



e waste



e-Waste Assessment in Trinidad & Tobago

A situational analysis of e-waste management and generation with special emphasis on personal computers

Final Report

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Executive Summary

Economic development that has evoked a series of information and communication technology initiatives in Trinidad and Tobago (T&T) has also contributed to the increased generation of a new waste type on the island, Waste Electrical and Electronic Equipment (WEEE). In order to address this new challenge it is primarily important to gain knowledge about the country's e-waste landscape, by means of ascertaining the current and future flows of e-waste, estimating the present volumes of e-waste in the country, determining the existing processing practices and identifying local capacities to handle the recycling of different types of material.

As a first response, the Government of T&T, the United Nations Industrial Development Organizations (UNIDO), Microsoft and the Commonwealth Secretariat – who have already partnered to develop a commercially and environmentally sustainable refurbishment centre project – have mandated Egarr&Associates and Empa to conduct a rapid assessment regarding the current e-waste management practices in the country.

The specific objectives of this rapid assessment state as follows:

- Provide an overview of the current e-waste landscape, ascertain current and future flows of e-waste, estimate the current volume of e-waste in the country, determine the existing processing practices and identify local capacities to handle the recycling of different types of material.
- Determine the support required for the development of sustainable e-waste management in Trinidad and Tobago through a demonstration dismantling and/or recycling unit within the UNIDO-Microsoft refurbishment initiative, considering locally existing informal and formal operations.
- Provide options for a stakeholder network and form e.g. a local e-waste strategy group which will recommend a roadmap for further investigations.

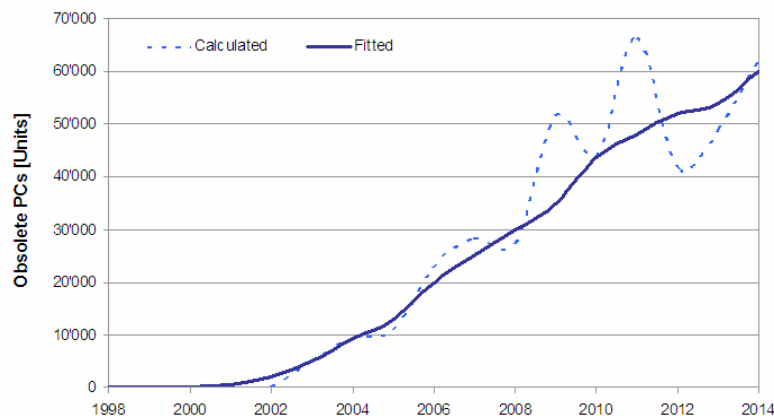
Situation Analysis – Current e-Waste Landscape

In summary the following findings should be highlighted in this context:

- There is no legislation that specifically addresses e-waste management in Trinidad and Tobago. Legal instruments that can be associated with the management of this post-consumer item are the Environmental Act of 2000, the Litter Act, 1973, the Public Health Act, 1950 and the Municipal Corporation Act of 1990. Trinidad and Tobago is also a signatory to several treaties and conventions the most relevant being the Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (Adopted March 1989).
- Data at the Central Statistical Office has indicated an importation figure of 33,536 units during the year 2008 of which 50% were sold to schools, 29% to government and 21% to

private institutions and individuals. The import figures do not capture computers brought into the country by individuals during their travels. World Bank figures for Trinidad and Tobago calculate a total installed base of 238,500 computers for the same year.

- For the year 2008 approximately 30,000 computers have become obsolete of which 11,000 have been recycled through a formal e-waste recycling company. It is assumed that the remaining 19,000 are in storage, donated, collected by informal collectors or dumped at the landfill site. The 30,000 PCs correspond to approximately 500 tons of computer waste or around 0.40 kg per capita. If this amount is compared to other data gathered from Empa in different developing countries around the world, the computer waste generation in Trinidad and Tobago meets the level of countries like Morocco, Chile and South Africa, but clearly exceeds the levels of Colombia, Uganda or China for example.
- Approximately 45,000 computers are calculated to be obsolete in 2010 with that figure increasing to 60,000 by the year 2014 (see Figure below). These levels certainly require a strategy to reverse the trend that is patterned from the projections when one considers an importation on an average of 1,600 tons per year of different computer appliances and peripherals. Approximately 24,000 tons of these items have been imported into the country since 1995.



Estimated and projected generation of obsolete computers in Trinidad and Tobago from 1996 to 2014 (in PCs per year).

- There exists a fairly formal practice of recycling with some refurbishment in the country. Two formal e-waste recycling companies could be identified. One of these recyclers even counts on BAN auditing and has obtained the certification as an e-steward. The normal practice of both recyclers is to charge their clients (mostly private companies) for the recycling and disposal service.
- The main identified weaknesses of the current e-waste management are the absence of reliable data on imports, sales and usage of electronic equipment in the country, the lack of a legal framework addressing specifically the end-of-life management of obsolete electrical

and electronic appliances, the lack of a clear position of manufacturers, importers and distributors regarding the extended producer responsibility, the absence of a hazardous waste facility for the disposal of certain fractions contained in e-waste and the continuing disposal of PCs and other e-waste commingled with municipal waste reaching the landfills and illegal dumpsites.

Recommendations for an e-Waste Management Strategy in T&T

The projected e-waste quantities require that some strategy be adopted to manage e-waste as a separate waste type. The results of this rapid assessment have suggested that the administrative, legislative and infrastructural requirements be identified and adopted to monitor the imports and to manage the resulting wastes generated from the use of these items. As discussed it is expected that the level of use will continue given the existing GDP of the country where access and affordability are influenced by effective marketing and sale bargains.

Regarding existing and planned e-waste management practices in Trinidad and Tobago it is recommended to develop a nationwide e-waste strategy with a short and medium-long term approach including the following steps:

Immediate to Short Term (1 year):

- *Stakeholder Strategy Group:* Immediate steps should be taken to establish a stakeholder network out of which the proposed e-waste management strategy group should be formed. This network should bring together the existing public and private sector committees and sub-committees of industries, and academia, community initiatives and other non-governmental partners to appoint the strategy group with appropriate representation.
- *Institutional Framework:* Inter and intra institutional arrangements should be made to identify a key governmental agency, possibly the Ministry of Public Administration, to direct the national initiative. Some of the relevant institutions may include the Ministry of Planning, Housing and Environment, Ministry of Local Government, SWMCOL, Environment Management Authority, and Chambers of Commerce.
- *Legal Framework:* The existing legislation such as the Environmental Management Act, the Litter Act and the Draft Waste Management Rules should be strengthened to accommodate specific requirements for the management of e-waste. It should also be considered to develop a specific regulation for e-waste, as it exists in many countries in Europe and is currently being done in several Latin American countries.
- *Support Markets:* Attention should be given to ensuring that reliable final disposal points are identified and assured. The extended producer/manufacturer/importer responsibility should form the basis for this process, where specific programs are established for the return of end-of-life PCs to these sources.

Medium to Long Term (2 to 3 years):

- *Development of the E-Waste Recycling Sector:* Recyclers should be required to be certified to include monitoring of final disposal practices by associated e-stewards with whom they do business.
- *Collection and Management of Data:* These requirements should be established and monitored both at the national level and the sector level. The existing data collection practices at both the Customs and Excise Division and the Central Statistical Office should be strengthened particularly regarding the coding and delineation of items.
- *Public Education and Relations:* A plan should be develop under the guidance of the Strategy Group. The approach may involve the continuation of an annual e-waste symposiums to ensure the awareness remains current and consistent.
- *Re-Activation of Public Sector e-Waste collection initiatives:* There is an absence of any existing initiative, which contributes to the stockpiling of electronic items at Ministries other Governmental Agencies businesses and households.

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List of Abbreviations

BAN	Basel Action Network
BFR	Brominated Flame Retardant
COSTAATT	College of Science, Technology and Applied Arts of Trinidad and Tobago
CRT	Cathode Ray Tube
CSO	Central Statistics Office
EMA	Environmental Management Authority of Trinidad and Tobago
EMPA	Federal Swiss Institute for Materials Science and Technology
EOL	End-of-life
GOTT	Government of Trinidad and Tobago
ICT	Information and Communication Technology
ICTPS	Information and Communication Technology Professional Society
LCD	Liquid Cristal Display
MAR	Microsoft Authorized Refurbisher
MPHE	Ministry of Planning, Housing and the Environment
MS	Microsoft
NEP	National Environmental Policy
SME	Small and Medium Enterprise
STTE	Ministry of Science, Technology and Tertiary Education
SWMCOL	Solid Waste Management Company of Trinidad and Tobago
TATT	Telecommunications Authority of Trinidad and Tobago
TTCC	Trinidad and Tobago Chamber of Commerce
TTMA	Trinidad and Tobago Manufacturer Association
UNIDO	United Nations Industrial Development Organization
UTT	University of Trinidad and Tobago
UWI	University of the West Indies
WEEE	Waste Electrical and Electronic Equipment

1 Introduction

1.1 Problem Identification

E-waste, like other types of special wastes has begun to elicit greater attention from waste managers in developing countries. Defined as “any appliance using an electric power supply that has reached its end-of-life”, it contributes to a stream of post-consumer items consisting of non-biodegradable and potentially hazardous materials that require new strategies for treatment and disposal. Consequently, the increasing demand and ready access to electronic and electrical items continue to exacerbate the challenges of managing wastes generated from these products.

One response to this challenge has resulted in a partnership between the United Nations Industrial and Development Organization (UNIDO) and Microsoft (MS) that seeks to divert used and unwanted Personal Computers (PC) from the waste stream. This arrangement is guided by a strategy of “best practices” that plans to establish commercially and environmentally sustainable computer refurbishment centres. It is proposed that these centres address the recovery and distribution of refurbished PCs to Small and Medium Enterprises (SMEs) in developing countries. The process involves the recovery of used PCs, refurbishment and distribution of those that can be reused, and the proper disposal of the waste generated from the activities at the facility.

Trinidad and Tobago (T&T) has been identified as one of the countries for the conduct of a feasibility study regarding the establishment of a refurbishment centre. The Government of T&T, UNIDO, Microsoft and the Commonwealth Secretariat have partnered to undertake this initiative. The demand for information and communication technology (ICT) education and services with the supporting hardware and software have resulted in increasing concerns for the accumulation of used PCs throughout the country. In the absence of policy and legislation improper practices of e-waste disposal occur at landfill sites and unauthorised dumps contributing to the potential for water and land-based pollution. In addition reliable data on waste generation volumes are not readily available.

This assessment seeks to establish some understanding of the situation as it relates to this special waste. Focusing primarily on PCs at this rapid assessment stage, the exercise will inform a proposed model and system that can reverse improper practices by providing a sustainable solution to the management of these post-consumer items. The model is also intended to provide both a commercially and socially acceptable alternative for consideration by the key stakeholders.

1.2 Geographical Scope

T&T is the most southerly territory of a chain of islands running north to south in the Caribbean Sea from the southern tip of Florida, United States to Venezuela on the South American

continent. The twin state is situated between 10° 2' and 11° 12' N latitude and 60° 30' and 61° 56' W longitude and has a land mass of 5128 km² (1980 sq. mi), with the remaining area covered by numerous smaller landforms. The twin island state consists of Trinidad which is 4768 km² (1841 sq. mi) in area and Tobago which is 300 km² (120 sq. mi) in area.

T&T is the leading Caribbean producer of oil and gas, both of which are key drivers of the economy. The country is also one of the key suppliers of manufactured goods (mainly food and beverages) and cement to the other Caribbean countries. It is a highly industrialised country fuelled by investments in liquefied natural gas (LNG), petrochemicals and steel. Tourism also contributes on a smaller scale to the economy and is more evident in the island of Tobago.

Economic growth since its independence in 1962, has elicited a wide range of commercial activity to support the demand for goods and services. The country has seen development in infrastructure, technology, social services and education, which were supported by the considerably buoyant oil revenues in mid 1970s and again from the late 1990s to the advent of the global economic crisis beginning in 2008. Heavy and light industrial estates were established at strategic points, primarily along the west to east corridor south of the northern range, and also south of the island along the western coast. Commercial activity had increased tremendously to facilitate the expected life style of many sectors in the society with the purchasing power also extended to the acquisition of PCs in the public, private and residential sectors. This activity has penetrated every major urban centre and main access routes throughout the country creating a network of semi-zoned industrial, commercial and residential areas.

1.3 Product Scope

This rapid assessment is intended to gain an understanding of the e-waste landscape focusing primarily on PCs in the first instance, make recommendations on a strategy for future handling of e-Waste, and recommend approaches for handling of e-Waste generated by the proposed refurbishment centre.

1.4 Objectives

1.4.1 Assessment Objectives

The study seeks to obtain a reliable overview of the e-waste landscape in Trinidad & Tobago, through a baseline study (a rapid e-waste assessment), focusing primarily on computers and IT equipment. The findings of the study will provide:

- The necessary preliminary data for handling the e-waste associated with the UNIDO/Microsoft Computer Refurbishment Centre Project;
- A set of recommendations on the next steps for the development of a nation-wide e-waste strategy.

- Information for the development of policy and legislation that will address the management of e-waste.

1.4.2 Project Objectives

The specific objectives state as follows:

1. Provide an overview of the current e-waste landscape, ascertain current and future flows of e-waste, estimate the current volume of e-waste in the country, determine the existing processing practices and identify local capacities to handle the recycling of different types of material.
2. Determine the support required for the development of sustainable e-waste management in Trinidad and Tobago through a demonstration dismantling and/or recycling unit within the UNIDO-Microsoft refurbishment initiative, considering locally existing informal and formal operations.
3. Provide options for a stakeholder network and form e.g. a local e-waste strategy group which will recommend a roadmap for further investigations.

2 What is e-Waste?

2.1 Definitions

WEEE or e-Waste: Waste Electrical and Electronic Equipment (WEEE) or short e-waste can be described as any refuse created by discarded electronic devices and components as well as substances involved in their manufacture or use. These end-of-life products encompass electronic appliances such as computers, LCD and CRT screens, laptops, TVs, DVD players, mobile phones, mp3 players, cooling appliances etc. which have been disposed of by their original users. While there is no generally accepted definition of e-waste, in most cases, e-waste comprises of relatively expensive and essentially durable products used for data processing, telecommunications or entertainment in private households and businesses.

End-of-life (EOL): This term is normally used respect to a retailed product, indicating that the product is in the end of its product lifetime and a vendor will no longer be marketing, selling, or promoting a particular product and may also be limiting or ending support for the product.

In the context of e-Waste management, the term “end-of-life” refers to the state of an electronic equipment after the following three options have already been exhausted, namely:

- a) Reuse: The unit is somehow used again after becoming obsolete to the purchaser i.e. resold, reassigned or donated to another user following extensive modification.
- b) Repair: The product is being fixed and individual componentes or sub-assemblies are replaced in order to restore the serviceability of the product.
- c) Storage: Following use by the original owner stored machines are assumed to have been deemed obsolete else they would have been reused. Similarly, they must have been seen to have some relative value, or they would have been discarded. Storing is merely an activity which the user does in order to potentially extract future value from obsolete computers. At this point (which happens between six to eight years after initial purchase) there is little chance of effectively reusing this equipment.

Recycling vs Refurbishment¹: The term “refurbishment” is mostly used in conjunction with personal computers. A refurbished PC is a used PC that has gone through the following processes that leave the PC ready for use by a new owner: (i) data wiping, (ii) testing and (iii) minor repair and/or replacement of defective PC components. Refurbishment is considered to either leave the original motherboard as-is, or replace a defective motherboard with one of exactly the same make, model, and specification. Otherwise, replacing a motherboard results in a "new" PC and not a "refurbished" PC. A recycled computer has in some way been disassembled and sold for raw materials or as separate electronic components. Processing sometimes involve taking obsolete computers, making modifications, and donating them to

¹ Source: Microsoft MAR Programme

schools, non-profits organizations, and charities for extended lifetime use (which is "reuse"). Recycling of electronic equipment also involves extracting value from the components or high value materials like gold and other precious metals.

2.2 Categories

The following table provides a broad listing of e-waste categories as described in the WEEE Directive of the European Union.

Table 1: Categories according to the WEEE Directive of the EU.

No.	Category	EU WEEE
1	Large Household Appliances	Washing machines, dryers, refrigerators, air conditioners, etc.
2	Small Household Appliances	Vacuum cleaners, Coffee machines, Toasters, Irons etc.
3	Office Information and Communication Equipment	PCs, Laptops, Mobiles, Telephones, Fax Machines, Copiers, Printers, etc.
4	Entertainment and Consumer Electronics	Televisions, VCR/CD/DVDs, Hi-Fi sets, Radios etc.
5	Lighting Equipment	Fluorescent tubes, sodium lamps etc. (except bulbs and halogen bulbs)
6	Electric and Electronic Tools	Drills, Electric Saws, Sewing Machines, Lawn Mowers etc (except large stationary tool/machines.
7	Toys, Leisure, Sports, Recreational Equipment	Electric train sets, coin machines, treadmills.
8	Medical Instruments and Equipment	Medical Instruments and Equipment
9	Surveillance and Control Equipment	Surveillance and Control Equipment
10	Automatic Issuing Machines	Automatic Issuing Machines

NB: WEEE Directive implemented by member states by August 2005 - 08

The categories defined in Table 1 have been developed based on retailing activities. Consideration should also be given to categories that are developed based on the treatment and recycling process. Table 2 provides the suggested categories.

Table 2: The five e-Waste categories from an End-of-Life perspective.

Category	Examples	Justification
Cooling appliances	Fridges, freezers, other appliances containing cooling agents	Safe transport and proper handling of the cooling appliances are required
Large and medium sized household appliances	All other household appliances of large and medium size	Contain a lot of different metals and plastics that can be recycled according to common standards
Lighting equipment	Tubes, bulbs, etc.	Specific transport and recycling processes are required
All appliances with display monitors	CRTs, LCDs, TVs, etc.	Safe transport and proper handling of screens and plastics are required
Other electrical and electronic appliances	IT equipment, consumer electronics etc.	All appliances contain similar materials and substances and can be handled altogether

2.3 e-Waste Challenges

Disposal of e-waste has developed into a major environmental concern. These wastes continue to be generated at an alarming rate due to rapid advances in technology, drop in product prices and an ever growing demand for new features. Thousands of computers, monitors, printers, photocopiers, fax machines, mobile phones, televisions, and other electronic items are being replaced on an annual basis by new and advance models. Evidence of increasing storage, stockpiles and generation levels provide indications of the limited success of reuse, refurbishment and recycling efforts in developing countries. Some of the generators of e-waste include manufacturers, large and small businesses, institutions, Government agencies, equipment manufacturers and households.

Electronic waste (especially computers) contains toxic substances that pose a threat to human health and the environment. If improperly managed, these items will have adverse effects on natural resources, production workers and residents in close proximity to poorly managed disposal sites and unauthorized dumps. Some toxic materials include lead, cadmium, barium, brominated flame-retardants, highly flammable plastic, mercury and gases. The use of some of these compounds as flame-retardants in plastics can form persistent dioxins and furans on combustion at low temperatures (500-800 °C). Copper which is present in printed circuit boards and cables, acts as a catalyst for dioxin formation when flame-retardants are incinerated. The PVC sheathing of wires is highly corrosive when burnt, and also induces the formation of dioxins. Often, these hazards arise due to the use of improper recycling and disposal practices. Some hazards include Cathode Ray Tubes (CRTs) which have a high content of carcinogens such as lead, barium, phosphorus and other heavy metals. Dismantling, recycling or disposing CRTs in an uncontrolled environment coupled with the absence of the necessary safety

precautions can result in harmful side effects for the workers and also the release of toxins into the soil, air and groundwater.

Landfilling of e-waste, one of the most widely used methods of disposal in developing countries has become a hazard because of toxic leachates which often contain heavy metals such as mercury, cadmium and lead. Mercury, for example, will leach when certain electronic devices such as circuit breakers are destroyed. Lead has been found to leach from broken lead-containing glass, such as the cone glass of CRTs from TVs and monitors. Unsecured landfill sites and uncontrolled dumps also have the potential danger of releasing hazardous emissions, particularly where there is the frequency of uncontrolled fires which can release toxic fumes. When brominated flame retarded plastics or plastics containing cadmium are landfilled, both polybrominated diphenylethers (PBDE) and cadmium may leach into soil and groundwater.

Table 3 provides a listing of some substances and their occurrence in e-waste.

Table 3: List of hazardous substances and their occurrence in e-Waste.

Substance	Occurrence in e-waste
Halogenated compounds:	
PCB (polychlorinated biphenyls)	Condensers, Transformers
TBBA (tetrabromo-bisphenol-A)	Fire retardants for plastics (thermoplastic components, cable insulation)
PBB (polybrominated biphenyls)	TBBA is presently the most widely used flame retardant in printed wiring boards and casings.
PBDE (polybrominated diphenyl ethers)	
Chlorofluorocarbon (CFC)	Cooling unit, Insulation foam
PVC (polyvinyl chloride)	Cable insulation
Heavy metals and other metals:	
Arsenic	Small quantities in the form of gallium arsenide within light emitting diodes
Barium	Getters in CRT
Beryllium	Power supply boxes which contain silicon controlled rectifiers and x-ray lenses
Cadmium	Rechargeable NiCd-batteries, fluorescent layer (CRT screens), printer inks and toners, photocopying-machines (printer drums)
Chromium VI	Data tapes, floppy-disks
Lead	CRT screens, batteries, printed wiring boards
Lithium	Li-batteries
Mercury	Fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches
Nickel	Rechargeable NiCd-batteries or NiMH-batteries, electron gun in CRT
Rare Earth elements (Yttrium, Europium)	Fluorescent layer (CRT-screen)
Selenium	Older photocopying-machines (photo drums)
Zinc sulphide	Interior of CRT screens, mixed with rare earth metals
Others:	
Toner Dust	Toner cartridges for laser printers / copiers
Radioactive substances Americium	Medical equipment, fire detectors, active sensing element in smoke detectors

Figure 1 on the other hand provides an overview of the material compositions of different selected electronic appliances like PCs, laptops, CRT monitors and LCD screens. It is quite evident that the above mentioned pollutants only occur in very small percentages (2% and less), while metals and plastics dominate the weight of PCs, laptops and LCD screens. Only in the case of the CRT monitors the glass plays an important role as it represents more than half of the weight and at the same time is peppered with lead oxide.

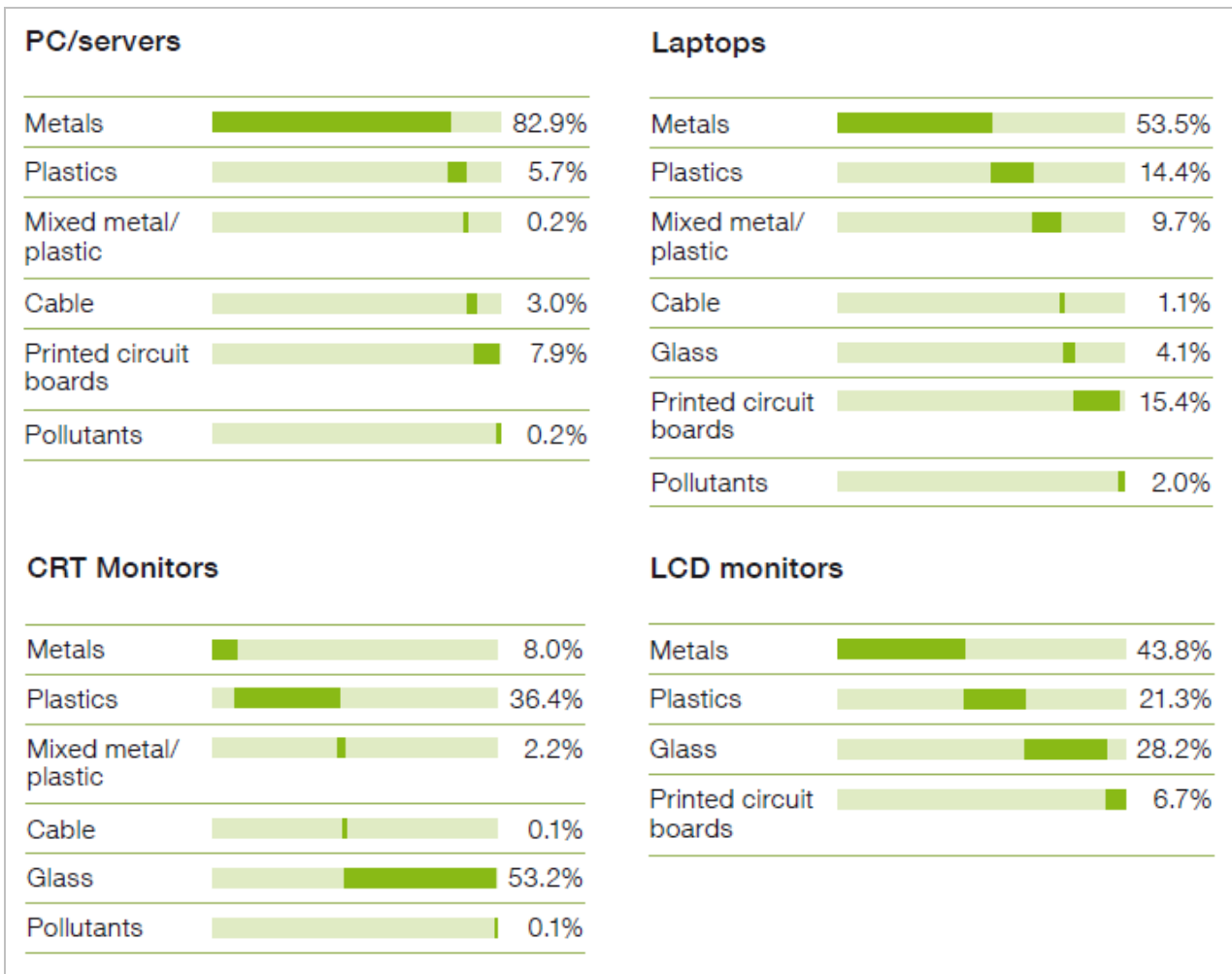


Figure 1: Material composition of PC/server, Laptops, CRTs and LCDs according to data captured by the e-waste recycling companies of the Swiss system. (Source: SWICO Activity Report 2008)

3 Methods

3.1 Data Acquisition

Literature

Documents specifically addressing volumes on used PCs or by extension e-waste in general were not readily available. Also a review of the most current waste characterisation studies did not identify electronic waste as a specific waste type. Some articles and presentations emerging from three national e-waste symposiums conducted between 2005 and 2007 provided some insight to existing practices as it relates to the life cycle of e-waste, primarily PCs. These symposiums were conducted by The Trinidad and Tobago Solid Waste Management Company (SWMCOL) as an attempt to sensitize the general public to the potential environmental dangers associated with inadequate e-waste management practices. Other sources included internet searches and data compiled at the Central Statistical Office (CSO) of the Ministry of Planning, Housing and the Environment.

Importers and distributors of PCs were identified through the business directory, internet searches and membership listings of the Chambers of commerce and Trinidad and Tobago Manufacturing Association (TTMA). The client listing of local recyclers also provided some retailers of PCs in the country.

Existing information on policies and legislation was extracted from publications available at the printing centre of the central government. Information was also obtained at the documentation centre at the Environmental Management Authority (EMA) which is the monitoring environmental agency in the country.

Questionnaires

In the absence of readily available data and limited time for the field study, questionnaires were developed targeting key importers, distributors, retailers and recyclers. These questionnaires were also sector-specific identifying the government, non-government and the academic institutions. The structure of the questionnaires was modified from the suggested format at Annexes B and C of the e-waste Assessment Methodology Manual. The modified documents (see Annex B) sought to obtain primarily information on:

- General information on the institution's policies and views as it relates to e-waste management.
- Stock and generation of e-waste
- Distribution and retail profile
- End-of-life management of e-waste

Interviews

Direct interviews and site visits were conducted with distributors, retailers and recyclers. This methodology also involved stakeholders at the various relevant ministries and agencies of Government, and the business and student services departments of the academic institutions.

A list of stakeholders interviewed is attached at Annex C.

3.2 Massflow Assessment

Material flow analysis method was selected for this assessment. The system and mathematical descriptions are well described in Empa's e-Waste Assessment Methodology (Empa 2009) and applied in other e-waste assessment studies (i.e. e-Waste Assessment in Uganda, 2008).

4 System Definition

4.1 Development Indicators

4.1.1 People

The twin state of Trinidad and Tobago is inhabited by a multiracial society with two major ethnic groups, Afro-Trinidadians and Indo-Trinidadians, representing approximately 80% of the population. The remaining inhabitants comprise mixed races and descendants of Europeans, Chinese and Syrians and Lebanese. English is the official language of the country.

While economic success has seen the development and commercialization of many of the urban areas, real urbanization has not been realized, as the practice of daily movement by the transient population to and from these town centres is primarily to attend the workplace and to access the required social goods and services. The wide distribution of Government assisted housing in the absence of stringent zone occupation enforcement has allowed a mix of residential and commercial areas in close proximity to each other. There is increasing evidence of indiscriminate rural, suburban and urban development in parallel, where small and medium commercial enterprises sometimes share the same space with a residential community

Table 4: Development Indicators for Trinidad and Tobago – People (World Bank 2009).

Indicators	Value
Population (million)	1.34 (July 2008 est.)
Population Growth	-0.12% (2009 est.)
Urbanization	13% of total population (2008)
Age Distribution	0-14 years: 19.6% (male 123,214/female 117,548) 15-64: 72.6% (male 457,868/female 434,486) > 65 years: 7.9% (male 41,467/female 55,334) (2009 est.)
Unemployment total (% of labour force)	7.5% (2009)
GINI Index	40.3 (2009)

4.1.2 Environment

Heavy industrialization in Trinidad since its independence in 1962 has brought the added challenge of air, water and land pollution. The main industrial centre at Point Lisas along the western coast of the country has been developing as the centre for industries in methanol,

ammonia, nitrogen, iron, steel, cement, downstream oil industries and light manufacturing. There are a series of sub-industrial estates throughout the country also involved in small industrial and manufacturing businesses. Added to this sector are the numerous formal and informal small and medium enterprises that generate volumes of wastes, some of which are considered hazardous.

T&T continues to be faced with outdated solid waste disposal systems and has no dedicated hazardous waste disposal facility. Municipal solid wastes are disposed in authorised and unauthorised sites that lack the required environmental management infrastructure to prevent pollution. While waste collection has been able to capture as much as 80 % of the waste generated, the disposal function still needs immediate attention, given the increasing volumes and types of waste generated on a daily basis.

The efforts of the EMA have seen the development of environmental pollution control standards and rules to arrest the challenges facing the country. The EMA has established effluent standards, and draft Waste Management Rules (2008) are now under consideration. While these efforts have drawn some level of attention, limited monitoring has allowed the unchecked release of industrial waste into the waterways, and also in unauthorized dumps. Landfilling continues to be the method of disposal for solid waste with some of the sites being in close proximity to residential areas.

Table 5: Development Indicators for Trinidad and Tobago – Environment (World Bank 2009).

Indicators	Value
Forest Area (sq. m.) thousands	5.1
Agricultural Land (% of land mass)	1.34
Renewable internal freshwater resources per capita (cubic meters)	2,881
Improved sanitation facilities, urban (% of urban population with access) (2000)	92
Energy use (kg of oil equivalent per capita)	9,624
CO ₂ emissions (metric tons per capita) (2005)	24.7

4.1.3 Economy

Petroleum and petroleum products, natural gas, chemicals, steel products, and fertilizer are the most important exports. Trinidad possesses sizable oil and gas reserves, and its prosperity is linked directly to the production of petroleum and petrochemicals. A peaking of petroleum production in the late 1970s and the decline in worldwide petroleum prices in the 1980s affected the economic strength of the country. However, increased exploitation of the country's natural gas reserves since the 1990s, as well as rising prices for oil, petrochemicals, and liquefied natural gas, has caused an economic boom. The islands also have a significant tourist industry.

Agriculture employs a smaller proportion of the population producing products such as cocoa, rice, coffee, citrus fruit, and flowers. The main trading partners are the United States, Jamaica, and Brazil.

Table 6: Development Indicators for Trinidad and Tobago – Economy (World Bank 2009).

Indicator	2000	2005	2007	2008
GDP(Current US\$ billions)	8.15	15.14	20.88	23.90
GDP Growth (Annual %)	6.1	6.1	5.5	3.4
Agriculture, value added(% of GDP)	1	1	0	---
Industry, value added(% of GDP)	49	59	59	---
Services, etc., value added(% of GDP)	49	40	41	---
Inflation, GDP deflator (annual %)	12.9	8.5	3.9	9.9

4.1.4 States & Markets

T&T continues to enjoy a comfortable availability of telecommunications services partly because of its 2006 liberalization process regulated by the Telecommunications Authority of Trinidad and Tobago (TATT). Its information and technology services have developed as planned initiatives by various business sectors in response to commercial growth, and also as a result of some initiatives proposed by government for stronger national e-management activities. ICT services range from telecommunication infrastructure (voice, data, and media services) to information applications tailored to specific sectors and functions (such as services in banking and finance, education, and health), to electronic government (e-government). Some proposed policies and regulations have created competitive ICT markets which have increased access to ICT services for citizens. This competitive market environment has encouraged the widespread use of technology.

Other plans presented by the government include a gradual build-up of infrastructure, implementation of back-office components and several e-government initiatives guided by a proposed strategy. National banks exchange information and transactions electronically, facilitating business operations. E-commerce is continuing to flourish, with several national stores on-line and a small and medium enterprise business marketplace. The Ministry of Communication and Information Technology was created in 2001 to support and, in some cases, lead ICT initiatives in Trinidad and Tobago with particular emphasis on building export oriented software and ICT services industries. Also proposed is the development of a science and technology park and a cluster strategy to attract local and multinational ICT companies. ICT training programs are also being strengthened in universities and vocational centres. Some potentially advantageous factors for developing an ICT services industry include the nation's

literate, English-speaking population, its proximity to the U.S., and its position as an “English commercial gateway” to Latin America.

Trinidad and Tobago ranks 82 in readiness for the networked world². Network readiness is the potential and preparation of a community within its encompassing environment to participate in the Networked World. Some of the initiatives to support this readiness include facilitating access (telecommunications sector, internet access, and community access), building capacity and knowledge, and facilitating business and commercial activities. As part of the Fast Forward initiative³, the government is seeking to establish a model for Community Access Centres (CAC) that facilitates coordination and alignment among the different agencies and stakeholders involved in the establishment of these centres. It is intended that access will provide knowledge to the community in readiness for the use of the Government Portal and its many on-line services. Internet access and ICT services have also been provided by The National Library System, including facilities for visually handicapped and physically disabled persons, to citizens at a number of local libraries at no charge for several years. More recently, ICT services has been provided by the Ministry of Legal Affairs.

Building capacity and knowledge is proposed through a series of educational streams at the primary, secondary and tertiary levels. One commitment by the decision-makers is the School Net that looks at various aspects of ICT in education, including connectivity, curriculum and content development, teacher training, and distance learning. The Human Capital Development projects in the Social and Economic Policy Framework 2006-2008⁴ include:

- Implementation of the School Net Programme and the continuation of full computerization of all schools;
- Enhancement of adult education programmes through distance learning;
- Provision of infrastructure for Information and Communication Technology and Tec Voc Education.

Despite these stated plans there is a common notion among stakeholders that the proposals have not elicited the required advances and investments on ICT at the primary and secondary levels. Several institutions at the tertiary level have been established beyond the capability goals of the National Institute of Higher Education. Some of these institutions include:

- **The Ministry of Science Technology and Tertiary Education:** Established in December 2001 to support the development of national human capacity and promote coordination and interaction among the academic, scientific, technological and productive national sectors;

² The Global Information Technology Report 2007–2008 © 2008 World Economic Forum.

³ **Fastforward** agenda is Government’s plan to transform the country into a knowledge-based society by 2008.

⁴ Social and Economic Policy Framework 2006 – 2008. Government of Trinidad and Tobago, 2005.

- **College of Science, Technology and Applied Arts of Trinidad and Tobago (COSTAATT):** Established in 2000 as a Community College to unite several former tertiary education institutions in the public sector and the former NIHERST Colleges under one umbrella.
- **University of Trinidad and Tobago (UTT):** A non-profit tertiary education institution that partners the Government, Industry and regional and international Universities to develop national human capital in light of the competitiveness requirements brought by globalization and the CARICOM Single Market Economy(CSME).

The third approach towards achieving network readiness involves facilitating business and commercial activities. There is widespread and fairly advanced use of ICT by corporations and in the large business world in Trinidad and Tobago due in part to the presence of large multinational corporations related to the natural gas and other industries. The use of ICT by medium size industries continues to expand, although the technology is limited primarily to managing finances (accounting systems), providing support business tools (spreadsheets, presentations and word processing) and maintaining conventional communication (e-mail and web browsing).

Table 7: Performance of the ICT-Sector – (World Bank, ICT at a Glance 2009).

Indicator	Year		High Income Group
	2000	2007	
Access			
Telephone Lines (per 100 people)	24.4	23.1	50
Mobile cellular subscriptions (per 100 people)	12.0	113.3	100
Internet subscribers (per 100 people)	2.0	6.2	26
Personal computers (per 100 people)	6.2	13.2	67
Households with television sets (%)	86	88	98
Usage			
International voice traffic (minutes/person/month) ^a	15.1	31.3	14
Mobile telephone usage (minutes/user/month)			353
Internet users (per 100 people)	7.7	16.0	66
Quality			
Population covered by mobile cellular network (%)		100	99
Fixed broadband subscribers (% of total internet subscribers)	0	43.4	83
International Internet Bandwidth (bits/second/person)	46	675	18,242
Applications			
ICT Expenditure (% of GDP)	---	---	6.7
e-Government web measure index ^b	---	0.44	0.60
Secure internet servers (per 1 million people, Dec. 2008)	9.2	45.6	663

4.2 Policy and Legislation

4.2.1 Waste Related Policies

The National Environmental Policy (NEP) first laid in parliament in 1998 is aimed at providing a rational, practical and comprehensive framework for environmental management in Trinidad and Tobago. The specific objectives of the policy are to:

- Prevent, reduce and where possible recycle all forms of pollution to ensure adequate protection of the environment and consequently the health and well being of the humans;
- Conserve the vitality and diversity of the natural environment through the conservation of ecological systems and biodiversity within;
- Develop the carrying capacity (the assimilative capacity of the environment) of the country through national physical development and planning and the sustainable use of renewable resources and conservation of non-renewable resources;
- Change attitudes and practices of citizens with a view to reducing polluting practices of the public;
- Ensure that all industry install a certified Environmental Management System;
- Empower stakeholders including communities to care for their own environments by providing opportunities to share in the management of their local resources and the right to participate in decision-making;
- Promote the integration of the principles of environmental sustainable development in all country policies and programmes.

Other policies that seek to ensure environmental protection include:

- T&T Wetland Policy
- Draft Tourism policy 2008
- Participatory Forest Management

4.2.2 Waste Related Legislation

E-waste related legislation can be drawn from a series of legal rules developed over time that have some impact on the generation of this waste type. **The Litter Act of 1973** and the **Public Health Act of 1950** with accompanying regulations are the two major pieces of legislation governing solid waste management in the country. At the local government level, the municipal corporations are charged with the function under these two acts in addition to the **Municipal Corporation Act of 1990**. Under the Municipal Corporations Act, the respective corporations

have the responsibility for the disposal of garbage from private and public property, the development and maintenance of sanitary landfills and the abatement of public nuisances. There are at least three other related Acts of Parliament administered by three separate government departments that control the manufacture, use or sale of hazardous substances. These are: the **Pesticides and Toxic Chemicals Act, 1979** and **Act No. 11 of 1986**, which regulate the importation, storage, manufacture, sale, use and transportation of pesticides and toxic chemicals; the **Occupational Health and Safety at Work Act**, concerned mainly with the workplace; and the **Environmental Management Act of 2000** which deals with the environment. Under the Environmental Management Act No. 3, the Environmental Management Authority (EMA) was formed in March 1995, with a mandate to write and enforce laws and regulations for environmental management, to educate the public about the nation's environmental issues, to control and prevent pollution, and to conserve natural resources. Producers of hazardous waste are subject to periodic inspections by the EMA, concerning collection and transport operations also relative to origin and destination. Documentary evidence of management operations must be supplied to the EMA on request.

Other relevant rules include:

- The **Certificate of Environmental Clearance Rules 2001** that guides the assessment of small and large-scale developmental projects which may have both positive and negative environmental effects.
- The **Water Pollution Rules 2001** that directs the Water Pollution Management Programme the overall objective of which is to control, reduce and prevent water pollution from point and non-point sources, and discharges into the waters of Trinidad and Tobago. The long-term objective would be the preservation and maintenance of good quality water that would support present and future generations.
- **Waste Management Rules 2008** (Draft) that seek to address the proper management of all wastes generated within the country.

T&T is also a signatory to a series of treaties and conventions that are related to the management of e-wastes. The relevant commitments include:

- The **Basel Convention** – on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (Adopted March 1989) – that aims to achieve the reduction of the trans-boundary movements of hazardous wastes and other wastes subject to the Basel Convention, the prevention and minimization of their generation, the environmentally sound management of such wastes and the active promotion of the transfer and use of cleaner technologies.
- **UNEP London Guidelines** for the Exchange of Information on Chemicals in International Trade (1989) aimed at enhancing the sound management of chemicals through the exchange of scientific, technical, economic and legal information.

- **The Vienna Convention (1985)** on Substances That Deplete the Ozone Layer is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion.
- **London Convention** on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 and 1996 Protocol Thereto is intended to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.
- **Rotterdam Convention** (Includes Prior Informed Consent Procedure (PIC)) which is aimed at promoting shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals, in order to protect human health and the environment from potential harm. It is also intended to contribute to their environmentally sound use by facilitating information exchange about their characteristics, providing for a national decision-making process on their import and export and disseminating these decisions to Parties.

4.2.3 Specific e-Waste Management Legislation

There is no specific e-waste management legislation in T&T. Any reference to such legislation is incorporated in the National Environmental Act 2000, Part V, Environmental Management, Sections 35 to 61 that addresses the Protection of Natural Resources, Pollution and Hazardous Substances, Air and Noise Pollution, Water Pollution, Wastes and Hazardous substances and Spills.

4.2.4 Institutional Framework

The constitution of the Republic of Trinidad & Tobago 1976 is the supreme or highest law of the land. It must be followed by the President, the Prime Minister, Ministers of Government, the Chief Justice, the judicial arm of the State, all State and public officials and all the citizens of Trinidad and Tobago. It sets out the structure and type of government that must be followed and what powers they have. It makes sure that the rights of citizens are protected and sets up institutions to ensure that the government and other State officials do not abuse these rights.

The Constitution divides the Government into three distinct arms of the State, namely

- The Legislature (Parliament) - composed of The President, The House of Representatives and The Senate
- The Executive made up of Cabinet, Ministries and Departments of government, statutory authorities and governmental institutions.
- The Judiciary, the arm of the State that deals with disputes between persons, enforcement of the Criminal laws and the interpretation of the laws passed by Parliament (including the Constitution).

Figure 2 provides the relation between the Cabinet and the various institutions discussed.

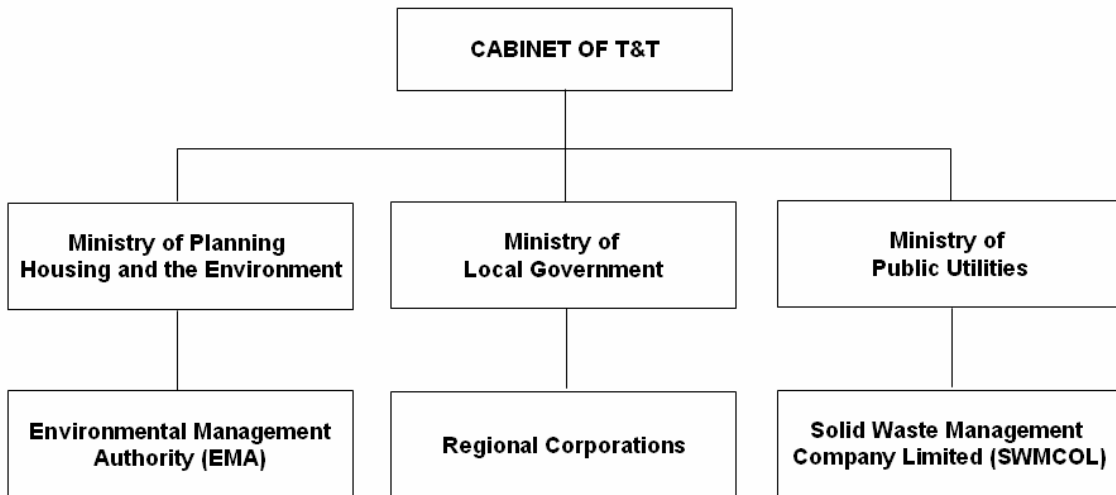


Figure 2: Government Institutions associated with e-waste management and e-waste related issues.

Functions of the Environmental Management Authority (EMA)

In accordance with the EMA Act 2000, the general functions are to:

- a) Make recommendations for a National Environment Policy;
- b) Develop and implement policies and programmes for the effective management and wise use of the environment, consistent with the objects of the EM Act;
- c) Co-ordinate environmental management functions performed by persons in Trinidad and Tobago;
- d) Make recommendations for the rationalization of all governmental entities performing environmental functions;
- e) Promote educational and public awareness programs on the environment;
- f) Develop and establish national environmental standards and criteria;
- g) Monitor compliance with the standards criteria and programs relating to the environment;
- h) Take all appropriate action for the prevention and control of pollution and conservation of the environment;
- i) Establish and co-ordinate institutional linkages locally, regionally and internationally;
- j) Perform such other functions as are prescribed; and
- k) Undertake anything incidental or conducive to the performance of any of the foregoing functions.

Related Functions of the Municipal Corporations

- a) Residential and commercial solid waste collection;
- b) Management of some rural solid waste disposal sites.

Related Functions of SWMCOL

- a) Management of the three (3) major landfill sites
- b) Municipal, industrial and commercial solid and faecal wastes collection

4.3 Stakeholders

4.3.1 Stakeholder Overview

Stakeholders associated with e-waste generation and management in Trinidad and Tobago include the importers, distributors, retailers, users, repair technicians, collectors and recyclers and disposal entities.

The following flow diagram illustrates the relationship between the various stakeholders regarding the movement of PCs from importation to the end of the life cycle. As Figure 3 illustrates, imported PCs are acquired either by a commercial distributor, or are brought into the country by individuals for their personal use in their homes, home offices or small businesses. Retailers provide sales services to the public or private sector institutions and also to individual households. End-of-life or discarded PCs are collected by the SWMCOL and recyclers upon request or by contracted municipal waste collectors in the case of households. A description of typical e-waste management options can be found in Annex A.

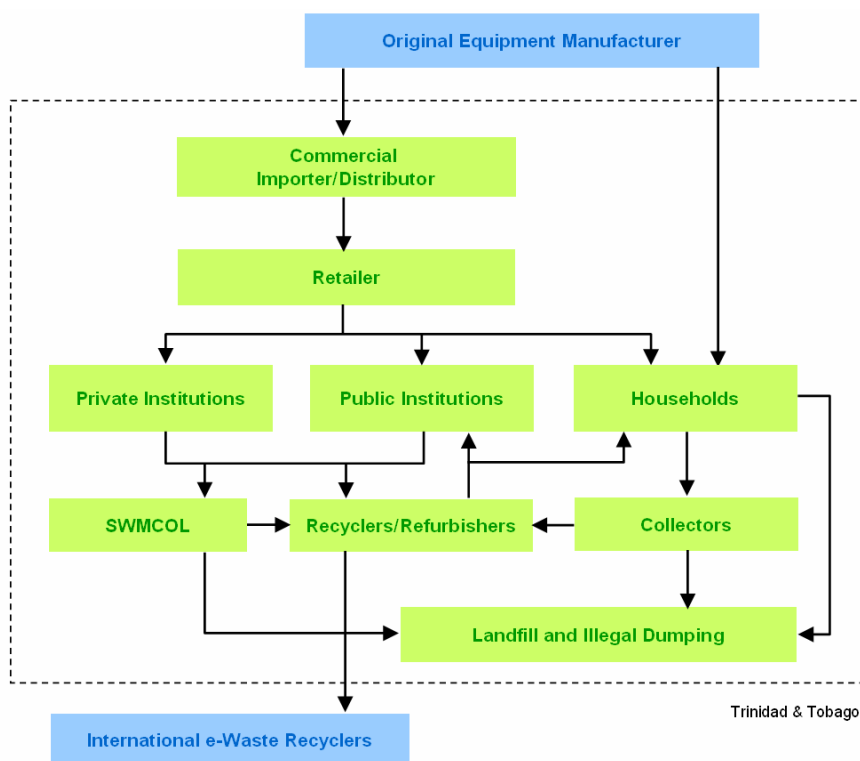


Figure 3: E-Waste stakeholder relationships in Trinidad and Tobago.

Waste collected by SWMCOL and contracted collectors are delivered to recyclers or directly to the landfill sites. Recycled/refurbished computers are donated to public institutions such as primary and secondary schools or sold and/or donated to households. e-Waste generated by the recyclers are shipped to foreign e-steward partners for processing and disposal.

4.3.2 Manufacturers and Importers

There is no manufacturing of PCs in Trinidad and Tobago except small-scale assembly by individual companies. Generally computers are mainly imported as assembled units or on a smaller scale in parts and assembled locally. Based on discussions with some of the retailers, a very miniscule percentage (less the 1%) of computers are assembled locally as newly assembled units become more affordable, and provides more features. Also the availability of used computers averaging a 4-5 year lifespan provides a more feasible option to that offered by the existing assemblers, some of which operate informally.

The larger computer importers also provide both sales and rental of hardware options in addition to support services to include software development, programming and equipment repairs. The major brands imported includes Dell, Hewlett Packard, Toshiba, Acer and IBM.

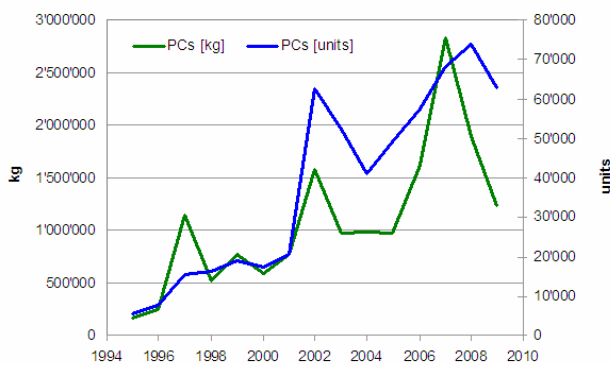


Figure 4: Imported computers (desktops and laptops) into Trinidad and Tobago since 1995 (in units/year and kg/year).

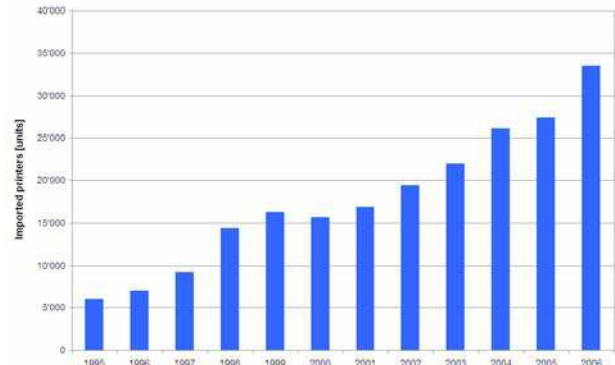


Figure 5: Annually imported printers from 1995 to 2006 (in printers/year).

Figure 4 and Figure 5 give an idea of the imports of computers and printers into Trinidad and Tobago⁵. The obvious fluctuation is due to not easily interpretable import data with changing tariffs and indistinct denomination.

⁵ Republic of Trinidad and Tobago, Ministry of Planning, Housing and the Environment, Central Statistical Office, Imports and Exports of Selected Items, 1995 to 2009.

4.3.3 Distributors

There are 101 registered distributors/retailers of PCs and other equipment in Trinidad and Tobago,⁶ providing hardware, software services. The five major retailers are:

- Illuminat
- Fujitsu
- Mc Enearney Business Machines (MBM)
- Memory Bank
- Next Technology Ltd.

It should be noted that Illuminat indicated that they were in the process of discussions with the manufacturer regarding a take-back service which is to be offered to consumers. Several of the major manufactures of PCs providing units to Trinidad and Tobago have already established take-back programmes in the United States of America and Canada.

4.3.4 Consumers

Response to questionnaires distributed to the five major distributors/retailers indicated that 50% of the computers were sold to schools, 29% to government and 21% to the private sector. Of the 50% sold to schools 94% were desktops, with the government sector purchasing the second largest number.

Interviews with four government ministries (Ministry of Planning, Housing and Environment, EMA, Ministry of Local Government and the Ministry of Education) provided information on purchases of approximately fifty (50) computers per year that provides access to approximately 1000 employees. The Tobago House of Assembly also a government institution indicated an annual purchase 20 computers per year servicing 250 employees.

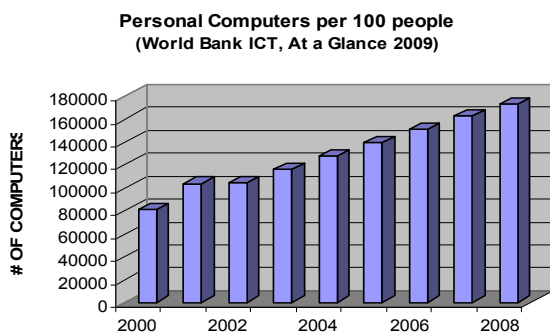


Figure 6: Total installed base of computers.

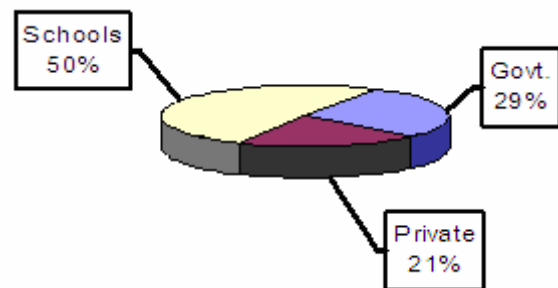


Figure 7: Sales distribution by sector for 2009. Sales to the Private Sector are 40% households.

⁶ Yellowpages-Caribbean.com ; Trinidad and Tobago, Computer Sales,

Both institutions accepted an average life of 4 years for their PCs. A decision on PC replacement is given by a Board of Surveys after which approximately 60% of the PCs are retained, some of which are refurbished. Many of the government officers interviewed were not aware of a clear policy on disposal. End-of-life PCs are either stored or collected for disposal by SWMCOL or other existing recyclers.

The University of the West Indies (UWI) of the St. Augustine campus has been acquiring an average of 545 computers on an annual basis. The reported life cycle is 4-5 years after which the older computers are redeployed to other areas, some are dismantled for parts to reconstruct other computers also for use in other areas, and the end-of-life units are collected by the Works Department of the campus for disposal.

The disposal of end-of-life computers are subject to the approval of a Board of Surveys as other government institutions. Once approval is given by the Board, new units can be sought for acquisition. The UWI has indicated that acquisition has been linked solely to the Dell brand of computers.

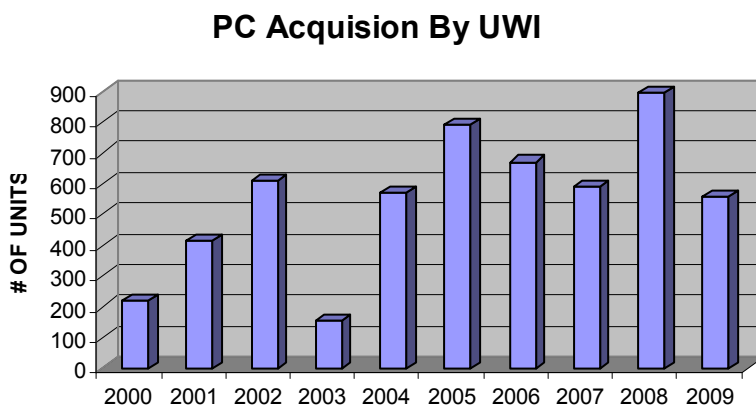


Figure 8: PC acquisition by the University of the West Indies (UWI) over the past years.

4.3.5 Collectors

Formal collection of PCs in Trinidad and Tobago is limited to the two major recyclers based on a request for service by the generator, or by the SWMCOL which requires that they be delivered for storage at a designated warehouse. In 2005 SWMCOL had commenced an initiative to sensitize the public to the hazards of e-waste, and devised a system of storage of the PCs delivered. In the absence of any formal e-waste management system SWMCOL was forced to discontinue the receipt of end-of-life PCs because of the overwhelming response coupled with the absence of sufficient storage room to accommodate the inflows. A ban on the disposal of PCs at the landfill site has since been instituted. SWMCOL has indicated that the collection exercise was intended to capture as many PCs that may have reached the municipal landfill sites. The company is still considering the commencement of a refurbishment process to reduce the volume of PCs in storage and also to address future volumes generated for disposal.

4.3.6 Refurbishers

During the conduct of the rapid assessment there were no indications of any major refurbishment initiatives in the country. Small and medium enterprises limit their refurbishment to primarily the replacement of hard drives so as to extend the life of used PCs. Piranha does provide some refurbishment based on the request and approval of the clients. Some of the units are retained by the clients and others are donated to community groups.

The UNIDO – Microsoft computer refurbishment project proposes to set-up a commercially and environmentally sustainable personal computer (PC) refurbishment centre with a view to contribute to:

- The supply of affordable quality personal computers with relevant software to local (business) communities, and
- The development and strengthening of the local PC refurbishment industries, creating jobs, know-how and new income generating opportunities on the ground,

The computer refurbishment centre proposes to provide a full life cycle solution to the computers that are going to be refurbished within the framework of this programme from the time the PCs arrive in Trinidad and Tobago until the time of their responsible disposal through local, regional and global recycling channels. In the immediate to short term, volumes of E-Waste generated by the Centre will be small. It is expected that these volumes will increase as refurbished PCs reach the end of the life-cycle and are being returned to the Centre for proper disposal. This situation can be expected to materialize in the medium-term (2 to 3 years).

As such, the programme will ascertain which parts of the computers will be either reused and/or recycled locally and which parts will need to be handled elsewhere for further processing.

4.3.7 e-Waste Recyclers

There are two major recyclers of PCs in Trinidad and Tobago, Piranha International and Caribbean Tech Disposals Limited. Both companies export processed items to external markets.

Piranha International is a certified electronic waste recycler as recognized by the Basel Action Network as an E-Steward. The company services clients in the government, private and academic sectors and advertises offices in Trinidad, United Kingdom and Saudi Arabia. Based on a request Piranha provides collection and processing services for end-of-life computers where components of plastic and metals are removed for recycling and the residue components are packaged and exported to other e-steward processing and disposal companies. The metal components are sold to the local steel mill or exported. A manifest system is also provided to assure the client that authorized disposal of the waste has been undertaken. The company has been subjected to several audits by international organizations and clients to ensure that the “best practices” approach is adopted in its operations. It has also been registered as a Microsoft

Authorized Refurbisher (MAR). It estimates that it processes less than 10% of PCs and other e-waste generated by the country.



Collected items to be processed



Laboratory facility

Caribbean Tech Disposals Limited is another major recycler in the country that offers collection and processing services for PCs. The company does not undertake the dismantling of the equipment. Collected PCs are plastic-wrapped and containerized for export. The company services include logistics management, inventory tracking of all shipped equipment supported by a certificate of disposal. Discussions are now in place with a major computer manufacturer regarding a take-back system for their units at the end of its life.

It should be noted that the two major recyclers also contribute to national waste diversion efforts by reducing the volume of waste generated for disposal. These efforts divert the waste from the landfill sites which reduces the potential for environmental pollution and also reduces the volume of waste to be disposed. This strategy extends the life of the site and reduces the cost per tonne for disposal.

4.3.8 Other Recycling Activities

Other waste recycling activities include glass, paper, metal and some plastic. Recycling to local markets following the dismantling process is limited to metals which are sold to available markets. Plastic while it is also recovered is shredded for overseas markets. The vibrancy of the recycling industry continues to be dictated by overseas market prices as shipping costs continue to be the major challenge in maintaining profitability.

This intermingling of communities and commercial sectors has also impacted on the recycling industry. Many of the recycling (salvaging) activities have been developed in communities in close proximity to the landfill sites. These activities include primarily the recovery of glass, metal, paper and cardboard, and some efforts on PET plastics depending on market prices. Some of the early recyclers have moved into formal small and medium recycling enterprises in mainly the glass recovery as the Carib Glassworks Limited offers a market for cullet to be used

in the remanufacturing of bottles for the beer and other beverage industries. Communities have also produced recycling activities in the metal industry where scrap items are sold to the local steel plant or exported to foreign markets. The prevalence of this activity is evident along one of the main arteries leaving the capital, opposite the Beetham Landfill, one of the largest municipal waste landfill sites in the country.

Table 8 provides a listing of other recycling businesses in the country that may complement an e-waste management system.

Table 8: Recycling Businesses in Trinidad and Tobago.

Business Name	Items Recovered/Recycled
Caribbean Salvage Ltd., 4 Pioneer Dr., Sea Lots, Trinidad, 623-8813	Metals
Trinidad Extraction and Recycling Limited, Dow Village, California, 665 1655	Metals
Premier Metals Ltd., Lot 17B O'Meara Industrial Estate, Arima,Trinidad, 646-8642	Metals
Carifta Scrap Dealers Ltd, 71 Eastern Main Road, Laventille 868 623-6386	Metals
Millenium Metals & Recycling Ltd. 67-69 Southern Main Rd., Pt. Lisas 636 9314	Metals
Ace Recycling Limited, 2 El Socorro Ext., San Juan, Trinidad 638 3946	Paper and other items
Trinidad and Tobago Solid Waste Management Company Ltd., 34 Independence Square North, Port of Spain, 625 6678	Paper
Carib Glassworks, Eastern Main Road, Champ Fleur, 662 2231	Glass
Caribbean Tech Disposals Ltd. 19 Dundonald Street, Port of Spain, 625 8324	Electronic Waste
Trinidad Recycling and Trading Company, Bilijah and Caroni Savannah Road, Chaguanas, 665 3855	Metals and various other items
Pirannha International Ltd. 10-11 Bahadoor St, California, 679 7826	Electronic Waste
Waste Plastic Recovery Ltd., 9 Concession Road, Sea Lots, 625 5546	Plastic

4.3.9 Downstream Vendors

There is no evidence of any major downstream vending activity for e-waste items. The practice of storage of end of life computers coupled with disguised entry of units to disposal sites creates a natural barrier between the potential vendors and the waste. Discussions have also indicated a lack of knowledge regarding the value of items to be derived from dismantling of PCs. Also the absence of the techniques for safe dismantling of the units provides another problem for potential vendors. Finally there is the unavailability of local feasible markets for the plastic components which require shredding to derive some measure of return on the collection, processing and shipping efforts.

4.3.10 Final Disposers

Trinidad and Tobago lacks a final disposal system for hazardous waste vis-a-vis e-wastes. Two of the three major landfill sites are not lined and while the disposal of e-waste is prohibited, these special waste items continue to enter the sites commingled with regular municipal wastes. As indicated SWMCOL instituted a ban on items entering the site and has also discontinued the receipt of end-of-life PCs.

4.3.11 Most Affected Communities

In the absence of a formal or informal e-waste recycling industry few if any communities are significantly affected. The presence of waste pickers (salvagers) is already a factor at two of the major landfill sites, Beetham and Guanapo which are in close proximity to communities. These communities have historically been involved in salvaging with a substantial number of the residents earning an income by rummaging through the waste entering the sites. The recovery of e-waste has not been as visible as other items such as glass, steel, and paper. Also there is no indication of stockpiles of PCs around the country which may signal some community dismantling activity.

4.3.12 Other Stakeholders

Several other stakeholders have indicated interest in e-waste management both prior to the assessment project by way of articles and the symposium conducted by SWMCOL and also during the interviews at the data acquisition stage. The following is a listing of some of these stakeholders:

(i) Government Sector

- a) Ministry of Planning, Housing and the Environment
- b) Environmental Management Authority
- c) Trinidad and Tobago Solid Waste Management Company Limited
- d) Ministry of Communication and Information Technology

- e) The Attorney General's Office as it relates to establishing legislation
- f) The Ministry of Local Government regarding the waste management function in the Municipal Corporations.
- g) Ministry of Education
- h) Ministry of Labour and Small and Micro-Enterprises Development
- i) Ministry of Science, Technology and Tertiary Education

(ii) Academic Institutions

- a) University of the West Indies
- b) University of Trinidad and Tobago

(iii) Other Institutions and Associations

- a) Trinidad and Tobago Chamber of Commerce
- b) Trinidad and Tobago Manufacturers Association
- c) Information and Communication Technology Professional Society (ICTPS)
- d) The Community HUB Corporation – This is a locally incorporated NGO. “The purpose of the Corporation is be to act as an investment rallying point and central locus of administration for the creation of “Community HUBs” the aims of which will be to facilitate the development of especially youth, through the offering of educational, arts, enterprise-based programming and environmental education, relevant to the current local cultural and socio-economic realities of the area in which the HUB is located; thus ushering in a new paradigm in thought and lifestyle especially among the region’s youth.” One initiative currently being considered by the Corporation is the development of sustainable E-Waste Recycling / PC Refurbishment centres, in communities across Trinidad and Tobago, facilitating youth employment.

5 Massflow Assessment

5.1 Massflow System Chart

Figure 9 gives an overview of the different life cycle stages of a computer in Trinidad and Tobago. Main stages of the product are the import, the distribution via retailers and the consumption. Once the computer reaches its end-of-life it might stay in storage at the consumer for some time (shown in diagram), but eventually enters the waste stream. In the waste stream it either gets dumped informally or formally.

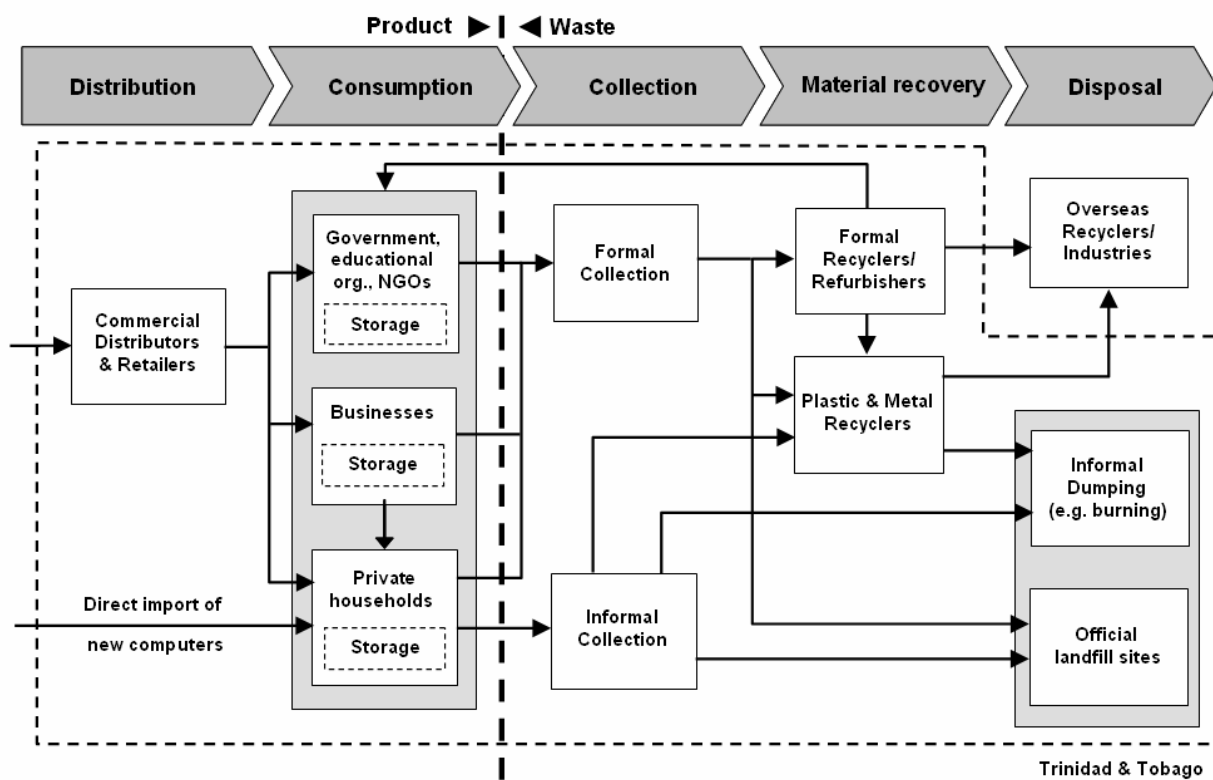


Figure 9: Massflow chart for Computers in Trinidad and Tobago (2009).

5.2 Current Massflows

Information on the level of distribution and retailing sales were not readily available. Many of these stakeholders preferred not to divulge the required information for the purposes of retaining market share information. The project had to make projections based on import data from the Customs and Excise and the Central Statistical Office and available information obtained during the data acquisition stage.

The Central Statistical Office of Trinidad and Tobago⁷ has recorded a total of 32,474 computers (laptops and desktops) imported into the country for the year 2007, for 2008 a total of 33,536 and 12,856 for the period January to September 2009, based on input data from the Customs and Excise Division. These figures do not represent importation by individuals during their personal or business travels. These latter units may not have been reported and as a result are not captured by the Customs and Excise data bank, adding justification to a greater estimation of units imported into the country.

World Bank statistics⁸ have stated a total installed base of computers for low, medium and high income groups in 2007 as 238,550, based on a calculation of 13.2 computers per 100 persons for the low and medium income groups and 64.7 computers per 100 for the high income groups, distributed as 95% and 5% respectively.

Based on information provided by the five major distributors/retailers of PCs for the period 2007, 2008 and 2009, an average of 23,000 PCs are sold annually to the various sectors. Indications are that 85% represents desktops and are retailed primarily to schools.

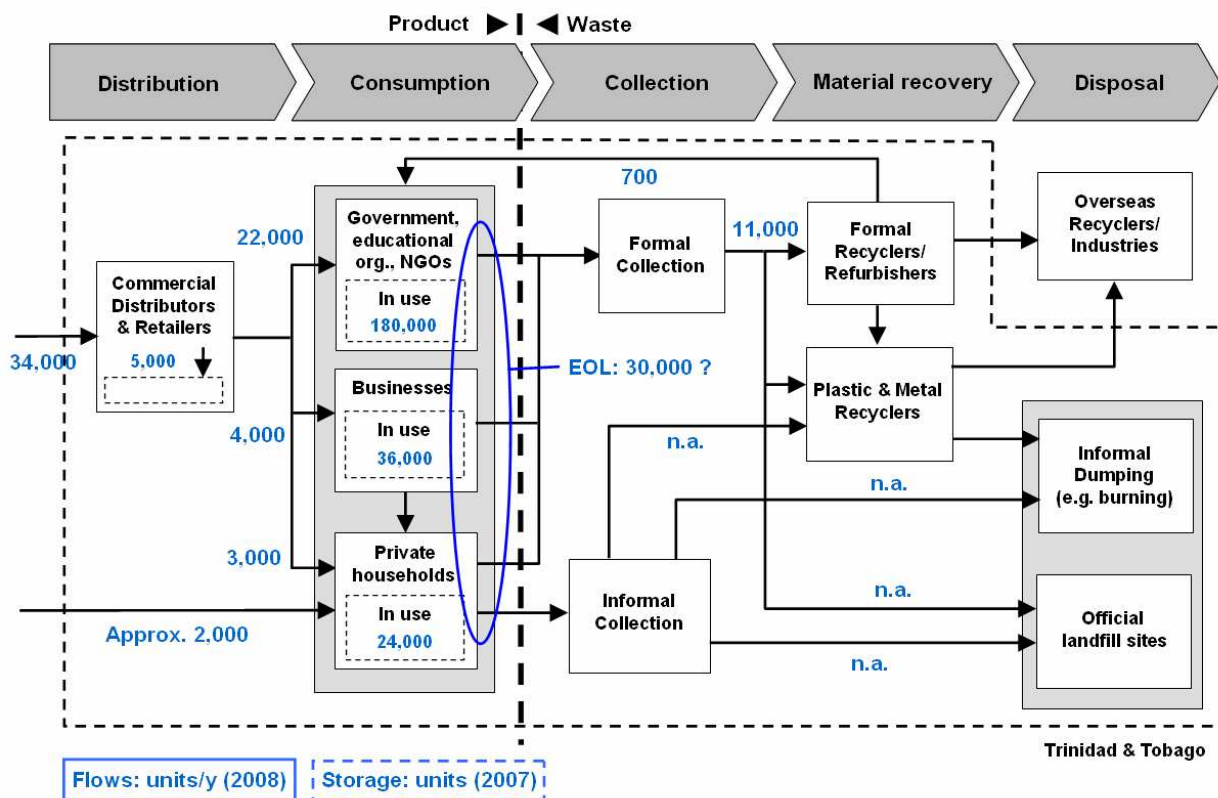


Figure 10: Estimated computer flows in Trinidad and Tobago for 2008 (in computers/year).

⁷ Central Statistical Office – Trade Section: Imports and Exports on Selected Items

⁸ World Bank – Trinidad and Tobago ICT at a Glance, 2007

An overview of estimated computers flows for the year 2008 taking into account the flowchart from chapter 5.1 can be appreciated in Figure 10. It is estimated that in the year 2008 approximately 30,000 became obsolete in Trinidad and Tobago. From these 30,000 PCs, around 11,000 have been recycled through a formal e-waste recycling company. Unfortunately, the faith of the remaining 19,000 computers is not clear. They have probably been stored, donated, handed over to an informal collector or dumped on a landfill.

The 30,000 PCs correspond to approximately 500 tons of computer waste or around 0.40 kg per capita. If this amount is compared to other data gathered from Empa in different developing countries around the world (Figure 11), the computer waste generation in Trinidad and Tobago meets the level of countries like Morocco, Chile and South Africa, but clearly exceeds the levels of Colombia, Uganda or China for example. In developed nations this amount can be up to five times higher than in T&T, like in the case of Switzerland – which by the way has one of the world’s highest numbers of PCs per capita – with 2 kg of computer waste per habitant and year.

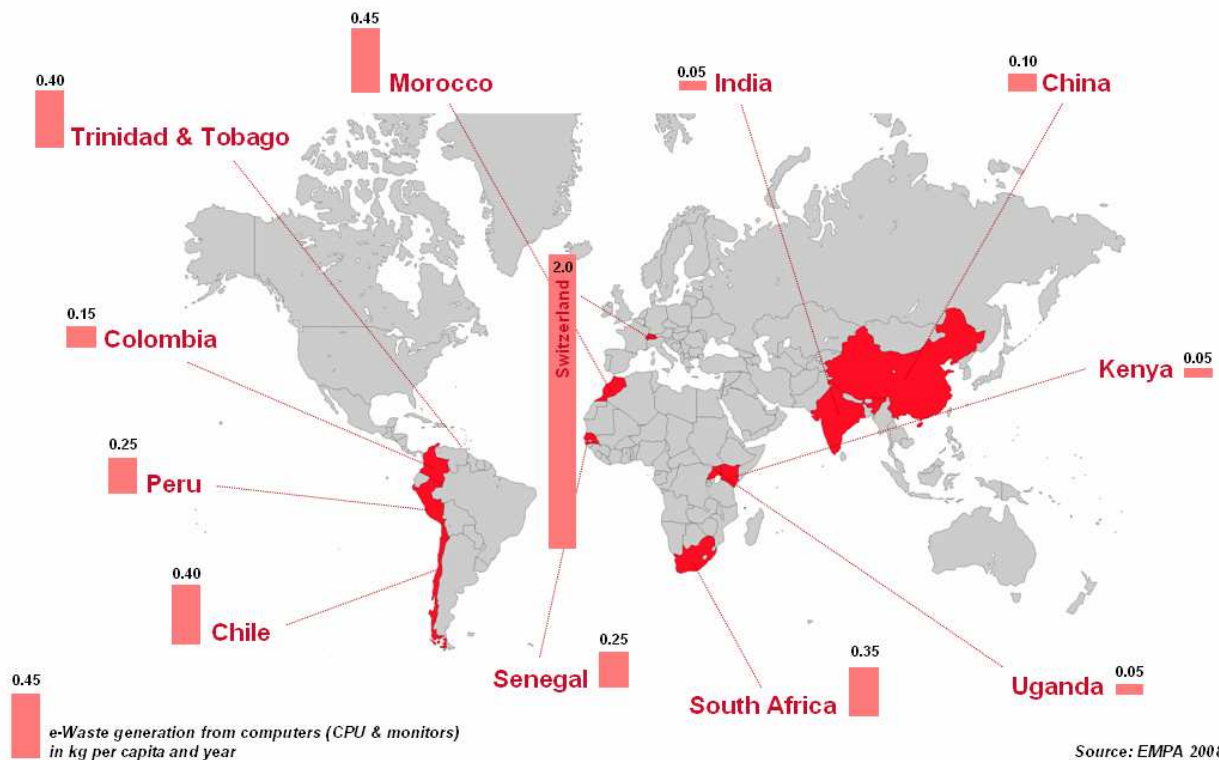


Figure 11: Estimated computer waste generation in kg per capita and year for selected developing countries and comparison with Switzerland.

Figure 12 shows the estimated and projected development of the generation of obsolete computers for Trinidad and Tobago. During the year 2010, approximately 45,000 computers will reach their end of life and become e-waste. This corresponds to more than 0.5 kg per capita.

The growth of obsolete computers is linear and is suspected to double between 2008 and 2014 from 30,000 to 60,000 PCs per year. The trend indicates that a further delay in addressing the build-up of a sustainable e-waste management system could lead to a strong increase in the

amount of obsolete PCs which could possibly have a negative impact on the environment and human health through improper recycling practices and inadequate disposal.

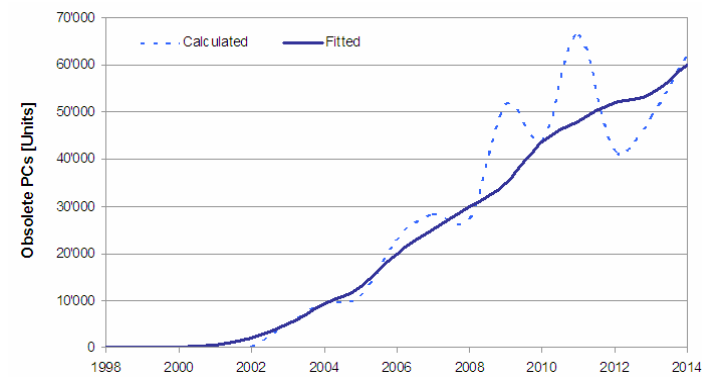


Figure 12: Estimated and projected generation of obsolete computers (Desktops and Laptops) in Trinidad and Tobago from 1996 to 2014 (in computers per year).

Figure 13 on the other hand is an attempt to estimate the amounts of electronic data processing equipment coming into Trinidad and Tobago since 1995. The noticeable peak in 2007 may have been attributed to high acquisition levels when the country was experiencing an economic boom as a result of unusually high oil prices. Also the drive by the government to strengthen e-activities at institutions and agencies would have led to the import of hardware to support this initiative.

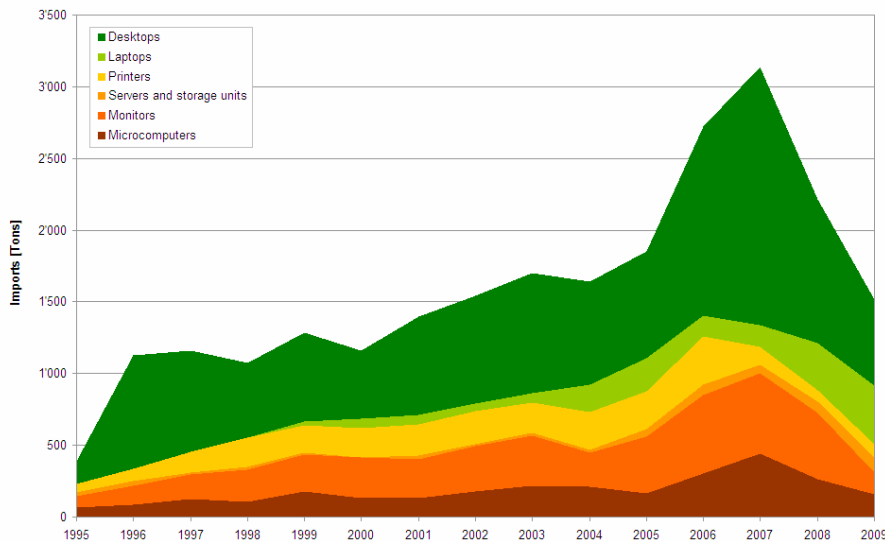


Figure 13: Estimated annual imports of different computing appliances and peripherals (in tons).

As an average, every year approximately 1,600 tons of these appliances are imported. In total, more than 24,000 tons have been imported since 1995. And inevitably, a big part of this amount has already become obsolete and thereby e-waste that needs to be handled properly.

6 Impacts

6.1 Society

The social impact analysis focuses on four major sub-sectors that are relevant to e-waste management in Trinidad and Tobago, namely: Collection, Dismantling, Material Recovery and Final Disposal. The issue of proper e-waste management was highlighted at three national symposiums over the period 2005 to 2007 hosted by SWMCOL. While these initiatives may have achieved some of the objectives of sensitization and education the system development that was envisaged to follow the outcome of the discussions has not materialized. In its absence e-waste management has been limited to recovery and some dismantling, prior to final disposal of unrecovered components at overseas processing systems.

The existing collection system engages approximately 20 permanent employees which are distributed among the two recyclers in the country because of its limited activity. It is suggested that certification requirements be established to govern the activities of these recyclers where certain standards and regulations are enforced. Some of these rules should include the use of “best practices” in the system, equipment and human resource management. Training and re-training should precede the engagement of employees so that formal system development will see an increase in opportunities for these trained individuals. The provision of these skills will facilitate effective processing of the anticipated larger volumes of units.

Given the embryonic stage at which the e-waste management sector now stands in the country, there is the opportunity to design, initiate and facilitate a formal sector that could be developed with the appropriate infrastructure, incentives and legislation to capture a substantial volume of e-waste and create a sustainable industry. Like other recovery industries such as glass and ferrous metals, small and medium companies will be developed with the accompanying increase in the number of persons employed, to respond to market demand and also to the need for compliance requirements by generators. Failure of the government to support the “best practices” approach may result in the proliferation of an informal “backyard” industry where proper public and environmental health and safety issues do not elicit the attention that is required.

Material recovery from the solid waste stream has also attracted the development of communities in proximity to landfill sites. The socioeconomic arrangements have seen large percentages of the community, including young adults and families, engaged in the industry once there is a demand for the recovered items. This has been evident with the glass, paper, cardboard and metal industries that have influenced intense salvaging of items from the landfill by rummaging through waste on a daily basis. This practice continues to pose a risk to the health and safety of those involved, both in the collection of items and also the processing of items. Recovered items are also stored in adjacent areas to the community, increasing the potential for mosquito breeding during the rain season, a situation that has been attributed to a

dengue outbreak in the late 1990s. If an unregulated industry is allowed to develop many of these poor environmental and health conditions will persist in the surrounding communities.

6.2 Environment

Limited activities in e-waste recovery and processing to date have reduced concerns for major environmental damage. One of the major recyclers that dismantle computers does not go beyond the removal of plastics and metals. All other items are shipped to overseas e-Steward partners for disposal. The plastics are shredded for export.

Informal metal recovery by other individuals is of concern as some of the salvaging activities involve the burning of cables to recover the copper metal, a process that results in the release of dioxins into the atmosphere. There are no visible signs of informal dismantling of end-of-life electronic items or the processing of other types of e-waste.

The EMA has introduced legislation that requires that a Certificate of Environmental Clearance be obtained before any facility is developed. This document certifies the environmental acceptability of an activity. Many of the regulations auger well for the formal organization of the e-waste management sector.

While the existing operations by the recyclers are not under close monitoring, site observations has indicated fairly environmentally safe practices are adopted. One of the facilities has been audited by the Basel Action Network (BAN) and as such is allowed to be registered as a certified E-Steward.

While some of these requirements may be seen as a disincentive, formal development reduces the potential for long term environmental costs. Remediation cost for contaminated sites continue to exceed the cost of compliance as penalties and interest costs for damages are incurred.

6.3 Economy

E-waste management provides the potential for vibrant economic activity once it is formally developed to a level of sustainability. In the absence of enforced environmental legislation, the viability of the recycling industry is driven by a need of generators in the absence of a proper disposal system. A request for removal of used items is spearheaded mainly by the larger industries in the private sector. The further development of the industry formally or informally will increase the demand for a greater collection function. In response more clients will request services, there will be an increase in the dismantling process as more units enter the system, employment to address both the dismantling and handling of the items will increase as a consequence, and also demands for brokerage and shipping services will increase. The existing formal recycling sector presently engages an average of 10-12 persons permanently and may increase to 40 persons temporarily depending on the size of the project. These figures can increase as more labour is required to fulfil the demands.

7 Conclusions

7.1 Strengths and Weaknesses of the Current Situation

The formal e-waste management industry is potentially on the brink of becoming vibrant once the administrative, environmental and technical frameworks are introduced. Discussions during the data acquisition stages revealed that large stocks of PCs are presently stored at many of the generators particularly at government institutions. The country has to be prepared to accommodate the influx of these stored PCs by expanding and strengthening the collection, processing, refurbishment and disposal functions. Ready access to affordable PCs continues to be another avenue for the acute increase in units in the country. Academic institutions have indicated the incidence of students possessing sometimes two laptop PCs with the latest technology, and having a turnover time of approximately 2 years. With such a comfortable GDP, this trend is expected to continue and the country has to be prepared to address the anticipated volumes, which are estimated to increase at a rate of 1,600 units per year, a trend that is illustrated since 1995 as seen in Figure 12.

Some of the strengths of the current situation include:

- a) The positive impact of any recycling industry is a fundamental benefit that diverts waste from reaching the landfill thus increasing the life of the site and also reducing negative environmental and public health risks;
- b) The existence of a fairly formal practice of recycling with some refurbishment in the country to include the model set by one of the recyclers regarding the BAN auditing and the certification as an e-steward;
- c) The existence of some environmental regulations that indirectly address the development and operation of new e-waste refurbishment facilities;
- d) The opportunity to strengthen existing environmental management legislation to address e-waste management specifically;
- e) The expectation that mainly new computers are being imported into the country which facilitates effective refurbishment and reuse;
- f) The current practice of storage of end-of-life computers has limited the volumes entering the waste stream that may have contributed to illegal dumping;
- g) The three year sensitization initiatives by SWMCOL have raised some public awareness regarding the dangers of e-waste;
- h) The planned mobilization efforts of some non-governmental organizations regarding the reuse of refurbished PCs by young people in various communities provide a positive model that may be replicated nationally;
- i) The country's years of experience in the recovery and recycling industries empowers

existing and future stakeholders to successfully develop and operate e-waste recovery and refurbishment SMEs;

- j) Recycling initiatives can facilitate the interaction and mobilization of a number of diverse groups such as schools, communities, industries and social groups to achieve a common national objective.

Some of the main weaknesses include:

- a) The absence of reliable data on e-waste generation;
- b) The absence of, also the lack of enforcement of existing, policy and legislation addressing e-waste management;
- c) The lack of a clear position of the manufacturers, importers and distributors regarding the extended producer responsibility which labels them as the main responsible stakeholder for their end-of-life products;
- d) The lack of a proper inventory system by government institutions as the largest users, regarding stored end-of-life PCs and other types of e-waste;
- e) The absence of a hazardous waste facility for the disposal of certain fractions contained in e-waste;
- f) The continuing disposal of PCs and other e-waste commingled with municipal waste reaching the landfills;
- g) Lack of public awareness.

7.2 Recommendations for an e-Waste Strategy in Trinidad and Tobago

While advances in technology and personal affordability give consumers the availability to upgrade to newer, small, and more energy-efficient electronic products, it is important to remember that older electronics units and devices may not have reached the end of their useful life. On average, the original owner keeps a laptop computer for only 4 years and will discard their cell phone after only 24 months. However, many televisions, computers, computer monitors, mobile phones and other electronics are still in good working condition and can be reused, refurbished or recycled. There could be a vibrant, for-profit secondary market for recent models of laptop computers, desktop computers and cell phones because these products retain significant value.

Trinidad and Tobago is at a juncture where a formal e-waste management system can be developed with the required legislation and infrastructure to support effectiveness. It has an opportunity to build on the recycling initiatives already taken so that generators can be provided with a solution to volumes of items stored in warehouses, offices and housing communities.

This rapid assessment required a specific focus on PCs in an attempt to capture an understanding of the landscape concerning the life cycle of computers. While this may be of

importance at this time the development of policy and legislation should not ignore the broader coverage of e-waste items in an attempt to address the larger national challenge.

Regarding existing and planned e-waste management practices in Trinidad and Tobago it is recommended to develop a nationwide e-waste strategy with a short and medium-long term approach including the following steps:

Immediate to Short Term (1 year):

- **Stakeholder Strategy Group:** Immediate steps should be taken to establish a stakeholder network out of which the proposed e-waste management strategy group should be formed. This network should bring together the existing public and private sector committees and sub-committees of industries, and academia, community initiatives and other non-governmental partners to appoint the strategy group with appropriate representation. This group should be provided with a clear terms of reference regarding the way forward recognising the existence of other forums i.e. the e-business roundtable.
- **Institutional Framework:** Inter and intra institutional arrangements should be made to identify a key governmental agency, possibly the Ministry of Public Administration, to direct the national initiative. While the EMA should be represented, this authority should retain its responsibility for monitoring and regulating the development of the e-waste management industry. Some of the relevant institutions may include the Ministry of Planning, Housing and Environment, Ministry of Local Government, SWMCOL, Environment Management Authority, and Chambers of Commerce. Government should continue its role as regulators and facilitators while the private sector should be allowed to address the sustainable commercial activities.
- **Development of the Legal Framework:** The existing legislation such as the Environmental Management Act, the Litter Act and the Draft Waste Management Rules should be strengthened to accommodate specific requirements for the management of e-waste. It should also be considered to develop a specific regulation for e-waste, as it exists in many countries in Europe and is currently being done in several Latin American countries.
- **Support Markets:** Attention should be given to ensuring that reliable final disposal points are identified and assured. The extended producer/manufacturer/importer responsibility should form the basis for this process, where specific programs are established for the return of end-of-life PCs to these sources. The deposit/refund mechanism can be considered to ensure that individuals adhere to the return practices established as an incentive. The government may consider supporting reduced shipping tariffs and costs on the export of end-of-life PCs and their waste components.

Medium to Long Term (2 to 3 years):

- **Development of the E-Waste Recycling Sector:** The initiative already made by existing recyclers should be recognized and the required support systems (system and legislation) be provided to encourage “best practices” in e-waste management. Recyclers should be required to be certified (i.e. BAN audited and recognition as and e-steward) to include monitoring of final disposal practices by associated e-stewards with whom they do business. As mentioned earlier GOTT should consider facilitating the shipping process recognizing the role of recyclers in diverting volumes of waste away from the existing landfills and dumps.
- **Collection and Management of Data:** These requirements should be established and monitored both at the national level and the sector level. The existing data collection practices at both the Customs and Excise Division and the Central Statistical Office should be strengthened particularly regarding the coding and delineation of items. This requirement should also be available from a central procurement unit of the government sector and the various chambers and associations in the private sector. Information should include PC acquisitions, expected duration for use, storage, disposal practices. Recyclers should also be required give volumes of PCs processed, packaged, the waste generated and the volumes shipped to other certified disposal companies.
- **Public Education and Relations:** A plan should be develop under the guidance of the strategy group. The approach may involve the continuation of the annual e-waste symposiums to ensure the awareness remains current and consistent.
- **Re-Activation of Public Sector e-Waste collection initiatives:** There is an absence of any existing initiative, which contributes to the stockpiling of electronic items at Ministries other Governmental Agencies businesses and households. There is also the expected increase in the incidence of e-waste commingled with municipal waste reaching the landfill sites. SWMCOL’s initiative was abandoned through lack of resources. SWMCOL should be allocated the resources to continue the earlier initiative, allowing them to address dismantling and diversion as an immediate priority, operating at a national level. Diversion would have to include identifying one or more foreign recyclers, recognising the requirements of the Basel Convention. Refurbishment can be incorporated at a later date.

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Annexes

- Annex A: Typical e-Waste Management Options**
- Annex B: Questionnaires**
- Annex C: List of visited/interviewed stakeholders**

Annex A

Typical e-Waste Management Options

Households and Small Businesses

e-Waste can be managed in various ways, depending upon its continued usability, availability of reprocessing facilities, where it is generated and other factors. Some options for management include:

- *Reuse*: Preventing waste in the first place is the preferred management option. Repairing or upgrading used electronic equipment can extend the use of the unit. For example, adding memory to a computer or upgrading software can improve the unit's performance and extend its usefulness. Instead of purchasing a new digital television, a converter box can be purchased to receive and reformat DTV signals.
- *Donate*: As the amount of electronic waste increases, many charitable organizations have become overwhelmed with electronic waste and no longer accept it or they will have to bear the cost of disposal, further straining their limited budgets. Items can be donated to some charities, schools, materials exchanges.
- *Recycle*: In response to consumer concerns, several electronics manufacturing companies have implemented take-back programs. Some programs allow the purchaser to pay a fee at the time of sale to cover shipping to a reprocessing facility when the unit becomes unwanted or obsolete. Others allow owners to ship e-waste to their facilities for a nominal fee or will provide owners with a rebate when the unit is shipped to a participating recycling center. Some waste management companies also offer similar management options to households and businesses.

Corporate and Large Public Users

For big companies and large users from the public sector, there basically exist the same options as mentioned above. As large corporate and public users in general have a higher turn-over of computers and office equipment than small businesses, they are often able to establish B2B solutions directly with e-waste recyclers. In addition, over the recent years there has been an increasing tendency for leasing electronic equipment instead of buying it. This allows the user normally to give it back directly to the manufacturer or distributor which thereby is forced to fulfil his extended producer responsibility.

Manufacturers/Industries

Industries can also adopt waste minimization techniques through sustainable product design. Some of these techniques involve adopting:

- *Inventory Management:* Proper control over the materials used in the manufacturing process is an important way to reduce waste generation. By reducing both the quantity of hazardous materials used in the process and the amount of excess raw materials in stock, the quantity of waste generated can be reduced. This can be done in two ways i.e. establishing material-purchase review and control procedures and inventory tracking system.
- *Production-Process Modification:* Changes can be made in the production process, which will reduce waste generation. This reduction can be accomplished by changing the materials used to make the product or by the more efficient use of input materials in the production process or both. Potential waste minimization techniques can be broken down into three categories: (i) improved operating and maintenance procedures, (ii) material change and (iii) process-equipment modification.
- *Volume Reduction:* Volume reduction includes those techniques that remove the hazardous portion of a waste from a non-hazardous portion. These techniques are usually to reduce the volume, and thus the cost of disposing of a waste material. The techniques that can be used to reduce waste-stream volume can be divided into 2 general categories: source segregation and waste concentration. Segregation of wastes is in many cases a simple and economical technique for waste reduction. Wastes containing different types of metals can be treated separately so that the metal value in the sludge can be recovered. Concentration of a waste stream may increase the likelihood that the material can be recycled or reused. Methods include gravity and vacuum filtration, ultra filtration, reverse osmosis, freeze vaporization etc.
- *Recovery and Reuse:* This technique could eliminate waste disposal costs, reduce raw material costs and provide income from a salable waste. Waste can be recovered on-site, or at an off-site recovery facility, or through inter industry exchange. A number of physical and chemical techniques are available to reclaim a waste material such as reverse osmosis, electrolysis, condensation, electrolytic recovery, filtration, centrifugation etc. For example, a printed-circuit board manufacturer can use electrolytic recovery to reclaim metals from copper and tin-lead plating bath. However recycling of hazardous products has little environmental benefit if it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use nonhazardous materials, such recycling is a false solution.

Annex B

QUESTIONNAIRE FOR STAKEHOLDER

Date: _____

Questions	Answer	Remarks (please enhance your replies with comments, suggestions, details, etc.)
General		
1. Are you aware about the environmental hazards caused by discarded electronic equipment?	Yes / No	
2. Are you aware that some electronic parts may be profitably recycled?	Yes / No	
3. Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed?	Yes / No	
4. Does your company have a policy for the management of e-waste?	Yes / No	
5. If not, does your company plan to adopt a policy of e-waste management?	Yes / No	
Stock and generation of e-waste		
6. What is the installed base of electric & electronic equipment (in numbers)	___ computers (including CRT, mouse, keyboard) ___ printers ___ telephones ___ televisions ___ refrigerators ___ others	
7. How many new items does your company purchase per year?	___ computers (including CRT, mouse, keyboard) ___ printers ___ telephones ___ televisions ___ refrigerators ___ others	
8. Where do you purchase your equipments?	___ retail shop ___ general distributor ___ directly to the producer ___ lease ___ second hand market ___ other	

Question	Answer	Remarks (please enhance your replies with comments, suggestions, details, etc.)
Stock and generation of e-waste (continuation)		
9. What do you do with the equipment you don't use anymore?	<input type="checkbox"/> store <input type="checkbox"/> sell <input type="checkbox"/> throw them away with general waste <input type="checkbox"/> give them to a recycler <input type="checkbox"/> donate them to schools, employees, friends, etc. <input type="checkbox"/> give them back to the person who sold them to you <input type="checkbox"/> other	
10. Do you keep inventories of the equipments you discard / store?	Yes / No	
End-of-life management of your electric and electronic equipment		
11. Are you aware of what happens to the equipments you have discarded?	Yes / No	
12. Would you be ready to pay for your equipment to be collected and recycled?	Yes / No	
13. If yes, under what conditions? (e.g. pick-up service, guarantee of proper disposal, etc.)	Provide details	
14. In your view what are the major obstacles to proper recycling of electric and electronic equipments in the country?	<input type="checkbox"/> costs <input type="checkbox"/> lacking infrastructure and/or policy within your company <input type="checkbox"/> absence of recycling possibilities <input type="checkbox"/> lack of legislation <input type="checkbox"/> other	
15. What should be done to implement proper recycling channels in the country?		
Institution information		
16. Name and address of the institution		
17. Please provide the coordinates of a contact person		
18. Type of institution	<input type="checkbox"/> government <input type="checkbox"/> private company <input type="checkbox"/> NGO <input type="checkbox"/> other	
19. Principal activity of the company		
20. Number of employees		
21. Is your institution ISO 14'001 certified?	Yes / No	

QUESTIONNAIRE FOR ELECTRONIC WASTE RECYCLER

Questions	Answer	Remarks (please enhance your replies with comments, suggestions, details, etc.)
General		
1. What volume of computers is processed on an annual basis?	Desktops _____ Numbers _____ Weight(tons) _____ Laptops _____ Numbers _____ Weight(tons) _____	
2. Is there any dismantling and refurbishment of PCs? If there is what items (number and weight) are recycled annually?		
3. How often and what volumes are shipped annually?		
4. What is the method of packaging?		
5. Does your company have or plan to adopt a policy for the management of e-waste?		
6. What is the final disposal point/market for processed e-waste?		
7. How many employees are involved in the processing of items?		
8. Is there a manifest system to ensure proper waste management to the point of disposal?		
9. To what standards/guidelines/rules does your company adhere to regarding the recycling of PCs and other e-waste?		
10. Has your company's operations ever been visited/audited by the national environmental regulatory body?		
11. Which sectors are serviced by your company?	Public __ Private(Specify) __ Schools ____ University ____ Residential __ Other __	
12. What are the service charges to generators?		
Stock and generation of e-waste		
13. What is the installed base of electric & electronic equipment (in numbers)	__ computers (including CRT, mouse, keyboard); __ printers; __ telephones __ televisions; __ refrigerators; __ others	
14. How many new items does your company purchase per year?	__ computers (including CRT, mouse, keyboard); __ printers; __ telephones; __ televisions; __ refrigerators; __ others;	

Question	Answer	Remarks (please enhance your replies with comments, suggestions, details, etc.)
Stock and generation of e-waste (continuation)		
15. What do you do with the equipment you don't use anymore?	<input type="checkbox"/> store <input type="checkbox"/> sell <input type="checkbox"/> throw them away with general waste <input type="checkbox"/> give them to a recycler <input type="checkbox"/> donate them to schools, employees, friends, etc... <input type="checkbox"/> give them back to the person who sold them to you <input type="checkbox"/> other	
16. Do you keep inventories of the equipment you store/discard?	Yes / No	
17. Which sectors are serviced by your company?	Public <input type="checkbox"/> Private(Specify) <input type="checkbox"/> Schools <input type="checkbox"/> University <input type="checkbox"/> Residential <input type="checkbox"/> Other <input type="checkbox"/>	
End-of-life management of your electric and electronic equipment		
18. In your view what are the major obstacles to proper recycling of electric and electronic equipment in the country?	<input type="checkbox"/> costs <input type="checkbox"/> lacking infrastructure and/or policy within your company <input type="checkbox"/> absence of recycling possibilities <input type="checkbox"/> lack of legislation <input type="checkbox"/> other	
19. What should be done to implement proper recycling channels in the country?		
20. What percentage (estimation) of PCs and other e-waste generated nationally is handled by your company annually?		
Institution information		
21. Name and address of the institution		
22. Please provide the coordinates of a contact person		
23. Type of institution	<input type="checkbox"/> government <input type="checkbox"/> private company <input type="checkbox"/> NGO <input type="checkbox"/> other	
24. Principal activity of the company		
25. Number of employees		
26. Is your institution ISO 14'001 certified?	Yes / No	

QUESTIONNAIRE FOR DISTRIBUTOR/RETAILER

Questions	Answer	Remarks (please enhance your replies with comments, suggestions, details, etc.)
General		
1. Does your company have a policy for the management of e-waste?	Yes / No	
2. If not, does your company plan to adopt a policy of e-waste management?	Yes / No	
Stock and generation of e-waste		
3. What is the installed base of electric & electronic equipment at your organization (in numbers)	<input type="checkbox"/> computers (including CRT, mouse, keyboard) <input type="checkbox"/> printers <input type="checkbox"/> telephones <input type="checkbox"/> televisions <input type="checkbox"/> refrigerators <input type="checkbox"/> others	
4. How many new items does your company purchase per year?	<input type="checkbox"/> computers (including CRT, mouse, keyboard) <input type="checkbox"/> printers <input type="checkbox"/> telephones <input type="checkbox"/> televisions <input type="checkbox"/> refrigerators <input type="checkbox"/> others	
5. Where do you purchase your equipments?	<input type="checkbox"/> retail shop <input type="checkbox"/> general distributor <input type="checkbox"/> directly to the producer <input type="checkbox"/> lease <input type="checkbox"/> second hand market <input type="checkbox"/> other	
Stock and generation of e-waste (continuation)		
6. What do you do with the equipment you don't use anymore?	<input type="checkbox"/> store <input type="checkbox"/> sell <input type="checkbox"/> throw them away with general waste <input type="checkbox"/> give them to a recycler <input type="checkbox"/> donate them to schools, employees, friends, etc... <input type="checkbox"/> give them back to the person who sold them to you <input type="checkbox"/> other	
7. Do you keep inventories of the equipments you discard / store?	Yes / No	
End-of-life management of your electric and electronic equipment		
8. Are you aware of what happens to the equipments you have discarded?	Yes / No	

Question	Answer	Remarks (please enhance your replies with comments, suggestions, details, etc.)		
9. In your view what are the major obstacles to proper recycling of electric and electronic equipments in the country?	<input type="checkbox"/> costs <input type="checkbox"/> lacking infrastructure and/or policy within your company <input type="checkbox"/> absence of recycling possibilities <input type="checkbox"/> lack of legislation <input type="checkbox"/> other			
10. What should be done to implement proper recycling channels in the country?				
Distribution/Retail Profile				
How many PCs were provided to clients for 2007, 2008 and 2009		Laptops _____ Desktops _____		
What is the distribution per sector			Laptops	D'tops
		Government (including schools)		
		Private Sector		
		Residential		
Are there request for, and does your company offer PC end-of-life take-back programmes? If not is your company considering such a programme?				
Institution information				
11. Name and address of the institution				
12. Please provide the coordinates of a contact person				
13. Type of institution	<input type="checkbox"/> government <input type="checkbox"/> private company <input type="checkbox"/> NGO <input type="checkbox"/> other			
14. Principal activity of the company				
15. Number of employees				
16. Is your institution ISO 14'001 certified?	Yes / No			

Annex C

List of visited/interviewed Stakeholder Institutions

- Caribbean Tech Disposal Limited
- Environmental Management Authority
- Illuminat/ICTPS and Neal&Massy ITC Group Limited
- Ministry of Education
- Ministry of Local Government
- Ministry of Planning, Housing and Environment
- Ministry of Public Administration (MPA) and National Information and Communication Technology Company Limited (NICTCL)
- PIRANNHA International
- Trinidad and Tobago Chamber of Industry and Commerce – Northern Chapter
- Trinidad and Tobago Manufacturers Association
- Trinidad and Tobago Solid Waste Management Company Limited
- University of Trinidad and Tobago
- University of the West Indies