is hazardous or not), and which are the owner´s responsibilities regarding its management. On the other, the legal framework should give clarity in terms of how to conduct the transport, storage, treatment, and disposal operations, aspects required to conduct and economic evaluation. The lack of clear procedures hinders traceability of e-waste, makes it difficult to promote penalties in cases of non-compliance, and obstructs the internalization of treatment costs by EEE producers or waste owners. In the face of the recent decision adopted by the fifteenth Conference of the Parties to the Basel Convention to amend Annex II of the Convention to include e-waste, thus leading to all transboundary movements requiring prior informed consent, it is imperative that EEE, used EEE and e-waste be defined in order to prevent incorrect classification of materials destined for recovery abroad (as well as imported into the country) and ensure compliance with international obligations under this Convention.

In Guyana, waste is collected once or twice weekly in residential areas and daily in commercial areas. The high cost of transportation can be considered as one of the key factors for the low frequency of collection rates in residential areas. Waste is transported directly to disposal sites, since there are no transfer stations in the country. In many cases the costs of proper collection and recycling e-waste might exceed the revenues generated from the recovered materials; this is why a proper financing

mechanism, tailored on the societal context of the country, needs to be defined first and enforced afterwards (Cyrcle Consulting, 2015).

Also, a challenge raised by Piranha International, a company based in Trinidad and Tobago, is that some shippers do not want to handle hazardous wastes, so the only viable solution would be to classify waste “in-correctly” (Acosta and Corallo, 2020); an aspect that can be assumed to also affect waste handlers in Guyana. N&S Enterprise raised that some shipping lines have discontinued the export of scrap metal since some countries, e.g., Panama has disallowed the transit of scrap metal shipments. There constrains will probably needs governmental involvement and support to be solved.

In addition, no economic or fiscal incentives or disincentives have been identified to be in place, such as EPR schemes, or by taxing the importation of EEE for funding WEEE management. Also, fiscal programmes to incentivize sustainable investments have not been identified. Some economic incentives identified in the region by Acosta and Corallo (2020) that could be taken into consideration for the design of the system are exemption of duties fees, subsidies (e.g. for fuel or electricity), land use, or cession permit, arrangements of exclusivity, and collection campaigns.

6.2 Existing operator models for e-waste management

As presented in previous sections, in Guyana there are six (6) companies that manage e-waste in total. Five (5) of these companies collect, transport and dismantle e-waste. However, the amounts recycled are still at modest levels. Most of these companies do not offer a comprehensive service, since they are concentrated on valuable components such as printed circuit boards, neglecting the proper disposal of other components such as cathode ray tubes (CRTs) that are not economically valuable, and represent a risk for health and the environment. Also, companies that handle WEEE are currently facing challenges in finding more adequate methods for the processing and recovery of materials in a world where new types of equipment and technology are continuously emerging (Acosta and Corallo, 2020).

N&S Enterprise is a major purchaser of the e-waste. They receive approximately 70% of their e-waste, which is comprised primarily of central processing units (CPUs), from the Haags Bosch Landfill Site, while the remaining 30% is received from a combination of other sources, including residents. During the dismantling process, waste is generated and disposed at the Haags Bosch Landfill Site, since they do not have market for materials such as plastics and rubber. The largest volume of waste destined for the landfill is generated from appliances such as refrigerators, since 70-80% of the item requires disposal as only the motor and aluminium tubing are considered valuable to the

e-waste sector. On the other hand, there is a market for approximately 95% of air conditioning unit parts, such as copper, the iron frame, radiator, and motor. The mesh and rubber parts of air conditioning units account for the 5% of waste materials which are disposed at the landfill after dismantling. Mixed e-waste is stockpiled as the company awaits an opportunity for export. A few years ago, they sold circuit boards from television and computer monitors to Eternity Investment Inc. since they were only able to meet the buyer's demand in terms of quantity when combined.

Given that further information on the existing operator models was not provided, it is not possible to conduct a detailed economic assessment of the current situation.

6.3 Gaps, barriers, and opportunities to E-Waste Management operations

E-waste contains valuable materials that can be recovered for recycling, including iron, aluminium, copper, gold, silver, platinum, palladium, indium, gallium and rare earth metals, and thereby contributes to sustainable resource management since the extraction of these metals from the Earth has significant environmental impacts. Also, in many cases e-waste can be repaired or refurbished, extending its lifespan, contributing even more to sustainable development. By extending the life of equipment, reuse reduces the environmental footprint of the resource-intensive processes involved in producing the equipment. Reuse may also facilitate the availability of equipment to groups in society that otherwise would not have access to it since the cost of used equipment is lower than that of new equipment.

A main gap in the current operations is the lack of a mandatory framework and formal management system for e-waste. When compliance costs are high and there are no penalties for non-compliance, usually, proper handling and treatment will be avoided.

The lack of separate disposal and collection systems suggests that all e-waste ends up in non-fit-for-purpose landfills or dumpsites. On the other hand, there is almost no in-country capacity to manage/treat and dispose of this waste stream properly. Of particular concern are the current practices that are being used to extract precious and strategic metals, resulting in the release of UPOPs, regulated by the Stockholm Convention on Persistent Organic Pollutants, such as Polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF); Polybrominated diphenyl ethers (PBDEs) contained as flame retardants in plastics of TV and computer casings; and, Polychlorinated Biphenyl (PCBs). Once these contaminants are released, it´s quite impossible to address them adequately. Severe consequences to the environment and health can be expected, consequently, the social and economic impact generated by the improper management of e-waste can be expected to be relatively high. To address

these issues, a precautionary approach is to be implemented that aims to collect as much e-waste as possible.

Implementing ESM of e-waste would not only attenuate the negative impacts, but it would also promote the establishment of businesses that would generate work and revenue, extend the lifespan of final disposal sites – of particular concern for small islands – contributing to the reduction of greenhouse gas emissions when adequate technologies and methods are applied, and promote the compliance with MEAs and other relevant instruments to which the country is Party. Given the lack of capacity to manage/treat and dispose of e-waste locally, there is a need to export it, in compliance with the Basel Convention for the Transboundary Movements of Hazardous Wastes and their Disposal.

According to Acosta and Corallo (2020) the following initiatives would be necessary to promote the sound management of e-waste: mechanisms for cooperation and coordination among the key stakeholders, a generalized separate collection system, citizens' behaviour favouring recycling initiatives, policies or incentives for the reuse or recycling, and adequate treatment facilities for all waste streams. On the other hand, given the economic value of the recoverable materials in e-waste, some private initiatives that deal with small amounts could be used as a basis for implementation, by improving their capacity and processes, and feeding them with more material to treat. A relevant aspect to take into consideration is that there is an informal sector involved in the collection of these materials as a means of subsistence, which has to be addressed when designing any system.

One of several challenges for implementing ESM of e-waste is covering the sufficient financing needs. Investments in infrastructure and costs relating to the operation and maintenance of facilities require a sustainable flow of financing. There is no doubt that it is desirable for society to recover valuable materials and ensure adequate treatment and disposal of hazardous wastes. These types of projects often do not have positive net outcomes in terms of revenues, considering all investments and operative costs required for implementing sound management. Unfortunately, what represents a positive externality or an avoided cost for the community is not considered in a flow of private funds. Taking also into account the current low separation collection rates, the high idle capacity of investments, the low productivity of employees (as few tons processed per year per capita), it is necessary to consider incentives to raise interest by private actors. Based on findings from the E-waste SurWEEE Project, the private sector states that the market is not sufficient to attract entrepreneurs to relieve the pressures from the government; the main economically limiting issues are labour and freight prices, complexities of materials, low market price and challenges with the informal sector. Interviews with private sector stakeholders in Guyana revealed that they face

similar issues, as discussed above. Therefore, these operations require some type of compensation or subsidies from the State in order to increase their margins of profit.

From a broader perspective, there are three main stakeholders who could bear financial responsibility for end-of-life management of any kind of waste (i) entire society, (ii) waste holders or (iii) producers. One of the possible instruments that governments may wish to implement in this context is EPR. In principle, the producers of a product are held responsible for the collection and disposal of that product once it has become waste. Producers are free to include these costs in the pricing of their products. Another alternative would be to charge e-waste generators for its transport and operation, though it was identified that this would be the less-preferred option by stakeholders surveyed. In addition, different mechanisms could be set up in place for subsidizing certain aspects of the operations: fees paid by the government per ton received – or as a guarantee in case a minimum amount of e-waste is not collected-, collection financed by the government, goods and services (gas, electricity, fuel, others), exemption of duty fees, land use or cession permit, establish the principle of “non-taxable revenue” for access to waste contributions paid to individuals of entities delivering the waste to the formal collection points could create a positive incentive to channel material to the formal channel, etc.

Transparency on the real recycling costs should be pursued also to increase the awareness of the consumers and the society at large on the financial requirements of a proper e-waste management (Cyrcle Consulting, 2015).

Implementing a regional approach for e-waste treatment and facilitating economies of scale could be a recommended approach in the Caribbean Region, due to the limited availability of suitable land on small islands for treatment and storage facilities, and landfills; the high dependency on exporting recovered materials and hazardous wastes for making the recycling business economically viable; and, the small consumption rates in less populated countries that would facilitate investments. No previous experiences of a regional approach in waste management policies were identified. According to Acosta and Corallo (2020), a distinctive feature is that many of the same EEE importers operate within the Caribbean Region. This would facilitate a regional approach, such as the establishment of a recycling facility that acts as a regional hub, receiving e-waste from the different countries, improving operational costs and benefiting from becoming an economy of scale.

7 RECOMMENDATIONS AND NATIONAL STRATEGY FOR THE ENVIRONMENTALLY SOUND MANAGEMENT OF E-WASTE IN GUYANA

Sustainable management of resources must consider the pillars of economic, environmental and social costs and benefits. An integrated e-waste management system should therefore be aligned with Guyana's developmental thrust, the country's obligations to multilateral environmental agreements (MEAs), the Sustainable Development Goals (SDGs), and environmental and socio-economic best practices within the global e-waste industry.

The summary recommendations are as follows:

1. Establishment of a comprehensive e-waste policy, legislation, standards and an action plan that implements an integrated e-waste management system- This should adequately define the roles and responsibilities of stakeholders and create an enabling environment for promoting private sector investments in the national e-waste management industry. A clear definition of who is responsible for financing the e-waste collection and recycling must be included in legislation. The position of the Government of Guyana regarding the prohibition of e-waste imports should also be formally indicated in this legislation.
2. Establishment of an interagency committee with a mandate to enforce e-waste policy, legislation, action plans, standards, programmes and monitoring and evaluation (M&E) of the national e-waste management industry and guiding the country towards a lifecycle management approach for e-waste. Although there is evidence of communication among the different government stakeholders involved in e-waste management in Guyana, there is need for greater information-sharing and synergising of efforts. As such, an interagency committee would facilitate formal and frequent communication among these key stakeholders. This committee should therefore promote the adoption of international standards for best environmental practices for e-waste management

in Guyana and the industry is compliant with the national and international regulatory obligations through appropriate licencing schemes. It must be ensured that costs to run the system are transparent in order to stimulate competition in the collection and recycling system to drive cost effectiveness.

3. Development of national data collection system and inventory standards for the management of e-waste data such as quantity, type, coding, flows, lifespan for an improved understanding of the material flows of electrical and electronic equipment in Guyana, the amount and categories of e-waste generated on an annual basis. This can be supported by the Environmental Authorisation process of the EPA and the licensing processes of the SMU, as companies can be made to report data as a condition of their authorisation and licensing requirements.

4. Introduction of extended producer responsibility (EPR) schemes- This will guarantee the environmentally sound management (ESM) of e-waste, thereby diverting this waste stream from landfills and dump sites. The onus for ESM is placed on producers. It is important to understand how such a scheme will work in the context of Guyana's waste management system.

5. Forging of public-private-people partnerships that brings together government, the private sector and citizens to develop an efficient strategy for collection and disposal of e-waste. These efforts should be complemented by activities to enhance technical capacity and technology transfer in the public and private sectors and strengthen the e-waste management systems established. The end result of this should be favourable investment conditions for qualified recyclers to bring the required technical expertise to the country and ensure a net positive economic outcome for businesses in the e-waste industry. Awareness-raising campaigns on the environmental benefits of recycling among consumers should be conducted through these partnerships.

6. Careful examination of the role of the informal sector in the e-waste management system should be undertaken, so that future actions implemented do not result in

negative socioeconomic impacts to their operations and improve working conditions can be implemented.

7. Dissemination of awareness materials through formal (institutional) education at all levels, and by public communication campaigns (awareness activities). The ESM of e-waste would not become an economic operation if citizens do not appreciate positive and negative impacts to society and the cost of inaction.

7.1 Technical and Institutional Capacity

Integrated e-waste management is realisable in the presence of responsive human capital, systems, technology, facilities and finances.

Investment in human capacity development to meet the demands of e-waste management is critical. Training of personnel in data collection, inventorying, e-waste segregation and storage, occupational and environmental safety and health relative to e-waste management, and other technical aspects of the cradle to grave management of this waste stream is imperative.

The development of a national data collection and inventory standard for the management of e-waste data (quantity, type, coding, flows, lifespan) is also imperative for standardisation and harmonisation of e-waste data and statistics across all state and nonstate agencies. In this regard, requisite training on data collection and reporting may be required.

Coordinated e-waste management necessitates the establishment of an interagency committee with the mandate to enforce e-waste policy and all actions—plans, programmes and monitoring and evaluation (M&E)—and enforce compliance. This institution should represent the collaboration of public sector, private sector, citizens and nongovernmental organisations. Such an organisation can possibly create a single user interface, where information regarding e-waste management can be shared and viewed by all members of the interagency body; with some restrictions on access to confidential information where necessary.

The minimisation of e-waste cannot be realised without the employment of technology for resource recovery and recycling. Technology transfer, therefore, should be a priority of government and private sector in an effort to augment the circular-economy e-waste business model. Technology acquisition requires finance or capital investment, and only through feasibility studies can stakeholders confidently invest in such.

E-waste reaching open dumpsites poses the greatest management challenge and environmental threat. There must be establishment of treatment facilities to reduce the toxicity of e-waste reaching landfills, and creation of additional sanitary landfill facilities to match the increase in e-waste generation.

An efficient strategy for disposal and collection of e-waste has to be set up. It is recommended to ensure a consistent inflow of materials to the treatment facility. Identifying different strategies for the different sources of input (households, businesses, public administration offices, etc.) is advisable.

For deciding on the e-waste streams to be collected for treatment at the dismantling facility, it is recommended to select a combination that can ensure a net positive economic outcome. Components with high valuable fractions should be combined with those containing removable hazardous components through manual dismantling practices. A phased approach can be decided on, starting with a more simple combination of appliances, and widening the scope as experience is gained and disposal and collection mechanisms are perfected.

For each of the produced output fractions downstream partners have to be found. Some of the fractions, like copper, steel and aluminium can usually be commercialised locally. For other fractions like printed circuit boards a global market with quite volatile characteristics exists where prices offered for the same fraction can vary up to 40% within one year.

Depending on the location of the facility transport costs for the output fractions to the different downstream partners (material recovery or disposal facilities) on national, regional and international level may significantly reduce the potential revenues.

A licensing or certification to national or international standards should be encouraged. The application of a simple and effective licensing or certification system is key to ensure all recyclers (and collectors) are known to the authorities as well as appropriately authorized to carry out specific activities. Aspects related to treatment operations should be aligned with international best practices (such as the EN 50625-series of standards or the PACE Guidelines on the ESM of computers and MPPI guidelines for the ESM of mobile phones under the Basel Convention) as much as possible. The licensing system should appropriately address the environmental and health risks associated with the activities undertaken. The treatment facility should be licensed or certified to receive, dismantle, sort, treat and store e-waste and output material for final recycling.

Finally, it is recommended to ensure that all stakeholders involved in e-waste collection and recycling are aware of the potential impacts on the environment and human health as well as possible solutions for environmentally sound treatment of e-waste. Further awareness of serious environmental threats will encourage proper e-waste handling by generators and collectors, sound management and disposal of hazardous materials by recyclers, and it will stimulate the development cleaner technologies to manage these residues.

7.2 Policy and Legislation

The national integrated, interagency e-waste management system proposed should be founded on a legislative framework that coordinates hitherto fragmented legislations and regulations and reflects national commitment to honouring MEA obligations.

No legislation or policy can achieve sustained success without buy-in from the most important stakeholders of policy, that is the members of the public. Furthermore, public-private partnership (PPP) to actualise the proposed e-waste management system must have this stakeholder buy-in. A PPP is imperative for the functioning of the evolutionary circular-economy e-waste business model envisaged.

Moreover, at the core of e-waste management policy and legislation should be:

i. standards for e-waste data management and reporting, with established authorities identified
ii. key performance indicators (KPI) to track progress of action taken to minimise e-waste generation, maximise resource recovery, economic potentials, and safe treatment and disposal
iii. e-waste statistics for data-driven decision-making
iv. enforcement mechanisms to promote compliance

A clear legislation, with adequate definitions and roles and obligations of stakeholders creates a safer environment for promoting private investments. A clear definition of who is responsible for financing the e-waste collection and recycling must be included in legislation. On one hand, it has to be clear whether an object is used is EEE or E-waste (distinguishing if it is hazardous or not), and which are the owner´s responsibilities regarding its management. On the other, the legal framework should give clarity in terms of how to conduct the transport, storage, treatment, and disposal operations, aspects required to conduct and economic evaluation.

Introducing extended producer responsibility to ensure producers finance the collection and recycling of e-waste is recommended. The widely accepted method is also applicable in dealing with e-waste; it has proven effective in achieving high recycling rates when implemented. Economic instruments are of the most widely used EPR instruments. An example of this is the requirement for financing waste management costs (including collection and recycling) through taxes or a centralized fee structure.

Enforcing legislation for all stakeholders, and strengthening monitoring and compliance mechanisms across the country is required to ensure a level playing field. Enforcement will ensure that all stakeholders (e.g., collectors, recyclers and producers) meet the requirements of the legislation, so no company can gain a financial benefit from not meeting these requirements. Without enforcement, stakeholders that do meet the legislative requirements may be at a financial and operational disadvantage compared to companies that do not comply with the requirements; non-compliant companies can offer their products and services for a lower price by ignoring environmental, health and

safety standards. A clear list of criteria and sanctions can help send a strong signal to stakeholders that noncompliance will not be tolerated, and enforcement of legislation is a priority. A lack of enforcement creates the risk that more and more stakeholders will choose not to comply with the legislation's requirements, and this can eventually lead to a total failure of the legislation. As such, enforcement is critical to the success of e-waste legislation.

7.3 Prohibition of importation of used EEE of certain categories

The importation of used EEE of certain categories, particularly those categories with a lifespan of less than 5 years, and which produce more e-waste by mass should be prohibited. Much of the imported EEE with highly toxic and ozone-depleting components, are retained in country. This has negative implications for the environment and human health. The fact that the import of used EEE is permissible makes e-waste generation more rapid and increases the quantum of potential environmental stressors.

7.4 Economic Incentives/ Improvements

The government has the authority through legislations to institute taxes, fines and other mechanisms such as EPR to encourage private sector compliance with e-waste management directives. These may be considered negative incentives. However, actions such as tax exemptions for honouring of corporate social responsibility (CSR) by corporate citizens (business entities), and duty-free concessions for the import of technology for resource recovery and/or recycling in the e-waste industry are positive incentives. Both are necessary and can yield positive outcomes.

To encourage citizen participation, innovation and action, however, it is incumbent on government to prioritise positive incentives. Financial rewards for demonstrated sustainable e-waste management action may include grant from government and donor agencies to fund persons and NGOs involved in activities such as e-waste separation, collection, treatment, public awareness and even investment in innovation and acquisition of technology for e-waste business ventures. Additionally, financial

institutions can make borrowing for e-waste business investment easier, and even lower the interest rate on such loans.

Government can improve e-waste management immediately by promoting separation of e-waste at source and providing receptacles specially designated for e-waste. This is an incentive for separation and can be beneficial to the local e-waste business potentials. This may be achieved through a phased approach, where separation of waste at source first becomes a legislative requirement for industrial, commercial and government entities, and then be gradually implemented at the household level, taking cognisance of the lessons learned and opportunities for improvement.

Implementing ESM of E-waste would not only attenuate the negative impacts, but it would also promote the establishment of businesses that would generate work and revenue, extend the lifespan of final disposal sites – of particular concern for small islands – contributing to the reduction of greenhouse gas emissions when adequate technologies and methods are applied, and promote the compliance with MEAs and other relevant instruments to which the country is Party.

A favorable investment conditions for qualified recyclers has to be created to bring the required technical expertise to the country. It is essential to provide investors with favorable and stable market conditions, including fair competition among peers rather than unfair competition from informal players. These conditions can be both economic and regulatory. They may be created by providing tax relief for investors who possess technical expertise or entering into public-private partnerships. Favorable investment conditions shall not benefit only the e-waste recycling sector, but also the recycling industry as a whole.

It is recommended to ensure that costs to run the system are transparent and stimulate competition in the collection and recycling system to drive cost effectiveness. Transparency on the actual recycling costs should be pursued to increase the consumers' and the general public's awareness of the financial requirements needed for proper e-waste management. Fair competition between logistics providers and recyclers should be established to ensure the system's long-term cost effectiveness. In addition,

irrespective of the financing model adopted (EPR-based or not), it is paramount that the funds secured for e-waste management are used to cover technical costs for e-waste management only and not diverted for other purposes to ensure the system's cost effectiveness.

Informal collection systems in place can be regularized to support the collection of e-waste, and ensure e-waste is sent to licensed recyclers through incentives. To push existing flows of e-waste to regulated recyclers, it may be necessary to offer awareness and incentives to consumers (business, government and the general public) and collectors. The incentive could be offered by the producer, government or treater, and this needs to be defined. The incentive would typically need to be more attractive than the payment by informal recyclers and encourage the collection of whole products over cherry-picked and partly dismantled items. The informal collection and treatment network would shrink significantly over time, as the collectors enter into formal collection contracts with licensed recyclers. In addition to offering an incentive to collectors, informal collectors must receive access to training and safety equipment in order to start operating under environmental, health and safety standards.

7.5 Preliminary recommendations or considerations for local E-Waste material recovery, marketing, and disposal programmes

The lack of data on e-waste generation rates in Guyana makes it difficult to determine the viability of a local resource recovery and recycling business. Material recovery and recycling technology are capital intensive investments. An understanding of the landscape for e-waste management and the return on investment is therefore critical.

During engagements with some industry operators, it was revealed that the volatility of price for components of e-waste, as well as logistical difficulties such as access to external markets, internal transportation and storage, and transboundary movement, are key inhibitors to investment in the industry.

In order to enhance potential for investment into this sector in Guyana, it is necessary to conduct feasibility studies to understand the intricacies of the sector and determine

viability. Secondly, marketing of this emerging business will have to encompass promotion of its potential lucrative nature, incentives for investment in this potentially volatile business, and market access and logistics support.

As stated previously, a licensing or certification to national or international standards should be encouraged. In terms of collection, at a minimum, all collection points must be licensed or in compliance with national regulations to receive, manage, sort and store e-waste. Collection points should work with their collectors and instruct them on how to handle e-waste.

It is vital to create awareness on the environmental benefits of recycling among consumers. All waste collection programmes start with consumers (individual households or organizational entities), as consumers decide when and how to dispose of a product. It is therefore critical that consumers decide to utilize licensed recycling facilities instead of sending their waste to landfill, substandard treatment or incineration.

In Guyana, no local end-processing facilities exist for any e-waste fraction, thus, it is imperative to ensure good and easy access to international licensed treatment facilities. These plants usually process a large amount of these materials to achieve economies of scale; these can only operate at a profit by processing high volumes of this material, which is impossible on the national level. This means that in order for the system to run efficiently and economically, it is essential that countries allow specific material fractions to be exported and imported to these facilities and that this process is not heavily burdened with time-consuming bureaucracy. It must be ensured that legal requirements like the Basel Convention are met but do not lead to long delays or make it impossible to export waste fractions to these licensed international treatment facilities. Furthermore, legislative updates are therefore required to ensure control of the fate of imported waste if that is eventually accepted by the government. Continued monitoring of waste streams, for example through movement documents and following up on final disposal certificates, is necessary to ensure that they arrive in the specialised facilities for treatment. Additionally, profits could be optimized through the implementation of

EPR schemes. Given that voluntary EPR schemes are not as successful as legislated ones, it is also recommended that legislation be developed or amended to facilitate this.

7.6 Preliminary recommendations or considerations for the management of e-waste at a sub-regional level

Integrated e-waste management at the subregional level—within the Caribbean Community (CARICOM)—will require interstate collaboration on standardisation of e-waste management legislations for transferability. Enforcement of such legislations, therefore, must become the responsibility of each Member State.

Technology and knowledge transfer is another crucial determinant of sustainable e-waste management within CARICOM. The economic disparity among Member States often makes it difficult for the region as a whole to demonstrate sound management of resources and exploitation of resource potentials. To address this, the more economically and technologically advanced countries of the region will have to demonstrate unprecedented commitment to the sharing of experience, expertise and best available technology for e-waste management.

Generally, more collaboration on e-waste management and the exploitation of e-waste business potentials in the region is necessary. The CARICOM Secretariat, which is headquartered in Guyana, has a critical role to play. As one of the fastest growing waste streams, e-waste management must become a priority item on CARICOM's agenda, and the proposed intergovernmental agency must leverage its connection and authority and harness its collective might to fight the plight of e-waste mismanagement in the region.

Some constraints identified, characteristic to SIDS, are limited availability of suitable land for treatment and storage facilities and landfills; dependency on the viability of exporting recovered materials and hazardous wastes; and low level of consumption rates to facilitate investments. Implementing a regional approach for E-waste management and thus generating economies of scale would facilitate investments and

reduce space requirements due to larger collection rates and more frequency of exports.

A unified approach to e-waste management in the sub-region would likely be a suitable strategy to ensure sound benefits and market capture, as supported by Mohammadi, Singh and Habib (2021) who concluded that owing to the typical small economies of scale of SIDS, regional cooperation would be critical if the Caribbean is to move towards not only a circular economy but to maintain a sustainable framework. Therefore, considerations for e-waste management at a sub-regional level is required and should entail the collective assessment of country practices to identify opportunities and benefits, such as increased employment and strengthened GDP and determine the feasibility of a sub-regional e-waste management solution.

To adhere to this recommendation, Components 2 and 3 of this project will investigate the feasibility of a sub-regional dismantling or recycling centre. In this project, the results from the three (3) project countries, that is, Guyana, Suriname and Trinidad and Tobago are collectively analysed to determine the optimal mechanism for sub-regional e-waste dismantling facility. In this regard, a data-driven strategy can be formulated, and can involve regional bodies to encourage technical cooperation and ease of implementation. Depending on the feasibility of a dismantling centre in the sub-region, further studies and agreements can occur within the wider region to determine if additional e-waste can be directed to the centre to achieve greater productivity with the realisation of a joint vision in the region towards e-waste management.

The first suggestion to locate the sub-regional dismantling facility would be Trinidad and Tobago due to the high e-waste generation and level of industrialization of the country, compared to Guyana and Suriname. The infrastructure already available will reduce capital needed to set up the facility. To assess the economic feasibility of this alternative, the economic model presented in the previous section was run with some adjustments:

- Input e-waste considers the sum of e-waste generated in the three countries. The model still shows three scenarios of collection, which would be equivalent among the three countries: 30%, 50%, and 80%.
- The costs of transboundary movements were included, considering freight costs between Suriname and Trinidad and Tobago informed by a logistics provider based in Suriname. Due to lack of specific information, it was assumed the same freight costs for Guyana-Trinidad and Tobago.

Table 18 shows the results obtained.

Table 18: results obtained when running the economic model for the sub-regional approach based in Trinidad and Tobago

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total annualized fixed costs		**-$ 1,156,210**	**-$ 1,914,518**	**-$ 3,041,876**
Total Equipment costs		-$ 3,139,110	-$ 5,212,931	-$ 8,311,906
Total equipment costs annualized according to lifespan		-$ 191,645	-$ 317,285	-$ 504,512
Total rental costs per year		-$ 964,565	-$ 1,597,233	-$ 2,537,365
Total other fixed costs		$ -	$ -	$ -
Total Variable costs and revenues		**$ 721,850**	**$ 1,277,680**	**$ 2,113,547**
Total CMR costs per year		-$ 195,259	-$ 320,839	-$ 514,091
Total staff costs per year		-$ 793,440	-$ 1,255,824	-$ 1,939,824
Total materials revenues and costs per year		$ 2,016,380	$ 3,360,633	$ 5,377,012
Total Freigh Rate		-$ 305,830	-$ 506,290	-$ 809,550
Total Other variable costs		$ -	$ -	$ -
Total input quantities (tons/year)		4544	7573	12117
Annualized economic result (revenues - costs)		-$ 434,360	-$ 636,838	-$ 928,329
Total treatment cost/ton		**-$ 96**	**-$ 84**	**-$ 77**

As it can be seen from the model, the economic result of the sub-regional model is negative for the three collection rates scenarios. It could also be expected, given the larger quantities handled through this alternative, a reduction in the need of containers and storage areas. For example, if only 10% of containers are needed and

consequently 40% of storage area required is reduced, the following would be the results achieved:

Table 19: Results obtained when running the economic model for the sub-regional approach based in Trinidad and Tobago considering a reduction in containers and storage area needed

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		4544	7573	12117
Annualized economic result (revenues - costs)		-$ 47,181	$ 5,048	$ 106,207
Total treatment cost/ton		-$ 10	$ 1	$ 9

This reduction would imply that for the 50% and 80% collection scenarios, the economic output turns positive.

Additionally, if rental costs are eliminated though subsidies from the government, the following would be the positive economic outputs of each collection scenario:

Table 20: Results obtained when running the economic model for the sub-regional approach based in Trinidad and Tobago considering no rental costs

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total input quantities (tons/year)		4544	7573	12117
Annualized economic result (revenues - costs)		$ 530,205	$ 960,395	$ 1,609,036
Total treatment cost/ton		$ 117	$ 127	$ 133

On the other hand, a second alternative is tested. Given the lower labour and rental costs, Suriname would be the suggested location for the sub-regional dismantling facility. In this case, the results would be:

Table 21: results obtained when running the economic model for the sub-regional approach based in Suriname

		Escenario A	Escenario B	Escenario C
Percentage of e-waste collected	100%	30%	50%	80%
Total annualized fixed costs		**-$ 768,808**	**-$ 1,273,015**	**-$ 2,022,784**
Total Equipment costs		-$ 3,139,110	-$ 5,212,931	-$ 8,311,906
Total equipment costs annualized according to lifespan		-$ 191,645	-$ 317,285	-$ 504,512
Total rental costs per year		-$ 577,163	-$ 955,729	-$ 1,518,272
Total other fixed costs		$ -	$ -	$ -
Total Variable costs and revenues		**$ 1,207,983**	**$ 2,048,262**	**$ 3,308,661**
Total CMR costs per year		-$ 173,755	-$ 287,047	-$ 458,795
Total staff costs per year		-$ 348,000	-$ 550,800	-$ 850,800
Total materials revenues and costs per year		$ 2,016,380	$ 3,360,633	$ 5,377,012
Total Freigh Rate		-$ 286,641	-$ 474,524	-$ 758,756
Total Other variable costs		$ -	$ -	$ -
Total input quantities (tons/year)		4544	7573	12117
Annualized economic result (revenues - costs)		$ 439,175	$ 775,248	$ 1,285,877
Total treatment cost/ton		**$ 97**	**$ 102**	**$ 106**

It can be concluded that locating the facility in Suriname would imply that the economic result of the dismantling facility is positive in all the collection scenarios.

To make any sub-regional approach possible, user agreements must be in place among countries so that e-waste can move among them. The political and social impact of such measure should be taken into consideration, especially in the light that both hazardous fractions and fractions destined to landfill would be generated from treatment at the sub-regional facility, though a large part of input e-waste would have been originated abroad. These impacts should be estimated in order to evaluate the need of establishing a treatment fee and estimating its value.

At the time of writing this report, the position of the Government of the Cooperative Republic of Guyana on the import of waste, including hazardous waste, is that it will be prohibited. To this end, there may not be political will for supporting the siting of the e-waste dismantling facility for the sub-region (or the region at large) in Guyana.

Therefore, the siting of the facility in Suriname or Trinidad and Tobago would also be more favourable from a legal perspective.

The next steps of the project in Component 2 would include the identification of the best location for a dismantling centre, with further research into material streams identification, legal considerations such as the transboundary movement of materials and technical requirements including transportation, treatment and storage. In Component 3, a business plan for the proposed solution will consider cost factors throughout the value chain of e-waste recycling, identify markets for the sale of recyclable materials and estimate the financial demand of a dismantling centre. Therefore, final recommendations and tangible steps with regards to the management of WEEE at a sub-regional level can be made after the implementation of Components 2 and 3.

7.7 Recommendations for future research

Despite the best efforts to collect data on e-waste management in Guyana, there still exist tremendous data gaps. Therefore, targeted studies would be required to improve on the data collected, and more accurately inform a solution to e-waste management in Guyana.

Therefore, the following is recommended as areas for future research:

1. A specific study, geared towards information-gathering from the informal sector should be conducted to understand the intricacies of the e-waste trade and its direct and indirect impacts on their livelihoods. This should include an assessment of informal activities at other dumpsites throughout the country, since a more detailed assessment of the activities of the informal sector will provide a better estimation of key players at all stages of the e-waste management sector.
2. E-waste estimation should be attempted using a different methodological approach which estimates the mass of material composition of end-of-life EEE,

proportioned according to components valuable to the e-waste sector and those which are not. This approach will ensure improved accuracy of estimates regarding the proportion of EEE POM which eventually becomes e-waste.

3. Considering the willingness of respondents to be involved in sorting e-waste, coordination of collection and payment of fees for e-waste recycling, a feasibility study on the development of e-waste collection depots should be conducted. This study should also examine the appropriateness of a section of the Haags Bosch Landfill Site being utilised as the main drop off location, since this will continue to give the recyclers currently operating at the site, access to valuable e-waste, to support their livelihoods. Further, mechanisms such as specific days for the collection of e-waste from the public, and the use of a manifest form to document all e-waste collected, transported and dropped off, should be examined as part of the greater effort to implement an organised e-waste management system.

8 CONCLUSION

There appears to be consensus among global policymakers that the most sustainable means of curbing the growing e-waste problem is the pursuit of a circular economy which maximises resource recovery and e-waste-to-business opportunities. This, along with enhanced separation, collection, treatment and strong public-private partnership and citizen involvement, is the new paradigm shift in the management of this rapidly growing waste stream.

The EU promotes the Extended Producer Responsibility (EPR) policy which shifts significant e-waste management responsibility from taxpayers to EEE producers and importers. Although the cost of e-waste management that must be borne by EEE producers will still trickle down to consumers, one of the main benefits of EPR schemes is the opportunity presented for the recovery of secondary resources from e-waste. Creation of take-back systems, designation of special collection points for e-waste stream, promotion of ad-hoc e-waste collection campaigns, and establishment of recycling centres are required for ensuring an effective reverse supply chain is implemented for e-waste management.

In LAC, the management of e-waste is even more challenging, ranging from the lack of institutional capacity, relevant regulations, and inventory systems to low resource recovery, e-waste treatment and data dearth. UNIDO's Latin America and the Caribbean e-waste project—through the Sustainable Cycles (SCYCLE) Programme—produced a new report which asserts that only *3 % of Latin America's e-waste is reported as collected through formal channels and treated in an environmentally sound manner* (SCYCLE, 2022). The report submits that all 13 of the participating Latin American countries have legal and regulatory frameworks for waste management, but only Costa Rica, Ecuador, Bolivia, Chile and Peru have instituted specific legislation for e-waste management and EPR. Even in countries where there are responsive policies, enforcement remains deficient.

In the Caribbean subregion, the paucity of data on e-waste generation, treatment and disposal is symptomatic of the systemic deficiencies and lack of vision and commitment by governments to commit policy and resources to tackle a problem on a growth curve more acute than that of the global community. Absence of e-waste-specific legislations, and limitations in best available technology for resource recovery have compounded matters. However, some action to address the data deficit that plagues the region is afoot. This assessment is an example action that intends to contribute to legislative overhaul and capacity development in the region to respond to the evolving challenge presented by the e-waste revolution.

The project, Management of E-waste in Guyana, Trinidad & Tobago and Suriname, attempted to document the flow of e-waste, quantify e-waste generation, and identify key players in the e-waste management system. Despite the paucity of comprehensive and easily accessible data, e-waste generation quantities for Guyana, over the last 3 years were estimated.

This assessment highlighted the importance of the informal sector in Guyana's e-waste management system and emphasised the importance of this group in diverting valuable resources from the landfill. Although the assessment was unable to capture all players in the informal sector, it was clear that the GT Recyclers Cooperative Society Limited, although classified as 'waste pickers', were structured and organised differently from most players in the informal sectors in the Caribbean. This therefore begs the question of whether this group should really be categorised as members of the informal recycling sector. Irrespective of the answer to this question, it is evident that efforts should be made to integrate 'waste pickers' into the formal e-waste management system in Guyana. As such, irrespective of whether a local or regional solution to e-waste management in Guyana is adopted, policymakers must ensure that the livelihoods of the 'waste-pickers' are not unfairly disrupted.

As Guyana begins to examine the possibility of a circular economy approach to e-waste management, it is important to recognise that the end result should be a fair, inclusive

and sustainable option which not only focuses on the efficiency of the recycling chain, but also the environmental and socioeconomic implications which may result.

Finally, a 'one-size-fits-all' approach should be avoided, so that a country-appropriate strategy, building on practices proven to be successful, can be adopted. Furthermore, it is necessary to engage in a bottom-up consultative process involving all key players, to understand e-waste benefits and challenges, and examine the appropriateness of existing policies and systems so that sustainable legislative, infrastructural and economic solutions may be implemented.

An economic model for a dismantling facility at Guyana was developed with the aim of helping policy makers to understand the economic framework conditions for e-waste treatment in their country and sub-region. In addition, the model brings advantages to decision makers as it gives detailed background data which is useful when designing an e-waste policy framework. It can further provide support to entrepreneurs planning to set-up an e-waste dismantling facility to get a good overview of the expected costs and revenues. For established facilities this tool is helpful to identify options for improvement in the current process to optimize their dismantling operations. In addition to the benefits for the business, the tool brings advantages to decision makers as it gives detailed background data which is useful when designing an e-waste policy framework.

From studying the model, it can be concluded that, regardless the collection scenario, the economic result of the treatment facility is negative. However, for scenarios having higher collection rates, the profit margins increase due to the economies of scale being achieved.

The feasibility of setting up a sub-regional dismantling facility was assessed through the model. The first alternative was to locate it in Trinidad and Tobago, due to the high e-waste generation and level of industrialization of the country, in comparison to Guyana and Suriname. The second alternative was to locate it in Suriname, due to the lower labour and rental costs. Positive economic results are achieved when the sub-regional facility is located in Suriname. In the case of Trinidad and Tobago, positive economic results are only achieved following several adjustments to the factors input into the

model. To make any sub-regional approach possible, user agreements must be in place among countries so that e-waste can move among them. The political and social impact of such measure should be taken into consideration as well.

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10 APPENDICES

Appendix 1: Schedules I & II of Guyana's Hazardous Wastes Regulations

SCHEDULE I reg. 2(e) and (f)

LIST OF HAZARDOUS WASTES TO BE CONTROLLED

Waste streams

1. Clinical Wastes from medical care in hospitals, medical centers and clinics.
2. Wastes from the production and preparation of pharmaceutical products.
3. Wastes from the production , formulation and use of biocides and phytopharmaceuticals.
4. Waste pharmaceuticals, drugs and medicines.
5. Wastes from the manufacture, formulation and use of wood preserving chemicals.

Waste having as constituents

Metal carbonyls
Beryllium, beryllium compounds
Hexavalent chromium compounds
Copper compounds
Zinc compounds
Arsenic, arsenic compounds
Selenium, selenium compounds
Cadmium, cadmium compounds
Antimony, antimony compounds
Tellurium, tellurium compounds
Mercury, mercury compounds
Thallium, thallium compounds
Lead, lead compounds
Inorganic fluoride compounds excluding calcium fluoride
Inorganic cyanides
Acidic solutions or acids in solid form
Basic solutions or bases in solid form
Asbestos (dust and fibres)\Organic phosphorous compounds
Organic cyanides
Phenols, phenol compounds including chlorophenols
Ethers
Halogenated organic solvents
Any congenor of polychlorinated bibenzo-furan
Any congenor of polychlorinated dibenzo-p-dioxin
Organohalogen compounds other than substances referred to in this Schedule.

SCHEDULE II reg. 2 (e)

LIST OF HAZARDOUS CHARACTERISTICS

1. Explosives.

2. Flammable liquids.

3. Flammable solids or waste solids other than explosives which may be readily combustible.

4. Oxydising substances.

5. Organic peroxides.

6. Poisonous substances.

7. Infectious substances.

8. Corrosives.

9. Toxic gases.

10. Toxic substances which if inhaled or ingested may cause delayed or chronic effects.

11. Ecotoxic substances which if released may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon systems.

12. Materials capable, after disposal, of yielding another material which possesses any of the characteristics specified in items 1 – 11 of this Schedule.

Appendix 2: Composition of the National Working Group (NWG)

Name	Organisation	Rationale for Organisation's Selection
Ms. Odessa Duncan (Chairperson)	Environmental Protection Agency (EPA)	Guyana's principal environmental regulator and Focal Point and Competent Authority for the Basel Convention
Ms. Yonelle Drakes	Guyana Revenue Authority (GRA)	Responsible for promoting compliance with trade and border law, and responsible for record-keeping related to import and export of commodities
Mr. Al Donavon Fraser	Guyana National Bureau of Standards (GNBS)	National body for standards and quality in Guyana
Mr. Denzil Jones	Ministry of Local Government and Regional Development (MLGRD)	Has oversight for solid waste management in Guyana and hence operation of the Haags Bosch Sanitary Landfill and other waste disposal sites
Mr. Stephen Bourne	Eternity Investment Inc.	Only EPA- Authorised Exporter of E-Waste

Appendix 3: HS Codes Received from GRA

Large Household Appliances	
HS Code	**Description**
841510	Air conditioners window/wall types, self-contained
841581	Air conditioners nes with reverse cycle refrigeration
841582	Air conditioners nes, with refrigerating unit
841583	Air conditioners nes, without refrigerating unit
841810	Refrigerators and freezers; combined refrigerator-freezers
841821	Refrigerators, household compression type
841829	Refrigerators, household type, including non-electric
841830	Freezers of the chest type, < 800 litre capacity
841840	Freezers of the upright type, < 900 litre capacity
841850	Refrigerator/freezer chests/cabinets/showcases
841861	Compression refrigeration equipment with heat exchange
841869	Refrigerating or freezing equipment nes
842112	Clothes-dryers, centrifugal
842211	Dish washing machines (domestic)
845011	Automatic washing machines, of a dry capacity < 10 kg
845012	Washing machines nes, capacity <10 kg, built-in drier
845019	Household/laundry-type washing machines <10 kg, nes
845020	Household or laundry-type washing machines, cap >10kg
845110	Dry-cleaning machines
845121	Drying machines, capacity <10 kg, except washer-drier
845129	Drying machines, nes
845130	Ironing machines and presses including fusing presses
851621	Electric storage heating radiators
851629	Electric space heating nes and soil heating apparatus
851650	Microwave ovens
851660	Electric cooking, grilling & roasting equipment nes

Small Household Appliances	
HS Codes	**Description**
841451	Table, window, ceiling fans, electric motor <125 watts
842310	Personal weighing machines, baby & household scales
845210	Household type sewing machines
850980	Domestic appliances, with electric motor, nes
851640	Electric smoothing irons
910111	Wrist-watch, precious metal, battery, with hands
910119	Wrist-watch, precious metal, battery, other
910191	Pocket-watch, precious-metal case, battery
910211	Wrist-watch, base-metal case, battery, with hands
910212	Wrist-watch, base-metal case, battery, opto/electric
910219	Wrist-watch, base-metal case, battery, other
910291	Pocket-watch, base-metal case, battery
910310	Clocks with watch movements, battery (except vehicle)
910390	Clocks with watch movements, nes (except vehicle)
910511	Alarm clocks, battery or mains powered
910521	Wall clocks, battery or mains powered
910591	Clocks, nes, battery or mains powered
910700	Time switches
910811	Assembled battery watch movement, mechanical display
910812	Assembled battery watch movement,opto-electric displa
910819	Assembled battery watch movement, nes
910820	Watch movements, complete and assembled, auto-winding
910890	Watch movements, complete & assembled (excl. electrically operated), other ...
850940	Domestic food grinders, mixers, juice extractors
851672	Electric toasters, domestic
851679	Electro-thermic appliances, domestic, nes
851610	Electric instant, storage and immersion water heaters
851671	Electric coffee or tea makers, domestic
850811	Vacuum cleaners, with self-contained electric motor, Of a power not > 1,500 W & having a dust bag/other receptacle capacity not > 20 l
850819	Vacuum cleaners, with self-contained electric motor, other than of 8508.11
850860	Other vacuum cleaners,not with self-contained electric motor
851010	Shavers, with self-contained electric motor
851020	Hair clippers, with self-contained electric motor
851030	Hair-removing appl w/sel
851631	Electric hair dryers
851632	Electro-thermic hairdressing apparatus, nes
851633	Electro-thermic hand drying apparatus

IT & Telecommunication Equipment	
HS Code	**Description**
847010	Electronic calculators operable with internal power
847021	Electronic calculators, printing, external power
847029	Electronic calculators, non-printing, external power
847170	Storage units
847180	Units of auto data proce
847190	Automatic data processin
847141	Dig auto data proc w/cpu
847149	Dig auto data proc units
847150	Digital process units wh
847130	Portable digital data pr
844331	Machines which perform two/more of the functions of printing, copying/facsimile transmission, capable of connecting to an automatic data processing machine/to a network
844332	Other printers, copying machines & facsimile machines, whether/not combined , exclud the ones which perform two/more of the functions of printing, copying/facsimile transmission; capable of connecting to an automatic data processing machine/to a network
851711	Line telephone sets,cord
851718	Other telephone sets, incl. telephones for cellular networks/for other wireless networks, other than 8517.11 & 8517.12
851769	Other apparatus for transmission/reception of voice, images/other data, incl. apparatus for communication in a wired/wireless network (such as a local/wide area network) , other than 8517.61 & 8517.62
903040	Gain, /distortion and crosstalk meters, etc
851712	Telephones for cellular networks/for other wireless networks, other than Line telephone sets with cordless handsets
851761	Base stations for transmission/reception of voice, images/other data, incl. apparatus for communication in a wired/wireless network (such as a local/wide area network)
844312	Sheet fed, office offset printers, sheet < 22x36 cm
844339	Other printers, copying machines & facsimile machines, whether/not combined , excl. 8443.31 & 8443.32
847050	Cash registers
847090	Postage franking, ticket-issuing machines, etc
852849	Other cathode-ray tube monitors , not of a kind solely/principally used in an automatic data processing system of heading 84.71
852859	Other monitors, not of a kind solely/principally used in an automatic data processing system of heading 84.71
853120	Indicator panels incorporating electronic displays

Consumer Equipment	
HS Codes	**Description**
851830	Headphones, earphones, combinations
852712	Pocket-size radio-cassette
852713	Radio apparatus w/sound
852719	Radio receivers, portable, non-recording
852791	Other reception apparatus for radio-broadcasting, combined with sound
852792	Other reception apparatus for radio-broadcasting, not combined with sound recording/reproducing apparatus but combined with a clock.
852799	Other reception apparatus for radio-broadcasting, excl. 8527.91 & 8527.92
851840	Audio-frequency electric amplifiers
851850	Electric sound amplifier sets
851920	Apparatus operated by coins, banknotes, bank cards, tokens/by other means of payment
851930	Turntables (record-decks)
851981	Other sound recording/reproducing apparatus, using magnetic, optical/semiconductor media, other than 8519.20, 8519.30, 8519.50
852721	Radio receivers, external power,sound reproduce/recor
852729	Radio receivers, external power, not sound reproducer
852110	Video recording/reproducing apparatus, magnetic tape
852190	Video record/reproduction apparatus not magnetic tape
852560	Transmission apparatus for radio-broadcasting/televison incorporating reception apparatus
852869	Projectors, not of a kind solely/principally used in an automatic data processing system of heading 84.71
852871	Reception apparatus for televison, Not designed to incorporate a video display/screen
900661	Photographic discharge lamp flashlight apparatus
900669	Photographic flashlight apparatus, nes
900720	Cinematographic projecto
901010	Equipment for automatic development of photo film
901050	App & equip for ph labor
901060	Projection screens
903149	Optical instruments and
852580	Television cameras, digital cameras & video camera recorders
852873	Other reception apparatus for television, whether/not incorporating radio-broadcast receivers/sound/video recording/reproducing apparatus, black & white/other monochrome.
852872	Other colour reception apparatus for television, whether/not incorporating radio-broadcast receivers/sound/video recording/reproducing apparatus,

Lighting Devices	
HS Code	**Description**
853941	Arc-lamps
853949	Ultra-violet or infra-re
853931	Fluorescent lamps, hot cathode
853932	Mercury or sodium vapour
853939	Discharge lamps, other than ultra-violet lamps, nes
851210	Lighting/signalling equipment as used on bicycles
940510	Chandeliers, other electric ceiling or wall lights
940520	Electric table, desk, bedside and floor lamps
940530	Lighting sets of a kind used for Christmas trees
940540	Electric lamps, lighting fittings, nes

Electrical and Electronic Tools	
HS Codes	**Description**
846721	Drills of all kinds, for working in the hand, with self-contained elec. mot ...
846722	Saws for working in the hand, with self-contained elec. motor
846729	Tools for working in the hand, with self-contained elec. motor (excl. drill ...
851511	Electric soldering irons and guns
851519	Electric brazing, soldering machines and apparatus ne
851521	Electric resistance welding equipment, automatic
851529	Electric resistance welding equipment, non-automatic
851531	Automatic electric plasma, other arc welding equipment
843319	Mowers, powered, lawn, nes

Toys, Leisure and Sports Equipment	
HS Code	**Description**
950300	Tricycles, scooters, pedal cars & similar wheeled toys; dolls' carriages; dolls; other toys; reduced-size
950490	Articles for funfair, table and parlour games, nes
920790	Musical instruments nes, electric/requiring amplifier

Medical Devices	
HS Code	**Description**
902140	Hearing aids, except parts and accessories
901812	Ultrasonic scanning appr
901813	Magnetic resonance imagi
901819	Electro-diagnostic apparatus, nes
901841	Dental drill engines

Monitoring and Control Instruments	
HS Code	**Description**
853110	Burglar or fire alarms and similar apparatus
853180	Electric sound or visual signalling apparatus, nes
854340	Electric fence energiser
854370	Other machines & apparatus for electrical machines & apparatus, other than than machines & apparatus for electroplating/ electrolysis/electrophoresis/signal generators/particle accelerators.
901730	Micrometers, callipers and gauges
902410	Machines for testing mechanical properties of metals
902480	Machines for testing mechanical properties nes
902519	Thermometers, except liquid filled
902580	Hydrometer, pyrometer, hygrometer, alone or combined
902610	Equipment to measure or check liquid flow or level
902620	Equipment to measure or check pressure
902680	Equipment to measure, check gas/liquid properties nes
902710	Gas/smoke analysis apparatus
902780	Equipment for physical or chemical analysis, nes
903020	Cathode-ray oscilloscopes, oscillographs
903033	Other instruments & apparatus, for measuring/checking voltage, current, resistance/power, without a recording device, other than 9030.31 & 9030.32,
903039	Ammeters, voltmeters, ohm meters, etc, non-recording
903089	Electrical measurement instruments nes
903180	Measuring or checking equipment, nes
903210	Thermostats
901510	Rangefinders
901520	Theodolites and tacheometers
901530	Surveying levels
901540	Photogrammetrical surveying instruments, appliances
901580	Surveying, etc instruments nes

Automatic Dispensers	
HS Code	**Description**
847629	Machines; automatic beverage-vending machines, not incorporating heating or refrigerating devices
847689	Machines; automatic goods-vending machines, (e.g. postage stamp, cigarette, food or money-changing machines, excluding beverage-vending machines), not incorporating heating or refrigerating devices

Appendix 4: EEE POM,2019-2021 (GRA Figures)

Category	EEE POM (Mt)		
	2019	2020	2021
LHA	4,213	4,206	5,678
SHA	-1,688	532	1,841
ITE	609	508	574
CE	1,017	1,465	1,772
LD	820	617	742
EET	306	277	513
TLSE	766	693	919
MD	-119	-147	71
MCI	-574	338	79
AD	1	1	5
TOTAL	**5,351**	**8,490**	**12,194**

*LHA = Large Household Appliances, SHA = Small Household Appliances, ITE = IT and Telecommunications Equipment, CE – Consumer Equipment, LD = Lighting Devices, EET = Electrical and Electronic Tools, TLSE = Toys, Leisure and Sports Equipment, MD = Medical Devices, MCI = Monitoring and Control Instruments, AD = Automatic Dispensers.

Appendix 5: POM Values, 2009-2021 (without adjustment of values)

EEE Put on Market (kg)											
Year	Large Household Appliances	Small Household Appliances	IT & Telecommunications Equipment	Consumer Equipment	Lighting Devices	Electrical & Electronic Tools	Toys, Leisure& Sports Equipment	Medical Devices	Monitoring and Control Instruments	Automatic Dispensers	TOTAL
2009	1,703,956.00	764,369.00	749,869.00	728,466.00	373,465.00	92,890.00	405,126.00	6,136.00	88,072.00	257.00	**4,912,606.00**
2010	2,432,998.00	623,614.00	(738,955.00)	862,458.00	459,840.00	119,790.00	432,934.00	19,189.00	106,264.00	991.00	**4,319,123.00**
2011	2,963,846.00	815,762.00	990,813.00	1,129,324.00	610,351.00	165,008.00	587,769.00	64,897.00	84,152.00	4,883.00	**7,416,805.00**
2012	3,480,677.00	874,520.00	1,031,439.00	1,199,180.00	566,542.00	166,806.00	**5,285,834.00**	62,418.00	71,465.00	4,363.00	**12,743,244.00**
2013	2,884,493.00	1,016,225.00	872,221.00	992,066.00	633,027.00	173,931.00	663,766.00	74,902.00	242,773.00	193.00	**7,553,597.00**
2014	2,877,944.00	1,011,758.00	699,171.00	825,518.00	789,078.00	119,862.00	530,058.00	84,887.00	105,227.00	988.00	**7,044,491.00**
2015	3,286,383.00	1,023,163.00	658,163.00	896,040.00	635,650.00	113,778.00	540,913.00	155,545.00	130,310.00	**12,205.00**	**7,452,150.00**
2016	**26,487,842.00**	**31,721,735.00**	**6,812,325.00**	**31,742,228.00**	850,109.00	178,151.00	628,458.00	117,830.00	596,151.00	3,321.00	**99,138,150.00**
2017	3,432,091.00	1,261,641.00	816,540.00	1,373,162.00	754,469.00	83,454.00	**48,081.00**	104,118.00	**19,712.00**	1,349.00	**7,894,617.00**
2018	3,975,533.00	1,587,242.00	605,933.00	1,316,108.00	866,902.00	140,469.00	940,470.00	72,698.00	816,466.00	983.00	**10,322,804.00**
2019	3,980,811.00	1,450,982.00	575,421.00	946,680.00	798,945.00	277,128.00	766,120.00	61,245.00	1,133,863.00	1,715.00	**9,992,910.00**
2020	4,132,321.00	1,249,939.00	472,940.00	1,026,152.00	576,446.00	261,063.00	638,680.00	2,093.00	146,319.00	497.00	**8,506,450.00**
2021	5,301,381.00	1,608,319.00	437,847.00	1,395,230.00	684,457.00	419,238.00	871,170.00	44,301.00	159,181.00	4,729.00	**10,925,853.00**
TOTAL	**66,940,276.00**	**45,009,269.00**	**13,983,727.00**	**44,432,612.00**	**8,599,281.00**	**2,311,568.00**	**12,339,379.00**	**870,259.00**	**3,699,955.00**	**36,474.00**	

N.B Outlier values which have been adjusted are in red.

Appendix 6: Section of the SMU's Application forms

MINISTRY OF TOURISM INDUSTRY AND COMMERCE
229 SOUTH ROAD LACYTOWN, GEORGETOWN. GUYANA.

SCRAP METAL UNIT

For official use

APPLICATION FOR REGISTRATION OF SCRAP METAL YARD – 2021

A Scrap Metal Yard is a premises authorized and registered by the Unit for the storage, sorting and processing of scrap metal along with an approved designated loading area for export.

APPLICANT: (The Applicant is the person wholly responsible for making this application. Photocopy of ID card and a recent PP size photo required)

NAME IN FULL:		AGE:	
ADDRESS:		ID #:	
		TIN #:	
TEL #:		NIS #:	
EMAIL:			

BUSINESS INFORMATION: (The Applicant is responsible on behalf of the Business for making this application. Attach copy of Business Registration)

NAME OF BUSINESS:		TYPE:	(LL COMPANY/ TRADE NAME/ PARTNERSHIP/OTHER) - -
ADDRESS:		DATE REGISTERED:	
		REGISTRATION #:	
TEL #:		CURRENT NO OF EMPLOYEES:	
EMAIL:		YOUR POSITION:	
TIN:		NIS #:	

DETAILS OF THE YARD: (Attachments to confirm/verify information would be useful for site inspections)

NAME (IF ANY):		CCTV SURVEILANCE:	☐NO ☐YES
		NO. OF CAMERAS:	
ADDRESS:		IMAGE QUALITY (MP):	
EPA/NDC APPROVAL:	☐NO ☐YES	LOADING AREA COVERAGE:	☐NO ☐YES
YARD SIZE:		DATE/TIME STAMP IMAGES:	☐NO ☐YES
ESTIMATED CAPACITY IN TONNES:		OFF-SITE STORAGE:	☐NO ☐YES

MINISTRY OF TOURISM INDUSTRY AND COMMERCE
229 SOUTH ROAD LACYTOWN, GEORGETOWN. GUYANA.

SCRAP METAL UNIT

For official use

APPLICATION TO BE REGISTERED AS DEALER/EXPORTER OF SCRAP METAL – 2021

A Dealer/Exporter means a person or entity authorized and registered by the Unit to carry on business of dealing in, buying, selling and exporting of scrap metal.

APPLICANT: Please attach the photocopy of ID and one recent passport size picture.

NAME IN FULL:		AGE:	
ADDRESS:		ID #:	
		TIN #:	
TEL #:		NIS #:	
EMAIL:			

BUSINESS INFORMATION: Please attach copy of Business Registration.

NAME OF BUSINESS:		TYPE:	(LL COMPANY/ TRADE NAME/ PARTNERSHIP/OTHER) - -
ADDRESS:		DATE REGISTERED:	
		REGISTRATION #:	
TEL #:		CURRENT NO OF EMPLOYEES:	
EMAIL:		YOUR POSITION:	
OTHER:		TIN #:	
		NIS #:	

BACKGROUND/TRACK RECORD: Please attach relevant documents in support of your responses.

How long have you been in the scrap metal business?	
When was your first registration?	
Have you been compliant with the requirements of the GRA and the NIS?	☐NO ☐YES

Appendix 7 – Economic Model for Assessing Feasibility of Guyana's E-waste Management

11 Annexes