



e-Waste Assessment Methodology Training & Reference Manual

e-Waste Africa project of the Secretariat of the Basel Convention

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Summary

Access to Information Communication Technology (ICT) is pivotal of a country's economic and social development and is currently improving throughout the developed and developing world. ICT is also contributing to the ever growing amount of e-waste, when appliances reach their end of life. E-waste has been acknowledged as a complex waste stream containing both hazardous substances and valuable secondary resources. Serious health, socio-economic, and environmental problems that arise due to the unsound management of e-waste have been widely documented. While especially in OECD countries the paradigms of the "closed loop economy" and the "extended producer responsibility (EPR)" lead to a professionalized e-waste recycling sector, developing countries and countries in transition often lack the infrastructure and resources for the sustainable management of e-waste.

e-Waste management needs to fulfill different objectives which go beyond pure technical implementation. Especially in developing countries and countries in transition, with a lacking legal and institutional framework, as well as missing infrastructure, e-waste management demands for a comprehensive and structured approach. This has been echoed by various international organizations and initiatives, including the United Nations Developing Organization (UNIDO), the United Nations Environment Programme (UNEP), the Basel Convention, the Solving the e-Waste Problem (StEP) Initiative and the Partnership for Action on Computing Equipment (PACE). Several development cooperation projects [1–3] adopted a three-step approach:

1. Performing a country assessment in order to **understand the current framework conditions**, including a review of the current legislation, a stakeholder assessment, a massflow assessment (inventory) and an environmental & socioeconomic impact assessment.
2. Developing a **structured strategy in a multi-stakeholder approach** by assigning objectives and main activities to the following five topics: (1) Policy & Legislation, (2) Business & Finance, (3) Technology & Skills, (4) Monitoring & Control and (5) Marketing & Awareness.
3. Implementing the strategy through a **roadmap with assigned responsibilities and a timeframe**.

This document presents the methodology for the first step of this approach. In order to define a strategy and implement the most suitable e-waste management system, it is necessary to understand the framework conditions on local, national or regional level. An e-waste country assessment, as proposed with this methodology allows acquiring a detailed knowledge of the current situation in a comprehensive approach. The methodology has been summarized in [2] and applied in various countries as listed in Table 1.

The first step of an e-waste country assessment usually consists in defining the organizational setup of the study. This not only means structuring the assessment team, but also identifying the local stakeholder(s) to whom the study results will be delivered, and who will take ownership of the e-waste problem in the country. The approach also includes setting up a so called national e-waste strategy group, comprising representatives of relevant stakeholders related to the e-waste problem. The constitution of such a multi-stakeholder platform ensures that the further implementation of a proper e-waste management system will not be rejected by one or another interest group, as all strategic decisions resulting from the assessment study are debated and adopted within the group.

The scope of the assessment study has to be defined by geographical focus, as well as by equipment category. The geographical focus defines which cities and/or regions will be focused on, whether rural areas are considered and if transboundary movement is included in the study. Finally, the modes of data acquisition are also defined and planned, which may include a review of existing literature and statistical data, holding meetings and workshops for additional data gathering, field investigations and stakeholder surveys.

The assessment study eventually leads to a qualitative and quantitative description of the framework conditions related to the content as depicted in Table 2. One of the main results is the understanding of stakeholder interactions, massflows and the identification of hotspots, which need to be tackled in order to achieve a sustainable e-waste management system.

Results are meant to provide a global picture of the e-waste situation in a defined region to the relevant stakeholders. They may be suitable to estimate the potentials for employment and for improving the living conditions of the social groups traditionally involved in the scrap business. Data related to the mass flow accountancy and economic aspects may provide information for setting up the proper business models for the recycling activities. Finally, the outcome of an e-waste assessment shall provide all the necessary information that allows drafting an action plan for implementing a proper e-waste management system in the defined region.

Table 1: Selected countries with available e-waste country assessment studies which have been developed according to the methodology described in this document.

Country	Year	Focus ¹⁾	Programme	References
Benin	2010/11	Categories 1-4	Basel Convention	[4]
Burkina Faso	2010/11	Categories 1-4	PACE	[5]
Côte d'Ivoire	2010/11	Categories 1-4	Basel Convention	[6]
Ghana	2010/11	Categories 1-4	Basel Convention	[7]
Nigeria	2010/11	Categories 1-4	Basel Convention	[8]
Tanzania	2010	Category 3 & 4	UNIDO	[9]
Uganda	2008	Category 3 & 4	UNIDO	[10]
South Africa	2008	Categories 1-4	Swiss e-waste programme	[11]
Morocco	2008	Category 3 & 4	Hewlett Packard	[12]
Chile	2007	Category 3	Swiss e-waste programme	[13], [14]
Colombia	2008	Category 3 & 4	Swiss e-waste programme	[15]
Brazil	2009	Categories 1-4	Swiss e-waste programme	[16]
Kenya	2008	Category 3 & 4	Hewlett Packard	[17]

¹⁾ Categories according to the EU WEEE Directive [18]: large household appliances (cat. 1), small household appliances (cat. 2), IT and telecommunications equipment (cat. 3), consumer equipment (cat. 4).

Table 2: Structured outcome of an e-waste country assessment.

Policy & Legislation		The country's political and legal frame-work needs to be understood, by collecting information related to policies and legislations specific or related to e-waste: In addition the Institutional framework need to be known, i.e. the organization of the legislative, the executive and the judiciary systems as well as national and local governmental bodies related to environmental management
Stakeholder assessment	<ul style="list-style-type: none"> Manufacturers, Importers, Distributors Consumers Collectors, Refurbishers, Recyclers Final Disposers, Most Affected Communities 	The purpose of the stakeholder assessment is to identify the actors involved and their role in the e-waste management system by groups of stakeholders, by explaining who they are, what their role is, how they are organized and what may be their impact on e-waste management. Each group of stakeholders is characterized by a set of qualitative and quantitative indicators, which will also provide the necessary data for calculating the e-waste mass flows further in the assessment
Mass flow assessment		The mass flow assessment is a way to describe and quantify flows and stocks of a studied material in a simplified model. The model is characterized by the boundaries of the system it represents, and by fixing variables such as mass and time units (e.g. tons/year), as well as by the flows and stocks which are included in its limits. Finally, once the mass flows are calculated, a graphic representation can be made in a simplified graph.
Impact assessment		The impact assessment is meant to highlight in a qualitative and possibly in a quantitative way where the priorities are from an environmental and socioeconomic standing point.

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Readers guide

Editors

This document is edited by experts from the Swiss Federal Laboratories for Materials Testing and Research (Empa), based on the experience gained in e-waste projects with partners in developing countries.

Motivation

It has often appeared that it is not an easy task to make an assessment of the e-waste landscape in a developing nation, where access to data may be difficult, and where e-waste management largely relies on an informal sector not covered by statistical data. Therefore this manual for an e-waste assessment aims to provide guidance to civil servants of local or national administrations, consultants, researchers, and investigators conducting assessment studies in the field of e-waste. The objective is to cover similar aspects in all countries, so that the results may be comparable and easily updated.

User

The manual was designed to be used in cooperation with specialists in the field of e-waste and is hence **not entirely self-explaining**. Nonetheless, this introduction intends to illustrate the use of this manual. Together with the additional information given in the annexes, and after a brief technical training, users should be able to work with this manual almost independently.

Scope

The scope of this methodology is to provide approaches and strategies which have proved to be suitable when assessing the e-waste landscape of a defined region. The stakeholder's analysis and the massflow assessment are the core of the assessment methodology. However, this manual goes beyond as e-waste management in developing nations has often shown to have strong environmental, social impacts. Moreover, the material fractions which are generated when processing e-waste, such as metals, plastics and glass are highly influenced by the prices which are paid on the world market; therefore also economic aspects are covered.

Organization

The graph below illustrates the organization and the function of the chapters, the sub-chapters and the annexes of the manual and shows links of subchapters to individual annexes. The chapters are structured in such a way, that it can be used as a template for the final assessment report.

The sub-chapters are a list of tasks which should be considered when conducting an e-waste assessment. Consultants and researchers which are assigned to work with this manual do have specific terms of references and might find this list too broad and all-embracing. We would like to stress that this manual was written to provide a comprehensive overview, and that users should follow selected tasks according to the specific objectives of their assessment.

For some other important elements of the manual, annexes are provided. The annexes are either examples or templates which illustrate how to go about e.g. a household survey. Others provide more scientific texts which deepen the understanding of e.g. how assessment models were designed and programmed or list references of market research institutes.

The chapters start with a short introduction followed by the purpose of the individual chapter. Specific tasks or additional information are summarised on the left and shown in detail on the right. Direct links to annexes are shown in grey.

Chapters	Function	Sub-chapters Template for assessment report	Additional information Function: Additional information, Provision of scientific background, Templates e.g. for questionnaires
Introduction	Opener	<ul style="list-style-type: none"> Problem identification Objective of assessment 	<div style="text-align: center; border: 2px solid blue; border-radius: 15px; padding: 5px; width: fit-content; margin: 0 auto;">Annexes</div> <ul style="list-style-type: none"> Annex A Sources of information and key figures Annex B UN Comtrade database Annex C Questionnaire for private consumers Annex D Questionnaire for corporate and institutional consumers Annex E Questionnaire for importers and producers Annex F Questionnaire for recyclers and refurbishers Annex G Weight and composition of selected tracers and categories Annex H Example of overview of legal texts Annex J Checklist for establishing / analysing legislation on e-waste Annex K Example of stakeholder overview Annex L Balance and parametric equations for the mass flow model Annex M Quantitative assessment of e-waste flows Annex N Detailed guideline for the assessment of social impacts Annex O Example of downstream market infrastructure Annex P Durban Declaration
Methods	Methodology toolbox with various options	<ul style="list-style-type: none"> Literature review Meetings and workshops Survey, questionnaire sampling Field studies Mass Flow Assessment 	
System description	Starting point: System definition	<ul style="list-style-type: none"> Geographical scope Product scope Development indicators 	
Policy and Legislation	System understanding for legal lay-person	<ul style="list-style-type: none"> E-waste related policies & legislation Specific e-waste management legislation Institutional framework 	
Stakeholder assessment	System understanding: main players, quantitative and qualitative data collection	<ul style="list-style-type: none"> Stakeholder overview Manufacturers and importers Distributors Consumers 	
Massflow accountability	System evaluation: Calculation and analysis of results	<ul style="list-style-type: none"> Mass flow system chart Current massflows Future massflow trends 	
Impacts	System evaluation: Evaluation and interpretation of results	<ul style="list-style-type: none"> Overview Social Environmental Economy 	
Conclusions	Summarize main outcome, discuss lessons learnt	<ul style="list-style-type: none"> Conclusions 	
Recommendations	System enhancement: Proposition of ideas and solutions	<ul style="list-style-type: none"> Overall recommendations Recommendations on the massflow system 	

1 Introduction

The introduction should give the reader an overview of the project background and existing problems and specify the objectives of the study.

1.1 Problem identification

Purpose	<i>Explain the motivations and rational behind the project</i>
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1.2 Objective of the assessment

Purpose	<i>Define explicitly the objectives of the study. Write explicitly the questions that the study needs to address.</i>
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2 Methods

An e-waste assessment report should contain a chapter describing the methods used during the assessment process. The content below suggests various possible methods for data acquisition, the application of the mass-flow assessment method as one of the core elements of the study and a possibility on how to address limitations of such a study. During the data acquisition period the investigators should develop a selective perception of the entire e-waste recycling sector. By doing this, the methods can be fine-tuned to observe and describe very specific aspects of a particular country or region (e.g. particular habits of disposing waste from households or specific refurbishment procedures). To have an overview of important data that should be obtained during the data acquisition phase, a summary of sources of information as well as key figures are listed in annex A.

The massflow assessment method is introduced as one of the core elements of this assessment. The suggested method is suitable to produce quantified data as well as future trends of e-waste generation over a certain period. Chapter 6 "Massflow assessment" describes in detail how to apply the method.

2.1 Data acquisition

Describe how the data was acquired according to the listed methods below. Alternative sources of data should be briefly described.

2.1.1 Literature review and statistical data

Purpose	<i>Describe sources of literature and statistical data and what type of information was obtained</i>
Literature review	<ul style="list-style-type: none"> • Internet sites • Databases • Specific reports / press
Statistical data	<ul style="list-style-type: none"> • National Statistics • Census • Databases
Examples	See Annex A: Sources of information and key figures See Annex B: UN Comtrade Database

2.1.2 Meetings and workshops

Purpose	<i>Describe meetings and workshops arranged with stakeholders and explain what type of information was obtained.</i>
Method includes	<ul style="list-style-type: none"> • Analysis of inventories • Analysis of protocols (e.g. ISO audit) • Analysis of registers • Elaboration of questionnaires • Expert interviews

2.1.3 Surveys, questionnaire sampling

Purpose	<i>Describe surveys or questionnaires samplings that were carried out and explain what type of information was obtained.</i>
Method includes	<ul style="list-style-type: none"> • Online survey • Mail distribution to households, enterprises, government, education institutions etc. • Observations (e.g. e-waste fractions in landfills, recycling practices, ...)
Examples	<p>See Annex C: Questionnaire for private consumers (households)</p> <p>See Annex D: Questionnaire for importers and producers</p> <p>See Annex E: Questionnaire for importers and producers</p> <p>See Annex F: Questionnaire for recyclers and refurbishers</p>

2.1.4 Field studies

Purpose	<i>Describe field studies conducted and explain what type of information is obtained</i>
Method includes	<ul style="list-style-type: none"> • Photo documentation • Identification of activity areas (2nd hand market, informal recycling, ...) • Observations (e.g. e-waste fractions in landfills, recycling practices, ...)

2.2 Massflow assessment

Purpose	<i>Describe what method was selected to conduct the massflow assessment</i>
Method includes	<ul style="list-style-type: none"> • Identification of massflow system • Quantification of massflows • Extrapolation of current massflows to identify future trends
	<i>For a detailed description of how to apply the massflow assessment methodology see chapter 6 "Massflow assessment".</i>

2.3 Limitations

Purpose	<i>Define the limitations of the selected methods and how the accuracy. Assess critically if the methods applied meet the objectives of the study</i>
Error estimation	<ul style="list-style-type: none">• For data acquisition, indicate:• If possible, calculated standard deviation (+/- x%)• Qualitative estimation of the data quality (good, average, bad)• Type of data source (statistic, estimation, calculation)

3 System definition

In the system definition the physical boundaries (geography and products) are set and the overall development status of the country or region investigated are analysed.

3.1 Geographical Scope

Purpose	<i>Define the geographical system boundaries of the study.</i>
Geographical areas	<ul style="list-style-type: none"> Specify the following information: Country / countries in scope Regions / provinces in scope Focus on rural and/or urban areas Cities in scope Including transboundary movement (neighbouring countries, legal / illegal import through sea ports, etc.) or inland focus only

3.2 Product Scope

Purpose	<i>Define which electrical and electronic equipment (EEE) are in the scope of the study.</i>
Categories	<p>As a base use the definition of products as given by the EU WEEE Directive:</p> <p>No Category</p> <ol style="list-style-type: none"> Large household appliances (e.g. Washing machines, dryers, etc.) Small household appliances (e.g. Hair dryers, toasters, etc.) IT and telecommunication equipment (e.g. PCs, Mobiles, Faxes etc.) Consumer equipment (e.g. TVs, DVDs, Music Players etc.) Lighting equipment (e.g. Tubelights, Bulbs etc.) Electrical and electronic tools (with the exception of large-scale stationary industrial tools) Toys, leisure and sports equipment Medical devices (with the exception of all implanted and infected products) Monitoring and control instruments Automatic dispensers
Tracer	<i>Define tracers (components, weight) representing the relevant categories based on the data provided in Annex G. The selection of tracer products should take into account the specific characteristics of the country or region in scope</i>
Extrapolation	<i>Estimate the quantity of the tracer product as a percentage of its corresponding category.</i>
Recommended tracers	<ul style="list-style-type: none"> Category 1: Fridge, Washing machine Category 2: Iron, Kettle, Toaster, Microwave (depends highly on country characteristics) Category 3: desktop computers, including screen (CRT and LCD), mouse, keyboard, printer, laptop computers, Mobile phones Category 4;Televisions (CRT and LCD), Hifi <p><i>Adapt or add a tracer according to the characteristics of the assessed country or region.</i></p>
Examples	See Annex G: Weight and composition of selected tracers and categories

3.3 Development indicators

Purpose	<i>Provide a background for the countries' development status which may influence e-waste generation and management and provide a basis for comparison between countries and linkages between major indicators and e-waste characteristics, quantities and distribution.</i>
Data sources	<ul style="list-style-type: none"> • World Development Indicators – World Bank 2007 • Human Development Report 2007/2008 – UNDP 2008 • National Statistics
Examples	See Annex A: Sources of information and key figures

3.3.1 People

Indicators	<ul style="list-style-type: none"> • Total population • Number of households • Household size • Average annual population growth rate • Share of economically active children • Unemployment • Youth unemployment • Urban informal sector employment • Population below international poverty line (Population below 1\$ per day, population below 2\$ per day) • GINI index
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3.3.2 Environment

Indicators	<ul style="list-style-type: none"> • Electrification rate • Energy use • GDP per unit of energy use • Emissions of organic water pollutants • Land area • Rural population • Urban population • Population in urban agglomerations of more than 1 million • Population in largest city
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3.3.3 Economy

Indicators	<ul style="list-style-type: none"> • Gross domestic product (GDP) • Purchasing power parity (PPP) conversion factor • GDP per capita • GDP (PPP) per capita • GDP composition by sector (agriculture, industry, services) • Labour force by sector (agriculture, industry, services) • Consumer price index
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3.3.4 States & Markets

Indicators	<ul style="list-style-type: none">• Telephones access• Households with television• Personal computers per 1000 people• Internet users per 1000 people• Mobile Phone subscribers per 1000 people• Information and communications technology expenditures (% of GDP)• Micro, small, and medium-size enterprises• Tax revenue collected by central government
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4 Policy & Legislation

4.1 E-Waste related policies & legislation

Purpose	<i>Identify the legal regulations that may influence e-waste management. Present an overview of legal texts as proposed in Annex H.</i>
Environmental legislations	<ul style="list-style-type: none"> • Air • Water • Solid waste
Social legislations	<ul style="list-style-type: none"> • Freedom of association and right to collective bargaining • Forced labour and Child labour • Government programmes to foster employment and alleviate poverty • Legal status of migrants including issuing of work permits
International treaties	<ul style="list-style-type: none"> • Basel convention • Bamako convention
Example	See Annex H: Overview of legal texts

4.2 Specific e-waste management legislation

Purpose	<i>Identify specific legislation on e-waste management</i>
Legislation description	<i>If a legislation, or a draft legislation exists, analyse it with the use of the check list provided in Annex J</i>
Example	See Annex J: Checklist for legislation on e-waste

4.3 Institutional framework

<p>Purpose</p>	<p><i>Political structure: Describe how the legislative, the executive and the judiciary systems are organised in the country with special emphasis on environmental management.</i></p> <p><i>Important authorities: List governmental bodies related to e-waste at national and if important at local level, e.g.:</i></p> <p><i>List ministries of environment, health, technology, communication, economy (small business development), customs, etc.</i></p> <p><i>List important local governmental bodies, municipal services</i></p>
<p>Qualitative description</p>	<ul style="list-style-type: none"> • How is the law enforced? • What are the incentives / repressive measures they use? • Important social / economic / environmental programmes • Is e-waste a priority? • What is the policy regarding the informal sector? <p>...</p>
<p>Indicators</p>	<ul style="list-style-type: none"> • Number of employees • Number of inspectors • Environmental control material • Government organised microfinance scheme for informal entrepreneurs <p>...</p>

5 Stakeholders assessment

Purpose	<i>Define the actors involved and their role in the e-waste management system by groups of stakeholders. Characterise the stakeholder group with a set of indicators</i>
Description of the stakeholder group	<ul style="list-style-type: none"> • Who are they? • What is their role / activity? • How are they organised? • What is their impact on e-waste management? • Address, location? <p>...</p>
Qualitative indicators	<ul style="list-style-type: none"> • What are their interests, motivation? • How do they achieve their goal? What is their respective strategy and what are the main obstacles they perceive? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • Scalable answer, e.g. ratios, numbers <p>...</p>

5.1 Stakeholder overview

Purpose	<i>Show graphically interconnections and name the main stake holders. Identify the main individual players. The following stakeholders should be listed by their company name and the main business connections should be indicated by connectors.</i>
Stakeholders	<ul style="list-style-type: none"> • Producers/importers/assemblers • Local brands/assembly • Retailers • Refurbishment programs • Repair stores • Existing collecting systems • Existing take-back programs • Existing formal e-waste recyclers • Informal e-waste recycling <p>...</p>
Example	See Annex K: Example of Stakeholder overview

5.2 Manufacturers and importers

Stakeholder group description	Producers are defined as any organization manufacturing, assembling and / or importing EEE. This group is composed of the hardware brands and their associations (IT association, consumer electronics, electronic components, etc...), but also of "unidentified" producers, when the equipment is non-branded.
Qualitative indicators	<ul style="list-style-type: none"> • Marketing strategy? • Corporate social responsibility programmes (CSR)? • Special economic schemes (e.g. tax holidays, de-bonded equipment)?

	<ul style="list-style-type: none"> • Producer Responsibility Organisation? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • Annual imports of new equipment (time series) • Annual imports of 2nd hand equipment (time series) • Domestic manufacturing (time series) • % import vs. % domestic • % branded vs. % non-branded • Major brands and market shares • Growth forecasts of sector • % small and medium sized enterprises (SMEs) of total • Number of employees <p>...</p>

5.3 Distributors

Stakeholder group description	<p>Distributors are defined as all bodies selling the equipment directly to the consumers. They are composed of:</p> <ul style="list-style-type: none"> • Retailers • Second hand market • Organisations providing donated equipment's (imports?) • Others (e.g. online distributors, etc.). <p>...</p>
Qualitative indicators	<ul style="list-style-type: none"> • Preferred mode of distribution? • Mode of revenue for the distributor? • Importance of the second-hand market / non-branded market? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • Annual sales/distribution of new equipment (time series) • Annual sales/distribution of 2nd hand equipment (time series) • Retail shops / inhabitant • % retail vs. % 2nd hand market • Size of 2nd hand market • Take back schemes <p>...</p>

5.4 Consumers

Stakeholder group description	<p>Consumers are defined as the bodies that consume EEE and discard them as waste when they have reached the end of their useful life. Consumers are usually separated between:</p> <ul style="list-style-type: none"> • private (households) and • corporate (mainly business and government). Business consumers have to be distinguished between: <ul style="list-style-type: none"> ○ small and medium enterprises (SMEs), as their behaviour may be closer to the one of private consumers, and ○ large enterprises
Qualitative indicators	<ul style="list-style-type: none"> • Modes of consumption? (e.g. leasing, assembled equipment, new material, on-line purchase, etc.)

	<ul style="list-style-type: none"> • Modes of end-of-life management? (e.g. return to retail point, storage, pick-up service, sold to 2nd hand market, etc.) • Access to new (ICT) technology? • Awareness on social and environmental issues? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • % private vs. % corporate • % business and government • % large business vs. % small business • % urban vs. % rural • Life span private vs. life span corporate • Penetration rate (# equipment / 100 cap.) • e-Waste generated / capita • Disposal options • Disposal habits <p>...</p>

5.5 Collectors

Stakeholder group description	<p>Collection of e-waste may be either assured by:</p> <ul style="list-style-type: none"> • Collection points (municipal points, drop-offs, retail shops, ...) or • A pick-up service. <p>The latter may be organized (pick-up days organized by municipalities), semi-organized (e.g. door-to-door collection) or disorganized (rag-pickers, scavengers, etc.)</p>
Qualitative indicators	<ul style="list-style-type: none"> • Organised or left to informal sector? • Consumer pays or is paid for his waste? • Take back-schemes? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • e-Waste collected / cap. • % formal vs. % informal • Employment generated (Persons / ton collected) • Amount of people working for e-waste collection <p>...</p>

5.6 Refurbishers

Stakeholder group description	<p>The refurbishers group comprises all the repair units, service centers, etc., that extend the life time of equipment and feed the second hand market</p>
Qualitative indicators	<ul style="list-style-type: none"> • How is this sector organised? • Is it a formal economy (pays taxes, registered, etc.)? • Interactions with other value adding players (Waste2Art, etc...) <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • % of repairable equipment • e-Waste produced by a standard repair shop (kg/year) • Lifespan of refurbished equipment (in average, how old are the equipment brought for repair, and how long is their life extended?) • Average age of equipment to repair

	<ul style="list-style-type: none"> Revenue per refurbished equipment of a certain type (Pentium II and IV for PCs for example) <p>...</p>
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5.7 Recyclers

Stakeholder group description	Recyclers are any organization dismantling, separating fractions and recovering material from e-waste.
Qualitative indicators	<ul style="list-style-type: none"> How is this sector organised (formal/informal)? Is there a specific e-waste recycling industry? Which fractions are produced? How are different non-valuable fractions disposed of (hazardous/non-hazardous)? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> Yearly volume handled by the recyclers (t per company or/and in total) % formal vs. % informal Employment generated (Persons/ton e-waste recycled) Resulting fractions Fractions disposed of By-products / ton e-waste (e.g. litres of acid per kg of circuit boards, kWh/ton e-waste, etc.) Yearly turnover (1000 \$ per company or/and in total) <p>...</p>

5.8 Downstream vendors

Stakeholder group description	<p>Vendors are the industries buying the fractions (e.g. copper, plastics, metals, gold, etc.) produced by the recyclers. They can be national or international, and vary from jewelers to smelters, etc., for example:</p> <ul style="list-style-type: none"> experience in India showed that the gold and silver recovered from printed circuit boards was bought by jewellers copper smelters purchase the copper recovered from e-waste plastic parts from e-waste are used to manufacture car bumpers
Qualitative indicators	<ul style="list-style-type: none"> What kind of industry uses material from e-recycling? Does the material remain in an informal market, or is it re-injected in the formal economy? What gets exported and in what condition? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> % of raw material coming from e-waste (e.g. share of plastic coming from e-waste vs. plastic from other sources in a car bumper) Usage of raw material Revenue per weight of different fractions sold <p>...</p>

5.9 Final disposers

Stakeholder group description	Final disposers are organizations in charge of the final disposal of waste through incineration or landfilling.
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Qualitative indicators	<ul style="list-style-type: none"> • How is the ultimate waste treated? Is it formal, e.g. controlled landfill, energy recovery (incinerators), or informal (dumping sites, open burning, ...) • Which agencies are in charge of solid waste disposal? • Public vs. private? • Are there restrictions regarding landfill space in the country? • Infrastructure for hazardous waste? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • Available landfill volume in the country (non-hazardous / hazardous) • Capacity for hazardous waste (tons/year) • E-waste observed in municipal solid waste • Characterisation of solid waste stream • % of formal vs. % of informal disposal <p>...</p>

5.10 Most affected communities

Stakeholder group description	Communities that have – by close neighborhood relations to collection points, refurbishment / recycling centers or disposal areas – key interests in the development of an e-waste management system. This might include interests regarding the sector's economic possibilities or interests in limiting soil, water and air pollution.
Qualitative indicators	<ul style="list-style-type: none"> • Does the sector pose serious health risks to the community? • What is the quality of jobs compared to local alternatives at the same level of education? • Does the sector's presence positively or negatively influence other social and economic activities (e.g. negative impacts on agriculture)? <p>...</p>
Quantitative indicators	<ul style="list-style-type: none"> • Cases of negative health impacts or increased health risks (e.g. enhanced blood lead levels, visible soil, water and air contamination) • Number of jobs provided by the e-waste sector. • Number of low skilled jobs provided by the e-waste sector. <p>...</p>

5.11 Civil society / other stakeholders

Purpose	Identify institutions having the capacity to support the implementation of an e-waste management system within the country.
NGOs & International organizations	<ul style="list-style-type: none"> • Organisations active in solid waste management • Organisations working with informal sectors • International funding / implementing organisations <p>...</p>
Scientific institutions	<ul style="list-style-type: none"> • University institutes • Consultancy offices <p>...</p>

6 Massflow assessment

6.1 Massflow system chart

Purpose	Show graphically how the e-waste flows circulate between the different actors. The actors here may be defined as "active stakeholders". This allows seeing where the main stocks and flows are.
Mass flows and stocks	Show graphically the interconnections following the generic example of the in Figure 1. Identify: <ul style="list-style-type: none"> • The major stocks of e-waste • The flows between stakeholder groups

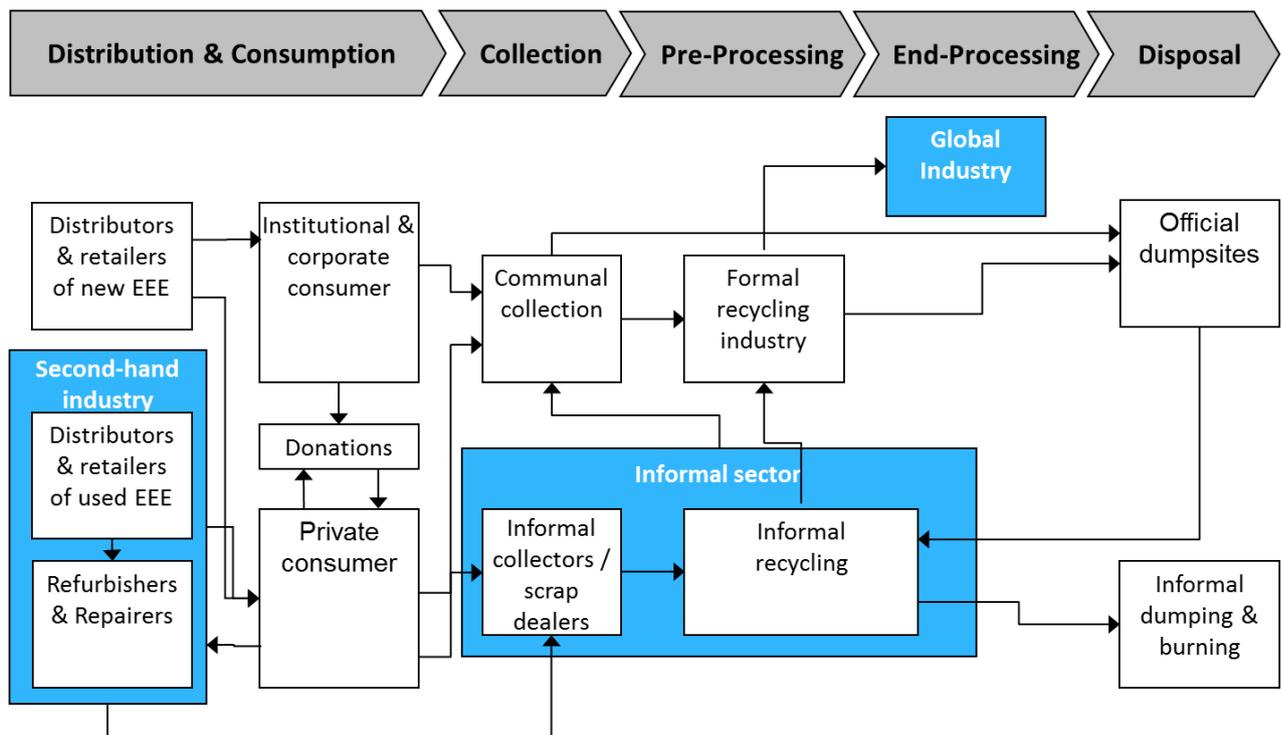


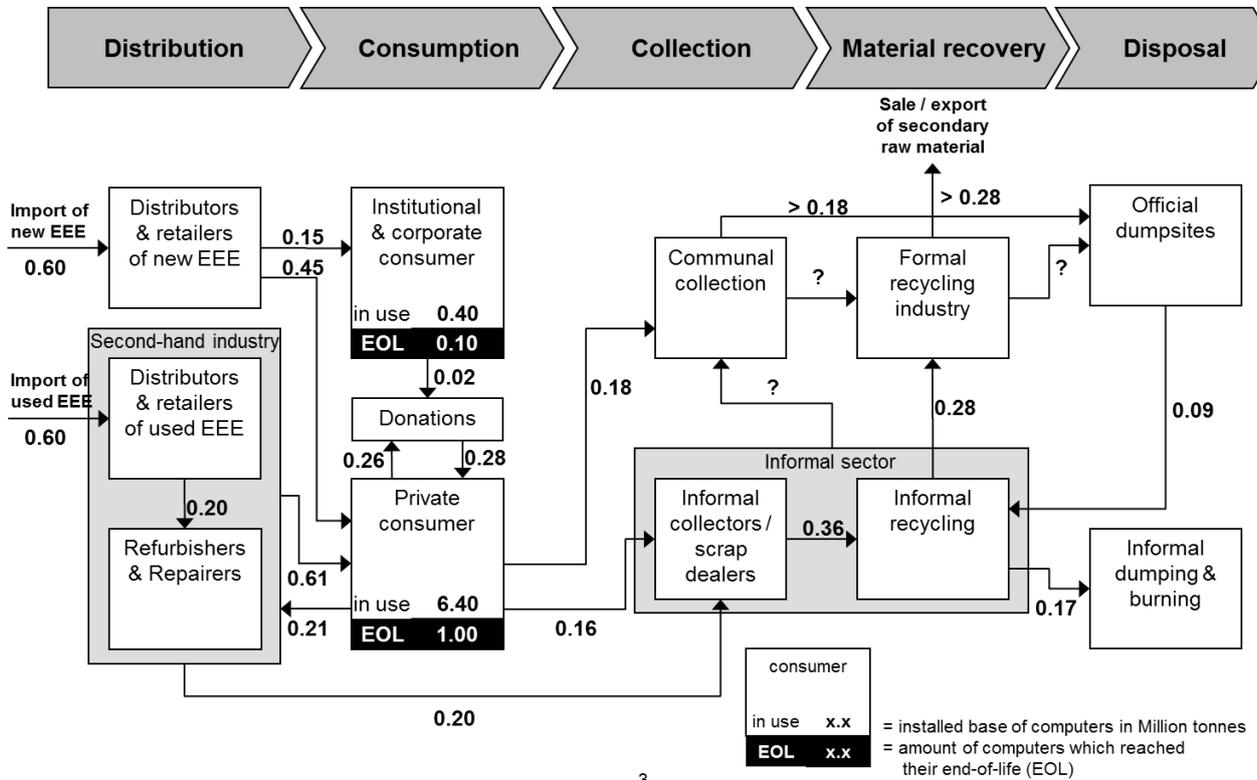
Figure 1: Example of a massflow system chart. The different actors of the system are represented with boxes, while the flows of e-waste are shown by black arrows.

6.2 Current massflows

The current mass flows are calculated based on key figures obtained through literature review, statistical data and the stakeholder assessment. A short explanation of methods, how to calculate mass flows and important key figures that are needed for this calculations are listed below and explained more in detail in the annexes A, L and M.

Purpose	Quantify the mass flows and stocks for the current situation.
System definition	<ul style="list-style-type: none"> Define units for time and mass (e.g. tons/year) Represent the current massflows in the massflow system chart developed for chapter 6.1 (see Figure 2)
Material flow analysis	<p>Mass balance equations:</p> <p>Based on the mass conservation law: $\Delta S = \sum F_{in} - \sum F_{out}$, where:</p> <ul style="list-style-type: none"> ΔS is the variation of stock in a process $\sum F_{in}$ is the sum of flows entering a process $\sum F_{out}$ is the sum of flows leaving a process <p>Parametric equations:</p> <p>The flows and stocks of the system are interdependent and can be mathematically related through parametric equations: $F_{i+1} = f(k_{i+1}; F_i, S)$, where:</p> <ul style="list-style-type: none"> F is a flow S is the stock K is the transfer coefficient i is the year <p><i>These two sets of equations allow extrapolating all flows and stocks from a given value. An example of a set of mass balance equations and parametric equations describing an e-waste system is provided in Annex L</i></p>
Assessment of e-waste streams	A set of different equations to calculate e-waste flows from sales or stock data are listed and explained in Annex M
Important key figures	<ul style="list-style-type: none"> Consecutive sales/distribution data for the tracer appliances ideally over 10 years+ Consecutive import and export data for the tracer appliances ideally over 10 years+ <p>And /or</p> <ul style="list-style-type: none"> Stock data for the tracer appliances over at least 10 years (per capita/ per household or per other denominator if feasible) <p>Further important key figures:</p> <ul style="list-style-type: none"> Estimation or research results on medium life span for the tracer appliances Estimates of e-waste generated (in tons/year) <ul style="list-style-type: none"> historically per year in the future Collected e-waste through existing take-back or collection systems (in tons/year) Formally recycled e-waste quantity per year (in tons/year materials recovered) Material exports resulting from e-waste recycling (in tons/year materials recovered)

Examples	See Annex A: Sources of information and key figures
	See Annex L: Balance and parametric equation for the mass flow model
	See Annex M: Quantitative assessment of e-waste flows



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Figure 2: Example of a massflow system chart of computers stocks and flows in Nigeria. Estimated massflows are in million tonnes/year, estimated stocks in million tonnes. Since more new and second hand computers enter than leave the consumption process, the stock of equipment is growing.

6.3 Future massflow trends

Purpose	Quantify the mass flows and stocks for a future situation
Extrapolation	<p>Quantify future massflows in the same units as the current massflows by extrapolation existing time series (e.g. of import or sales/distribution data) according to different scenarios (see Figure 3), for example by varying parameters susceptible to change in the future, such as:</p> <ul style="list-style-type: none"> • Growth rate of imports or sales • Life span of equipment • IT penetration in the population • Changes in tracer composition (e.g. CRT replaced by LCD) <p>...</p> <p>For quantifying future mass flows and stocks the same equations in Annex L and M can be used.</p>

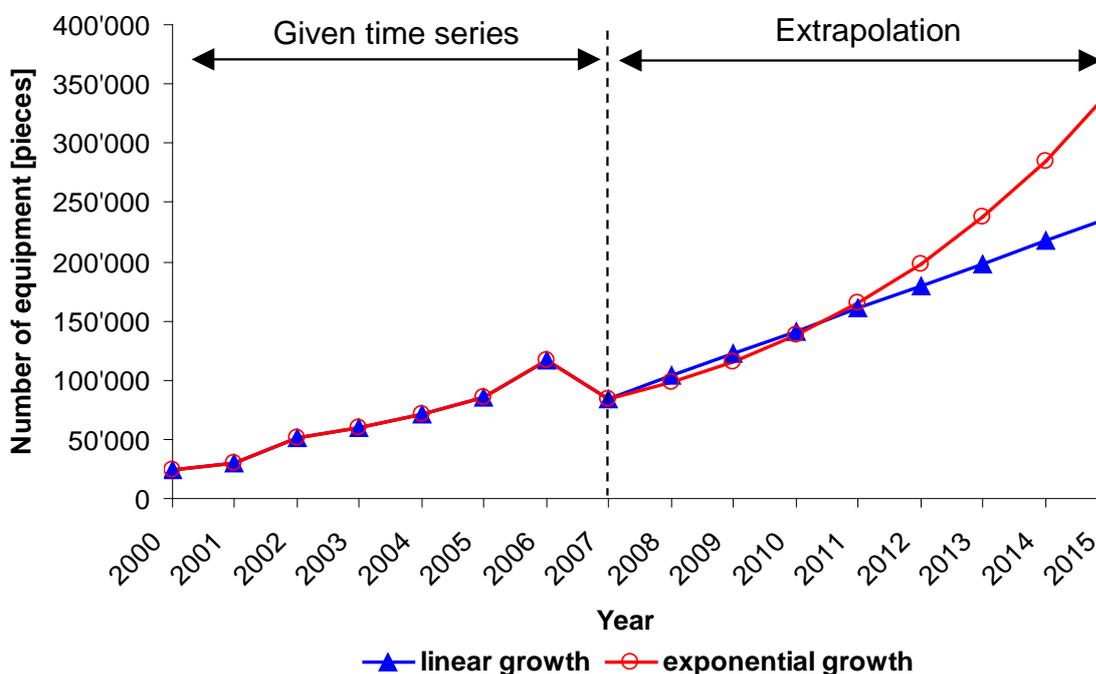


Figure 3: Example of extrapolation of an import time series. According to the growth behaviour of the imports from 2000 to 2007, two growth scenarios were assumed: Linear growth or exponential growth. The extrapolated import time series can be used to calculate future e-waste flows according to the equations in annex M-

7 Impacts

7.1 Overview

Purpose	Identify undesirable operations and negative impacts in the massflow system of the country or region investigated
"hot spots"	Show graphically the high priority "hot spots" in the massflow system chart. Use a colour code according to the example in Figure 4.

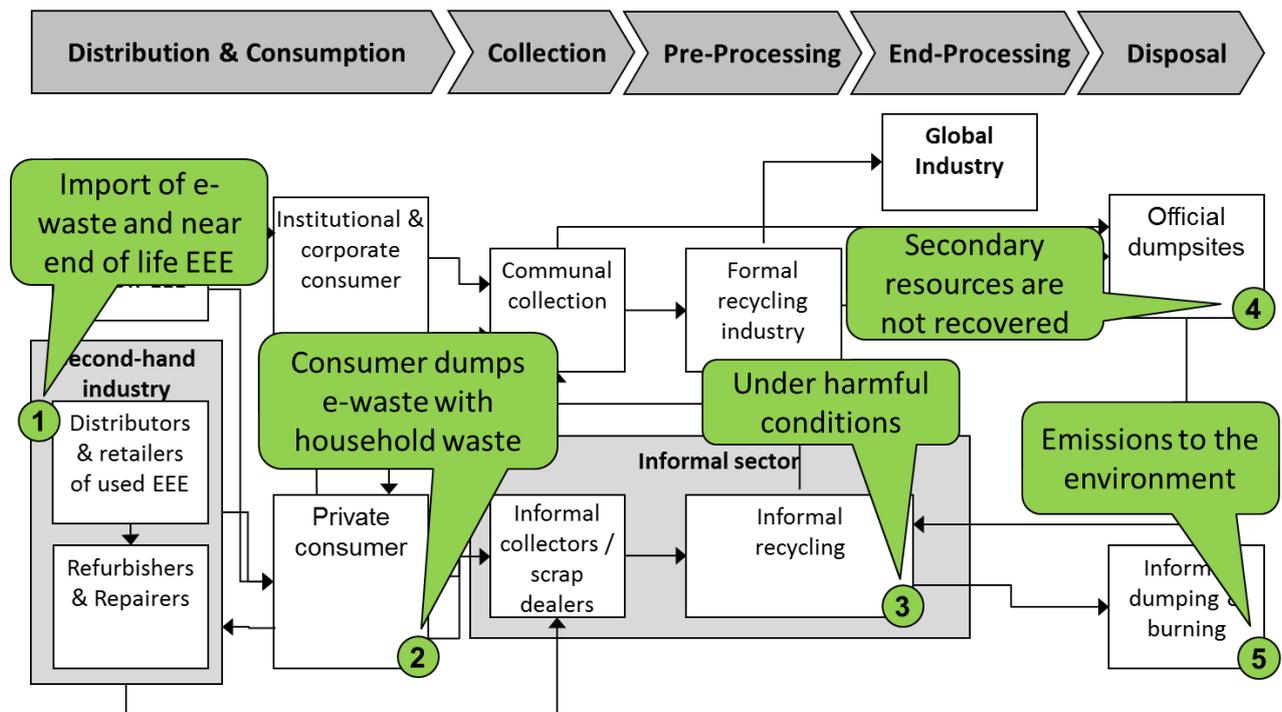


Figure 4: An example of a massflow system chart with its undesirable operations/"hot spots"

7.2 Assessment of impacts from the e-waste sector

The following research guidance is aimed to allocate the identified negative impacts or “hot spots” to social, environmental and economic impacts and evaluate them in more detail. Thereby the term “hot spot” does not only apply to negative impacts, but also to positive effects such as poverty alleviation and income generation. In order to come to meaningful results that can be used to find sustainable solutions, it is vital to sub-divide the e-waste sector into the five major sub-sectors *Collection, Refurbishment, Dismantling, Material recovery, Final disposal*.

7.2.1 Environmental Impacts

Because of difficulties to access reliable data in waste management, and because of the short duration of the rapid e-waste assessment, it is not possible to scientifically quantify the impact to environment by applying a complete life cycle analysis (LCA). Therefore, a qualitative approach based on the field observations and a quantitative approach based on the material flow analysis is adopted.

Purpose	<i>Conduct a qualitative assessment of the impacts to environment</i>
Emissions to air and water	<p>Based on the material flow assessment:</p> <ul style="list-style-type: none"> Identify, describe and quantify major flows of material to environment (air and water). Identify the hazardous substances used for the recycling processes (e.g. nitric acid, mercury & cyanide salts used in the precious metal recovery) <p>For emissions to air:</p> <ul style="list-style-type: none"> Identify and describe sources (dust during dismantling, burning of plastics, evaporation of chemicals during recycling, etc.) Identify hazardous substances emitted to the air Possible measures taken to control airborne emissions <p>For emissions to water:</p> <ul style="list-style-type: none"> Identify and describe sources (leaching of solid residues into ground water, disposal of wet chemical effluents into the sewage system, etc.) Identify hazardous substances emitted to the water Possible treatment measures of effluents
Solid waste	<p>Based on the Material Flow Analysis:</p> <ul style="list-style-type: none"> Quantify the flow of solid waste produced. <p>Below are listed some examples of components / fractions from e-waste containing hazardous substances:</p> <ul style="list-style-type: none"> Batteries and accumulators, notably: Nickel-Cadmium accumulators, batteries and accumulators containing Mercury, Lithium accumulators Condensers and ballasts (pre-switches), partly containing Polychlorinated biphenyls (PCBs) Mercury switches / mercury relays / mercury vapour lamps Parts containing Chlorofluorocarbons (CFCs) and hydro chlorofluorocarbons (HCFCs) (refrigeration cycle in refrigerators / insulation materials) Selenium drums in photocopying machines Components that release asbestos fibres Shredder fraction containing PCB, Cd, others Getter pills in electron-gun

	<p>For a selection of relevant components / fractions:</p> <ul style="list-style-type: none"> • Describe how they are disposed of (controlled landfill, incineration, wild dumping) • Identify major substances of concern contaminating the soil. Estimate the volumes.
Human Health	<p>Characterise the direct exposure to:</p> <ul style="list-style-type: none"> • The workers • The neighbouring communities • The general population <p>Based on the type of emissions, assess the risk of:</p> <ul style="list-style-type: none"> • Human toxicity (carcinogenic and non-carcinogenic), e.g. blood lead levels, observation of symptoms resulting from exposure to chemicals • Respiratory problems (dust, acid vapours, etc.)
Pressure on resource	<p>Identify, describe and quantify the types of resource involved in the recycling processes for:</p> <ul style="list-style-type: none"> • Use of energy (coal, oil, wood, etc.) • Inputs to the recycling processes (water, acids, chemicals, etc.)
Pressure on eco-systems	<p>Identify and quantify the substances emitted to the environment which can cause:</p> <ul style="list-style-type: none"> • Ecotoxicity (terrestrial and aquatic) • Acidification • Eutrophication

7.2.2 Socio-economic Impacts

The following questions are guidelines for the evaluation of social impacts. A more detailed guideline can be found in annex N. The following research guidance is aimed to identify major social hot spots in the e-waste sectors. Thereby the term "hot spot" does not only apply to negative impacts, but also to positive social effects like poverty alleviation and income generation. In order to come to meaningful results that can be used to find sustainable solutions, it is vital to subdivide the e-waste sector in different sub-sectors as this has been done in the massflow assessment chapter (figure 2 and 3).

Nevertheless the approach done in this chapter leads to a large number of sub-sectors, which is complicating practical analysis. Therefore it is proposed to focus on five major sub-sectors, which are considered decisive for a social impact analysis of e-waste management: Collection, Refurbishment, Dismantling, Material recovery, Final disposal.

Other sub-sectors like e-waste trading and the marketing of recovered materials are considered of secondary importance for the social impact analysis.

Purpose	<i>Conduct a quantitative and qualitative assessment of positive and negative social impacts from the e-waste sector</i>
Impacts on employees	<p>Describe major health and safety risks for workers in the different e-waste sub-sectors</p> <ul style="list-style-type: none"> • Lay out the bases of this judgement (e.g. visible risks, systematic health surveys, widespread symptoms of occupational diseases) • Estimate the share of workers being affected by these risks in each sub-sector. • Describe measures to protect workers' health (e.g. masks, special training) <p>Describe the organisation and official status of employment in the different sub-sectors</p>

- Are enterprises usually registered or informal?
- Describe the typical size-structure of the enterprises in each sub-sector.
- Elaborate on the workers' possibility to take influence on their working conditions (e.g. working hours, holidays, health and safety issues, unionisation)

Check on the gender, ethnic and age composition of the workforce in each sub-sector

- Share of women in each sub-sector
- Share of women in qualified positions (Definition of "qualified position": The position requires at least reading, writing, mathematic and/or enhanced mechanical skills)
- Share of minority ethnic groups in relation to the local population picture
- Predominant age structure

Check whether there are cases of people being employed involuntary or by means of coercion

- Special attention on vulnerable groups (e.g. illegal migrants) that might be commercially exploited

Cases of children working in the e-waste sector

- Describe typical tasks for children in the e-waste sector
- Indicate whether these activities are considered a risk to health and safety
- Describe the age structure of the children working in the e-waste sector
- Elaborate on working hours and general working condition of children in the e-waste sector (wages, housing, possibility to visit school, catering...)

Lay out the wage structure of the typical types of employment in each sub-sector

- State whether employees are compensated according to waste volumes treated, by hours of work, or by a fixed wage-level
- Calculate average and lowest wage levels per hour / per day / per month.
- Calculate wage-level per unit [ton] of e-waste treated in each sub-sector (IMPORTANT: Even if workers are compensated based on hours worked, it is also needed to analyse the labour costs per tonnes of e-waste)
- Elaborate on additional benefits by working in the e-waste sector (e.g. free catering, free housing, possibility to sell refurbished products)
- Indicate whether the sector provides a steady or interrupted source of income for workers

Evaluate on the length of a typical working day and working month in each sub-sector

- Working hours per day
- Rest periods or typical breaks per working day
- Number of working days per week / month
- Number of paid / unpaid days off (holidays) per year

Evaluate on the typical duration of employment in each sub-sectors

- Indicate typical reasons for ending an employment relation in the sector (e.g. better job opportunities in other sectors, workers are dismissed because of low work performance)
- Judge on the sector's dynamics: Is the sector likely to provide more or less jobs in

	<p>the future?</p> <p>Evaluate on social security schemes of each sub-sector</p> <ul style="list-style-type: none"> • How many workers are covered by basic social security schemes in each sub-sector? (Health, unemployment, old-age- and disability-pension, maternity). • Are these social security schemes granted by the government or the employer? <p>Evaluate on the social recognition of employment in the different e-waste sub-sectors</p> <p>What sub-sectors are perceived as dirty or unfavourable work by the employees themselves?</p>
<p>Impacts on local communities</p>	<p>Describe the geographic setting of major e-waste treatment facilities and sites</p> <ul style="list-style-type: none"> • Are major collection points, refurbishment-, recovery- or disposal sites located in or nearby populated areas or agricultural land? • If yes: Describe the socioeconomic set-up of the settlement (economic basis, typical kind of housing-structure, population density (above / below local average), distance to e-waste treatment sites). <p>Describe major health and safety risks for the local population by each sub-sector</p> <ul style="list-style-type: none"> • Lay out the bases of this judgement (e.g. visible risks, systematic health surveys, widespread symptoms of e-waste related diseases) • Estimate the number of residents being affected by these risks. • Describe measures by the community, the government and the industry to protect the residents' health. <p>Estimated the local economic importance of each e-waste sub-sector</p> <ul style="list-style-type: none"> • Number and share of local population active in / dependent on the e-waste sector • Description of the sector's role in local social and economic development (e.g. stimulating local economic growth, resulting hindrances for other economic activities) <p>Local perception of the e-waste sector (e.g. predominantly beneficial, regarded with suspicion)</p>
<p>Impacts on society</p>	<ul style="list-style-type: none"> • Absolute number of jobs provided by each sub-sector and the total e-waste sector in the country • Indicate risks of corrupt practices in the industry based on expert judgement, qualitative interviews and / or press reporting • Estimate the sectors' contribution to the national economy • Estimate the sector's monthly / annual value creation based on data for revenues by the sale of refurbished equipment and recovered parts and materials. • • Indicate whether the sector was subject to any political dispute leading to conflicts • Also check whether the e-waste sector was part of larger conflict cases (e.g. conflict over land-use-changes or massive pollution of agricultural land due to industrialisation)
<p>Additional information</p>	<p>This information can be derived from the collected data. Since these indicators are crucial for further impact analysis and data interpretation, the calculation should be</p>

	<p>made transparent. Furthermore the accuracy of the calculation should be cross-checked by two different calculation methodologies</p> <ul style="list-style-type: none"> • Number of working hours per unit of e-waste treated in each sub-sector (e.g. 5.5 h/t in e-waste collection) • First calculation method on national scale: Number of workers x number of working hours per worker / amount of e-waste • Second calculation method on individual scale: Median of data on individual basis: Amount of e-waste treated by one worker in a certain time • Labour costs per unit of e-waste treated in each sub-sector (e.g. 8 \$/t in e-waste collection) • First calculation method on national scale: (total annual sector revenues – estimated investments and running costs for material, rent, taxes...) / total annual amount of e-waste • Second calculation method on individual scale: Median of data on individual basis: Wage per day / amount of e-waste treated per day
Example	See Annex N: Detailed guideline for the assessment of social impacts

8 Conclusion

The conclusion considers the most important outcomes of all the results in the previous chapters. Some possible evaluations are listed below.

Purpose	<i>Summarize the main outcome of the assessment and discuss the lessons learnt from the assessment</i>
	<ul style="list-style-type: none"> • Evaluate strengths and weaknesses of the current situation • Evaluate main opportunities for the different e-waste sectors • Summarize downstream market infrastructure (example see annex O) <p>...</p>
Example	See Annex O: Downstream market infrastructure

9 Recommendations

9.1 Overall recommendations

Recommendations can be given regarding the seven main issues related to an improvement of the current e-waste management practices encountered on the African continent. These seven issues were elaborated by the signatories of the Durban Declaration in October 2008. The whole text of the Durban Declaration can be found in annex P.

Purpose	<i>Propose ideas and solutions, how the current situation could be enhanced</i>
Main issues to improve the current e-waste management practices	<p>Give recommendations, how to:</p> <ul style="list-style-type: none"> • improve cooperation among stakeholders • establish an institutional framework • create awareness at all levels of governance and the general public • support markets • collect and manage data • develop a legal framework • develop a qualified and efficient e-waste recycling sector
Example	See Annex P: Durban Declaration

9.2 Recommendation on the massflow system

Purpose	<i>Identify where and how the above recommended interventions would affect the mass-flow system of the country or region investigated</i>
Interventions	<p>Show graphically the possible interventions in the massflow system chart.</p> <p>Use a colour code according to the example in Figure 5</p>

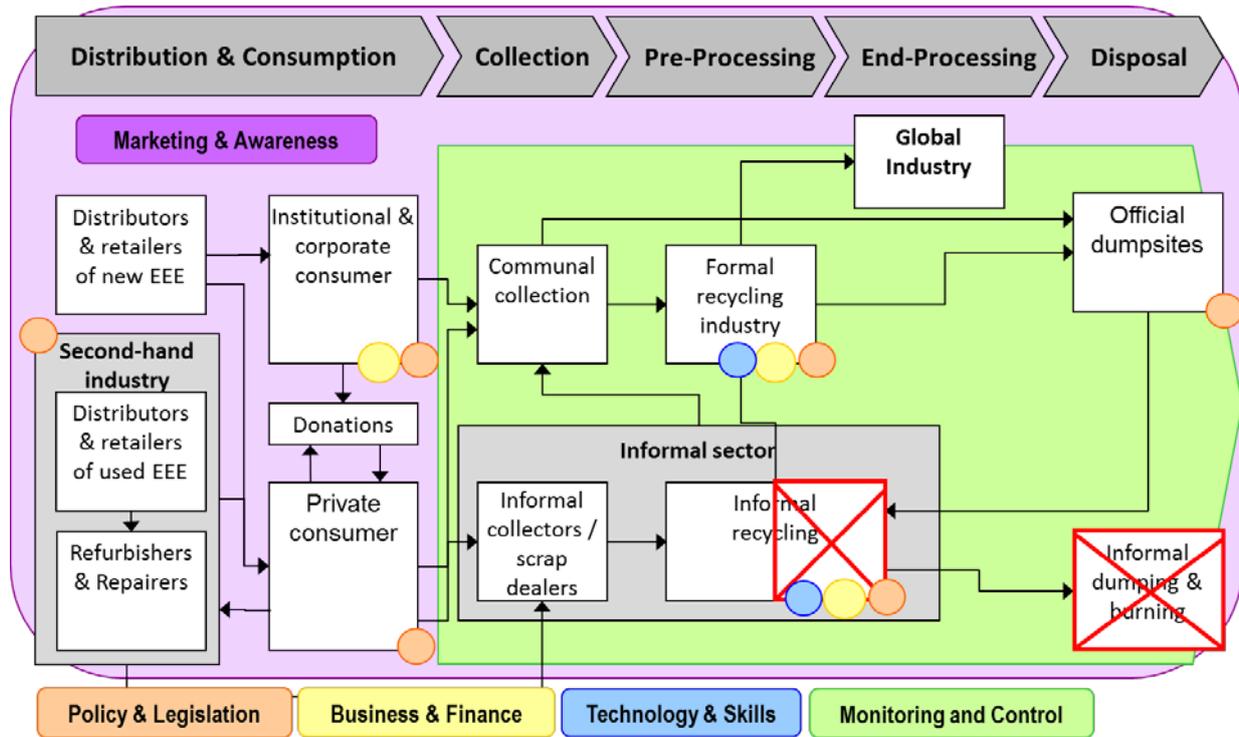


Figure 5: An example of a massflow system chart with its undesirable operations/"hot spots" and recommended interventions.

10 References

Purpose	<i>State all references used in the report</i>
Procedure	<p>For books, reports, press, journals etc.:</p> <ul style="list-style-type: none"> • State Author, Year, Title, Name of Journal, Name of Publisher etc. <p>For websites:</p> <ul style="list-style-type: none"> • State address and last date of access

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11 Annexes

- Annex A: Sources of information and key figures**
- Annex B: UN Comtrade database**
- Annex C: Questionnaire for private consumers**
- Annex D: Questionnaire for corporate and institutional consumers**
- Annex E: Questionnaire for importers and producers**
- Annex F: Questionnaire for recyclers and refurbishers**
- Annex G: Weight and composition of selected tracers and categories**
- Annex H: Example of overview of legal texts**
- Annex J: Checklist for establishing / analyzing legislation on e-waste**
- Annex K: Example of stakeholder overview**
- Annex L: Balance and parametric equations for the mass flow model**
- Annex M: Quantitative assessment of e-waste flows**
- Annex N: Detailed guideline for the assessment of social impacts**
- Annex O: Example of downstream market Infrastructure**
- Annex P: Durban declaration**

Annex A

Sources of information and key figures for the assessment of e-waste streams

Possible sources of information

General information on e-waste	
http://ewasteguide.info	Swiss e-waste guide designed by EMPA. General information about e-waste and e-waste management. Structured collection of bibliography and web links regarding all aspects of e-waste.
www.weee-forum.org	The WEEE Forum is an open non-profit association of voluntary industry-driven collective WEEE take-back systems, taking care of individual producers' responsibility in Europe.
www.basel.int	The Basel Convention, Control of Transboundary Movements of Hazardous Wastes and their Disposal
www.ban.org	The Basel Action Network to prevent the globalization of the toxic chemical crisis.
www.svtc.org	The Silicon Valley Toxics Coalition.

Information on ICT	
http://www.gartner.com	Gartner Consulting
http://www.idc.com	International Data Corporation
http://www.imrbint.com	International Market Research Bureau
http://www.itu.int	Key indicators of the telecommunication/ICT sector
http://www.nationmaster.com	Compilation of available statistics
http://www.internetworldstats.com/stats.htm	World Internet Users and Population Statistics

World development sources	
http://data.worldbank.org/data-catalog/world-development-indicators	World development indicators
http://www.nationmaster.com	Compilation of available statistics
https://www.cia.gov/library/publications/the-world-factbook/	CIA World Factbook
http://hdr.undp.org/en/statistics/	Statistics from the Human Development report of the UNDP
http://data.un.org/Default.aspx	Various statistics from the United Nations

Annex A - Sources of information and important key figures for the assessment of e-waste streams

http://unstats.un.org/unsd/default.htm	Various statistics from the UNSD
http://w3.unece.org/pxweb/Dialog/	Statistical Database of UNECE (only member countries)

Key figures for the assessment of e-waste streams

Key figures	Possible sources & tools	Results for chapter & remarks
General country figures		
Population	National statistics, World Bank, Nationmaster	Chapter 3 Needed for estimates
Share of urban/rural population	National statistics, World Bank, Nationmaster	Chapter 3 Needed for estimates
Number of households	National statistics, World Bank	Chapter 3 Needed for estimates
ICT expenditure per capita	World Bank, IT Association	Chapter 3 General information, indicator of development
Expenditure for HHE per capita	World Bank, HHE Association	Chapter 3 General information, indicator of development
Stakeholders		
Producers/importers/assemblers	Brands sold on the market, internet research	Chapter 5 and 6 Stakeholder overview, flow chart
Local brands/assembly	Brands sold on the market, internet research	Chapter 5 and 6 Stakeholder overview, flow chart
Retailers	Questionnaires, internet research, purchasing habits	Chapter 5 and 6 Stakeholder overview, flow chart
Refurbishment programs	Internet research, government, social institutions	Chapter 5 and 6 Stakeholder overview, flow chart
Repair stores	Retailers, brands,	Chapter 5 and 6 Stakeholder overview, flow chart
Existing collecting systems	Government, municipalities	Chapter 5 and 6 Stakeholder overview, flow chart
Existing take-back programs	Directly with producers	Chapter 5 and 6 Stakeholder overview, flow chart
Existing formal e-waste recyclers	Internet research	Chapter 5 and 6 Stakeholder overview, flow chart
Informal e-waste recycling	Waste associations, street recyclers, districts where equipment is sold and repaired	Chapter 5 and 6 Stakeholder overview, flow chart
Disposal options	Questionnaires, mouth-to-mouth	Chapter 5 and 6 Stakeholder overview, flow chart

Annex A - Sources of information and important key figures for the assessment of e-waste streams

Key figures	Possible sources & tools	Results for chapter & remarks
Disposal habits	Questionnaires, mouth-to-mouth, field visits	Chapter 5 and 6 Stakeholder overview, flow chart
Impacts		
Negative impacts on health, environment and economy	Field visits, literature	Chapter 7 Impact overview
For E&E products in general		
Time series of import figures of an electrical or electronic product	Customs authorities, national statistics, associations http://comtrade.un.org/db/	Chapter 5 and 6
Time series of local production figures	Direct contact with local producers, national statistics	Chapter 5 and 6
Share import vs. local production	Calculate from figures above, internet research, press releases	Chapter 5 Statement about importance of local brands and production industry
Export of local products	Customs authorities, national statistics, associations	Chapter 5 and 6 Gives us output of the system (together with export of second hand equipment)
Time series of product sales	Associations, IDC, internet research, press releases, directly with manufacturer	Chapter 5 and 6 Can be used to estimate e-waste flows with equations in annex L&M
Products in use (penetration rate) - Number of products/capita - Number of products/household	National statistics, census, surveys, World Bank, ITU, Nationmaster, directly with associations	Chapter 5 and 6 Can be used to estimate e-waste flows with equations in annex L&M
Distribution between sector (public, private, households) for products in use	Census, surveys, internet research, associations	Chapter 5 and 6 Allows estimation of stock by sector
Distribution between sector (public, private, households) for sold products	Internet research, IDC, associations, directly with manufacturer	Chapter 5 and 6 Allows calculation of stock changes per sector
Expected average lifespan per product	Questionnaires, international experiences and studies, surveys, own estimates	Chapter 5 and 6 Can be used to estimate e-waste flows with equations in annex L&M
Lifespan private vs. corporate	Questionnaires, international experiences and studies, surveys, own estimates	Chapter 5 and 6 Can be used to estimate e-waste flows per sector with equations in annex L&M

Annex A - Sources of information and important key figures for the assessment of e-waste streams

Key figures	Possible sources & tools	Results for chapter & remarks
Market share of different brands	Associations, IDC, press releases, internet research	Chapter 5 General information, allows identification of the most important brands in the country
Share of "travellers" and black market products	Estimates from associations, IDC, press releases	Chapter 5 and 6 Helps to evaluate potential and reach of a formal e-waste management system
Growth forecast of sector	IDC, press releases, economic journals, ICT journals	Chapter 5 and 6 Needed for estimation of future tendencies and flows
For estimation of e-waste quantities		
Estimates of e-waste generated - historically - per year - in the future	Calculated based on different key figures mentioned above and equations annex L&M	Chapter 6 e-Waste generated in tons/year, for different appliances
Collected e-waste through existing take-back or collection systems	Registries, surveys, information from recyclers and collection points	Chapter 6 e-Waste collected in tons/year
Formally recycled e-waste quantity per year	Directly with formal recyclers	Chapter 6 Waste recycled in tons/year
Material exports resulting from e-waste recycling	Export figures, information from formal recyclers	Chapter 6 Materials recovered from e-Waste and exported in tons/year
For computers (additionally)		
Number of internet connections	World Bank, ITU, Nationmaster, communications sector	Chapter 5 and 6. Can be used together with the number of average computers per internet connection, to estimate an alternative figure of computers in use (penetration rate)
Number of average computers per internet connection	World Bank, Nationmaster, communications sector	Chapter 5 and 6. Can be used together with the number of internet connections, to estimate an alternative figure of computers in use (penetration rate)
Number of jobs in finance, administration, consulting, etc.	National statistics, Ministry of Work	Chapter 5 and 6. Can be used to estimate possible number of computers used in the private sector

Annex A - Sources of information and important key figures for the assessment of e-waste streams

Key figures	Possible sources & tools	Results for chapter & remarks
Import figures for PC components (hard disks, CD drives, RAM, etc.)	Customs authorities, national statistics, associations	Chapter 5 and 6 Can be used to estimate/confirm quantities of locally assembled/non-branded computers (1 memory normally equals 1 assembled computer)
Import figures for monitors	Customs authorities, national statistics, associations	Chapter 5 and 6 Can be used to estimate/confirm number of locally assembled/non-branded equipments (monitors are normally branded, and 1 monitor equals 1 assembled equipment)
Share between desktop PCs and laptops (in use and sold)	Directly with Manufactures, press releases, sales figures	Chapter 5 and 6 Important for estimation of total weight generated
Share of locally assembled products	Directly with assemblers, press releases, internet research	Chapter 5 Used for evaluation of importance of local assembly industry
Number of non-branded products	Customs authorities, estimates from associations and OEMs, press releases, mouth-to-mouth	Chapter 5 Used for evaluation of importance of non-branded (informal) products on the market
Number of imported/exported second hand products	Customs authorities, second hand markets, social programs	Chapter 5 and 6 Can be used to estimate e-waste flows with equations in annex L&M
Sales of second hand products	Second hand markets, social programs	Chapter 5 and 6 Can be used to estimate e-waste flows with equations in annex L&M
Number of refurbished computers per year	Directly with refurbishment programs	Chapter 5 and 6 Used to analyze and estimate the importance of reuse in the system
For cell phones (additionally)		
Time series of number of mobile phone subscribers	Operators, World Bank, ITU, Nationmaster, communications sector, association	Chapter 3, 5 and 6 Leads to estimate of all cell phones in use (historically)

Annex A - Sources of information and important key figures for the assessment of e-waste streams

Key figures	Possible sources & tools	Results for chapter & remarks
Number of prepaid phone users	Operators, World Bank, communications sector, association	Chapter 3, 5 and 6 Leads to estimate of all cell phones in use (historically)
Development since introduction of mobile phones	Operators, communications sector, association	Chapter 5 and 6 Used for estimating number of obsolete equipments (and possible e-waste)
Share between operators	Operators, communications sector, association	Chapter 5 General information (to identify the most important operators)
Mechanisms for equipment replacement	Operators	Chapter 5 General information for better understanding of the sector and its characteristics

Annex B

Using the UN Comtrade database for e-waste assessments

"UN Comtrade" is the *United Nations Commodity Trade Statistics Database*. It contains annual trade data reported by all the countries members of the UN. The data are registered per commodities and years. This database can add valuable information on EEE imports and exports for the mass flow assessment. This annex presents the correspondences between the EU directive WEEE categories and the classification used in the database and shows how to use the database to extract data.

1 Commodities and classifications

1.1 Classifications used in Comtrade

The Comtrade database uses three different classifications to organize the commodities:

- the classification by Broad Economic Categories (BEC)
- the Standard International Trade Classification (SITC)
- the Harmonized Commodity Description and Coding Systems (HS)

The most common classification system is the HS. All the analyses of the database will be based on this classification. The whole list of the HS classification can be consulted on this web page: <http://www.foreign-trade.com/reference/hscode.htm>.

1.2 Correspondences between the EU WEEE Directive and the Comtrade classification system

1.2.1 EU WEEE directive

The annex IA of the Directive 2002/96/EC of the European Parliament and of the council of 27 January 2003 on waste electrical and electronic equipment (WEEE) defines 10 types of WEEE:

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensers

Most of the studies made in developing countries are concentrated on the 4 first categories. For this reason, the correspondences between the EU-directive and the HS classification is analysed only for these categories.

1.2.2 Method for the matching

For each product listed in the annex of the EU WEEE directive, a commodity or group of commodities is matched in the HS list. Sometimes an entire group corresponds to a product in the directive, sometimes only a part of a group or only a specific commodity.

The table of correspondences is presented in chapter 3 of this annex.

2 Using the Comtrade database

There are two ways to extract and analyse the information of the Comtrade database. The first one is to download the rough data (.csv files) and to analyse them, for example with MS Excel. The second one is to use an online tool that makes graphical representations and curves of the data.

2.1 Extraction from rough data

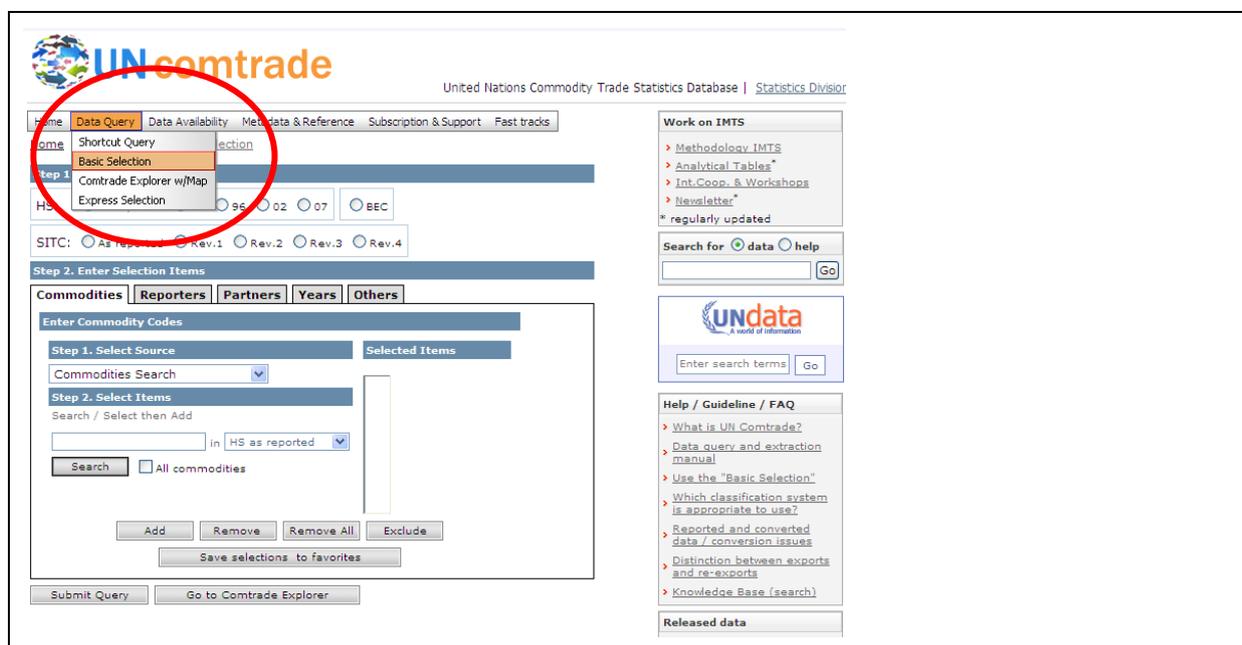
This chapter describes the best way to extract the data from the Comtrade database:

- Going to the database:

The web address of the Comtrade database is: <http://comtrade.un.org/db>. Because of the coding of the webpage, it's highly recommended to use Internet Explorer.

- Choosing a query method:

The most stable query method is the "basic selection"



Annex B - Using the UN Comtrade database for e-waste assessments

- Defining the criteria's of the query:

Select the HS classification
Select "As reported" to avoid excluding data from the selection because of the type of the HS

UN comtrade
United Nations Commodity Trade Statistics Database | Statistics Division

Home Data Query Data Availability Metadata & Reference Subscription & Support Fast tracks

Home > Data Query > Basic Selection

Step 1. Select Classification

HS: As reported 92 96 02 07 BEC

SITC: As reported Rev.1 Rev.2 Rev.3 Rev.4

Step 2. Enter Selection Items

Commodities | Reporters | Partners | Years | Others

Enter Commodity Codes

Step 1. Select Source Selected Items

Commodities Search

Step 2. Select Items

Search / Select then Add

Search / Select then Add in HS as reported

Search All commodities

Add Remove Remove All Exclude

Save selections to favorites

Submit Query Go to Comtrade Explorer

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Go

UNdata
A world of information

Enter search terms Go

Help / Guideline / FAQ

- What is UN Comtrade?
- Data query and extraction manual
- Use the "Basic Selection"
- Which classification system is appropriate to use?
- Reported and converted data / conversion issues
- Distinction between exports and re-exports
- Knowledge Base (search)

Released data

Enter the commodity you are analysing. It's possible to enter a type of commodity (for example 847130) or an entire group (for example 8471 or even 84). If an entire group is chosen, it's either possible to specify to include the "children" to get the data of each commodity included in the group or to leave the field empty to get only the aggregation of the entire group. Then click "search" and "add"

UN comtrade
United Nations Commodity Trade Statistics Database | Statistics Division

Home My Account Data Query Data Availability Metadata & Reference Subscription & Support Fast tracks

Home > Data Query > Basic Selection

Step 1. Select Classification

HS: As reported 92 96 02 07 BEC

SITC: As reported Rev.1 Rev.2 Rev.3 Rev.4

Step 2. Enter Selection Items

Commodities | Reporters | Partners | Years | Others

Enter Commodity Codes

Step 1. Select Source Selected Items

Commodities Search

Step 2. Select Items

Search / Select then Add

Search / Select then Add in HS as reported

Search All commodities

Here are the results: Include the children

TOTAL - ALL COMMODITIES

84 - Nuclear reactors, boilers, machinery, etc.

8471 - Automatic data processing machines (computers)

Add Remove Remove All Exclude

Save selections to favorites

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Released data

	# of country periods
today (2010.11.17)	0
in a week	4
in a month	38
year-to-date	324
in a year	344
all data	6107

Portal | Search | Database | Knowledge Base | Web Services / API | Community Forum | Live Help

Methodology IMTS | Analytical Tables (Publication) | International Cooperation and Workshops (IMTS)

Read Me First | UN Comtrade License Agreement | Copyright © United Nations, 2010 | Contact Us

Choose the reporter. The "reporter" corresponds to the country that is analysed. Then click "Add"

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Home > Data Query > Basic Selection

Step 1. Select Classification

HS: As reported 92 96 02 07 BEC

SITC: As reported Rev.1 Rev.2 Rev.3 Rev.4

Step 2. Enter Selection Items

Commodities | Reporters | Partners | Years | Others

Enter Reporters Codes

Step 1. Select Source Selected Items

Reporters List

Step 2. Select Items

Select and double click

Iraq

Ireland

Israel

Italy

Jamaica

Japan

Jordan

Add Remove Remove All

Save selections to favorites

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Released data

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today (2010.11.17)	0
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in a year	344
all data	6107

Annex B - Using the UN Comtrade database for e-waste assessments

Choose the trading partner. It's possible to leave the partner empty to get all the trading partners of the selected country (= "reporter"). By choosing "world" the results are aggregated.

UN comtrade
United Nations Commodity Trade Statistics Database | Statistics Division

Home | **Data Query** | Data Availability | Metadata & Reference | Subscription & Support | Fast tracks

Home > Data Query > Basic Selection

Step 1. Select Classification

HS: As reported 92 96 02 07 BEC

SITC: As reported Rev.1 Rev.2 Rev.3 Rev.4

Step 2. Enter Selection Items

Commodities | **Reporters** | Partners | Years | Others

Enter Partners Codes

Step 1. Select Source | Selected Items

Partners List: World

Step 2. Select Items

Select and double click

(All)
World
Afghanistan
Africa CAMEU region, nes
Albania
Algeria
American Samoa

Add Remove Remove All

Save selections to favorites

Submit Query Go to Comtrade Explorer

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- Distinction between exports and re-exports
- Knowledge Base (search)

Released data

# of country periods	
today (2010.11.17)	0
in a week	4
in a month	38
year-to-date	324
in a year	344
all data	6107

Choose the years. It's possible to leave the year empty to get all the available years for the chosen classification. By the HS classification, the oldest data collected is at the beginning of the 90's (depending on the selected country).

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Home > Data Query > Basic Selection

Step 1. Select Classification

HS: As reported 92 96 02 07 BEC

SITC: As reported Rev.1 Rev.2 Rev.3 Rev.4

Step 2. Enter Selection Items

Commodities | Reporters | Partners | **Years** | Others

Enter Years

Step 1. Select Source | Selected Items

Years List: 2009

Step 2. Select Items

Select and double click

(All)
2009
2008
2007
2006
2005
2004

Add Remove Remove All

Save selections to favorites

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- Knowledge Base (search)

Released data

# of country periods	
today (2010.11.17)	0
in a week	4
in a month	38
year-to-date	324
in a year	344
all data	6107

Choose in the tab "Others" the direction of the trade

UN comtrade
United Nations Commodity Trade Statistics Database | Statistics Division

Home | **Data Query** | Data Availability | Metadata & Reference | Subscription & Support | Fast tracks

Home > Data Query > Basic Selection

Step 1. Select Classification

HS: As reported 92 96 02 07 BEC

SITC: As reported Rev.1 Rev.2 Rev.3 Rev.4

Step 2. Enter Selection Items

Commodities | Reporters | Partners | Years | **Others**

Select Trade Flow

Exports figures always include Re-exports. Re-exports should be used only to distinguish between Domestic exports and Re-exports.

Import Export re-Export re-Import

Filter Trade Value

Greater Than Equal

Select Sort Order

--None--

Select Aggregation Option

Keep quantity unit differences Ignore quantity unit differences

Submit Query Go to Comtrade Explorer

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all data	6107

Annex B - Using the UN Comtrade database for e-waste assessments

By clicking "Submit Query" the data are shown on a web page. To download them as a .csv file, just click "direct download".

The screenshot shows the UN Comtrade database interface. The main content area displays a table of trade data for the year 1994, with columns for Period, Trade Flow, Reporter, Partner, Code, Trade Value, Net Weight (kg), Quantity Unit, Trade Quantity, and Flag. The table lists various importers from different countries into Jordan. A red circle highlights the 'Direct Download' link in the navigation bar. On the right side, there are sections for 'Work on IMTS', 'Search for data help', 'UNdata', 'Help / Guideline / FAQ', and 'Released data'.

Period	Trade Flow	Reporter	Partner	Code	Trade Value	Net Weight (kg)	Quantity Unit	Trade Quantity	Flag
1994	Import	Jordan	World	8471	\$22,972,854	21,120	#	21,120	0
1994	Import	Jordan	USA	8471	\$8,635,784	5,457	#	5,457	0
1994	Import	Jordan	United Kingdom	8471	\$5,143,483	2,608	#	2,608	0
1994	Import	Jordan	Other Asia, nes	8471	\$2,349,986	5,865	#	5,865	0
1994	Import	Jordan	Japan	8471	\$2,034,553	3,577	#	3,577	0
1994	Import	Jordan	France	8471	\$1,455,764	419	#	419	0
1994	Import	Jordan	Germany	8471	\$751,726	877	#	877	0
1994	Import	Jordan	Netherlands	8471	\$418,016	288	#	288	0
1994	Import	Jordan	Italy	8471	\$376,782	162	#	162	0
1994	Import	Jordan	Singapore	8471	\$330,026	195	#	195	0
1994	Import	Jordan	Ireland	8471	\$308,601	125	#	125	0
1994	Import	Jordan	Indonesia	8471	\$197,973	78	#	78	0
1994	Import	Jordan	Rep. of Korea	8471	\$184,385	363	#	363	0
1994	Import	Jordan	China, Hong Kong SAR	8471	\$137,844	187	#	187	0
1994	Import	Jordan	China	8471	\$132,435	117	#	117	0

2.2 Generation of graphics or curves

The *International trade centre* proposes a tool that arranges de data of the Comtrade database. To access this tool, choose the country list in the tab "metadata and references".

The screenshot shows the 'Metadata & Reference' section of the UN Comtrade database. The 'Country List' tab is selected, displaying a list of countries with columns for Code, Name, ISO, and Valid Years. The list includes Afghanistan, Africa CAMEU region, Albania, Algeria, and American Samoa. A dropdown menu is open over the 'Country List' tab, showing options like 'Reference Tables', 'Commodity List', 'Country List', 'Explanatory Notes', 'Publication Notes', 'Glossary', and 'Knowledge Base'. On the right side, there are sections for 'Work on IMTS', 'Search for data help', 'UNdata', 'Help / Guideline / FAQ', and 'Released data'.

Code	Name	ISO	Valid Years
4	Abbreviation: Afghanistan Full Name: Afghanistan Description: N/A Comment: N/A Type: Reporters/Partners	AF/AFG	1962 - Now
472	Abbreviation: Africa CAMEU region, nes Full Name: Africa CAMEU region, not elsewhere specified Description: N/A Comment: N/A Type: Partners Only	N/A	1962 - 2004
8	Abbreviation: Albania Full Name: Albania Description: N/A Comment: N/A Type: Reporters/Partners	AL/ALB	1962 - Now
12	Abbreviation: Algeria Full Name: Algeria Description: N/A Comment: N/A Type: Reporters/Partners	DZ/DZA	1962 - Now
16	Abbreviation: American Samoa Full Name: American Samoa Description: N/A Comment: N/A Type: N/A	AS/ASM	1962 - Now
20	Abbreviation: Andorra Full Name: Andorra Description: N/A Comment: N/A Type: Reporters/Partners	AD/AND	1962 - Now
24	Abbreviation: Angola	AO/AGO	1962 -

Then select from the selected country, "ITC Country profile". On this page, go to "Trade in goods statistics (HS)"

Annex B - Using the UN Comtrade database for e-waste assessments

The screenshot displays the ITC website for Afghanistan. The header includes the ITC logo and navigation links: HOME, PRODUCTS & SERVICES, COUNTRIES, BUSINESS SUPPORT, PARTNERS & NETWORKS, and ABOUT ITC. The main content area is titled "Afghanistan" and features a "Country Market Analysis Profile (Country Map)" section. This section includes a "Data" dropdown menu set to "2008" and a list of trade statistics with links to "Table" or "Time series" views. The "Trade in goods statistics (HS)" link is circled in red. To the right of the text is a map of Afghanistan showing major cities like Kabul, Herat, and Kandahar, and neighboring countries like Uzbekistan, Turkmenistan, Tajikistan, Pakistan, and India. A disclaimer at the bottom of the map states: "Disclaimer: The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the International Trade Centre (ITC) or UNCTAD/WTO".

On this page, the selection is very close to the one described for the extraction of rough data. The advantage of this tool is that the results can be displayed as curves, maps or tables. The problem, however, of this tool is that the query only allows choosing a group of commodities (for example 8471) and not a single commodity (for example 847130). For this reason, analyzing a precise commodity has to be done with the first method.

3 Correspondences between EU-directive and HS classification

Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
1. Large household appliances				
Large cooling appliances	8415	yes	841510	Window/wall type air-conditioning machines, self-contained/split-system, comprising a motor-driven fan & elements for changing the temp. & humidity, including those machines in which the humidity cannot be separately regulated
			841520	Air-conditioning machines of a kind used for persons, in motor vehicles
			841581	Air-conditioning machines incorporating a refrigerating unit & a valve for reversal of the cooling/heat cycle (reversible heat pumps)
			841582	Air-conditioning machines (excl. of 8415.10-8415.81), incorporating a refrigerating unit
			841583	Air-conditioning machines (excl. of 8415.10-8415.81), not incorporating a refrigerating unit
			841590	Parts of the air-conditioning machines of 8415.10-8415.83
Refrigerators	8418	yes	841810	Combined refrigerator-freezers, fitted with separate external doors, electric/other
			841821	Refrigerators, h-hold. type, compression-type, electric/other
			841829	Refrigerators, household type, excl. compression type.
Freezers	8418	yes	841830	Freezers of the chest type, not >800 l capacity, electric/other
			841840	Freezers of the upright type, not >900 l capacity, electric/other
Other large appliances used for refrigeration, conservation and storage of food	8418	yes	841850	Refrigerating/freezing chests, cabinets, display counters, show-cases & similar refrigerating/freezing furniture, electric/other (excl. of 8418.10-8418.40)
			841861	Compression-type refrigerating/freezing equip. whose condensers are heat exchangers
			841869	Refrigerating/freezing equip. n.e.s. in 84.18; heat pumps
			841891	Furniture designed to receive refrigerating/freezing equip.
Washing machines	8450	yes	845011	Household/laundry-type washing machines (incl. machines which both wash & dry), each of a dry linen capacity not >10kg, fully-auto.
			845012	Household/laundry-type washing machines (incl. machines which both wash & dry), each of a dry linen capacity not >10kg, other than fully-auto., with built-in centrifugal drier

Annex B - Using the UN Comtrade database for e-waste assessments

Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			845019	Household/laundry-type washing machines (incl. machines which both wash & dry), each of a dry linen capacity not >10kg (excl. of 8450.11 & 8450.12)
			845090	Parts of the h-hold./laundry-type washing machines of 8450.11-8450.20
Clothes dryers	8421	no	842112	Clothes-dryers, centrifugal
Dish washing machines	8422	no	842211	Dish washing machines of the h-hold. type
Cooking	8516	no	851660	Electric ovens other than microwave ovens; electric cookers, cooking plates, boiling rings, grillers & roasters
Electric stoves	8516	no	851660	Electric ovens other than microwave ovens; electric cookers, cooking plates, boiling rings, grillers & roasters
Electric hot plates	8516	no	851660	Electric ovens other than microwave ovens; electric cookers, cooking plates, boiling rings, grillers & roasters
Microwaves	8516	no	851650	Microwave ovens
Other large appliances used for cooking and other processing of food	8516	no	851610	Electric instantaneous/storage water heaters & immersion heaters
	8419	no	841981	Machinery, plant & equip., n.e.s. in Ch.84, for making hot drinks/for cooking/heating food, whether/not electrically heated
	8509	yes	850940	Food grinders & mixers; fruit/vegetable juice extractors, domestic, with self-contained electric motor
			850980	Food grinders & mixers; fruit/vegetable juice extractors, domestic, with self-contained electric motor
			850990	Parts of electro-mechanical domestic appliances, with self-contained electric motor, other than vacuum cleaners of heading 85.08.
Electric heating appliances	8516	no	851621	Electric storage heating radiators
Electric radiators	8516	no	851629	Electric space heating apparatus & electric soil heating apparatus, other than storage heating radiators
Other large appliances for heating rooms, beds, seating furniture	8516	no	851679	Electro-thermic appliances n.e.s. in 85.16
			851680	Electric heating resistors
Electric fans	8414	yes	841451	Table/floor/wall/window/ceiling/roof fans, with a self-contained electric motor of an output not >125W
Air conditioner appliances	8415	yes	841410	Vacuum pumps
			841420	Hand-/foot-operated air pumps

Annex B - Using the UN Comtrade database for e-waste assessments

Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			841430	Compressors of a kind used in refrigerating equip.
			841440	Air compressors mounted on a wheeled chassis for towing
			841460	Ventilating/recycling hoods incorporating a fan, whether/not fitted with filters, having a maximum horizontal side not >120cm
			841480	Air pumps, air/other gas compressors & fans (excl. of 8414.10-8414.59); ventilating/recycling hoods incorporating a fan, whether/not fitted with filters (excl. of 8414.60)
			841490	Parts of the pumps, compressors, fans & recycling hoods of 8414.10-8414.20
Other fanning, exhaust ventilation and conditioning equipment	8414	yes	841459	Fans, other than table/floor/wall/window/ceiling/roof fans, with a self-contained electric motor of an output not >125W
	8516	no	851633	Hand-drying apparatus, electric
2. Small household appliances				
Vacuum cleaners	8508	yes	850811	Vacuum cleaners, with self-contained electric motor, Of a power not > 1,500 W & having a dust bag/other receptacle capacity not > 20 l
Carpet sweepers	8508	yes	850819	Vacuum cleaners, with self-contained electric motor, other than of 8508.11
Other appliances for cleaning	8508	yes	850860	Other vacuum cleaners,not with self-contained electric motor
			850870	Parts of vacuum cleaners
Appliances used for sewing, knitting, weaving and other processing for textiles	8452	no	845210	Sewing machines of the h-hold. type
Irons and other appliances for ironing, mangling and other care of clothing	8516	no	851640	Electric smoothing irons
Toasters	8516	no	851672	Toasters, electric
Fryers	-	-	-	
Grinders, coffee machines and equipment for opening or sealing containers or packages	8516	no	851671	Coffee/tea makers, electric
Electric knives	-	-	-	
Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and	8510	yes	851010	Shavers, with self-contained electric motor
			851020	Hair clippers, with self-contained electric motor

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Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
other body care appliances	8516	no	851030	Hair-removing appliances, with self-contained electric motor
			851090	Parts of the electric appliances of 85.10
			851631	Hair dryers, electric
			851632	Electro-thermic hair-dressing apparatus other than hair dryers
Clocks, watches and equipment for the purpose of measuring, indicating or registering time	9101	yes	910111	Wrist-watches, electrically operated, whether/not incorporating a stop-watch facility, with mechanical display only, with case of precious metal/metal clad with precious metal
			910119	Other Wrist-watches, electrically operated, whether/not incorporating a stop-watch facility, without mechanical display, with case of precious metal/metal clad with precious metal
			910121	Wrist-watches other than electrically operated, whether/not incorporating a stop-watch facility, with auto. winding, with case of precious metal/metal clad with precious metal
			910129	Wrist-watches other than electrically operated, whether/not incorporating a stop-watch facility (excl. with auto. winding), with case of precious metal/metal clad with precious metal
			910191	Pocket-watches & other watches (excl. wrist-watches), incl. stop-watches, electrically operated, with case of precious metal/metal clad with precious metal
			910199	Pocket-watches & other watches (excl. wrist-watches), incl. stop-watches (excl. electrically operated), with case of precious metal/metal clad with precious metal
	9102	yes	910211	Wrist-watches, electrically operated, whether/not incorporating a stop-watch facility, with mechanical display only, other than with case of precious metal/metal clad with precious metal
			910212	Wrist-watches, electrically operated, whether/not incorporating a stop-watch facility, with opto-electronic display only, other than with case of precious metal/metal clad with precious metal
			910219	Wrist-watches, electrically operated, whether/not incorporating a stop-watch facility (excl. of 9102.11 & 9102.12), other than with case of precious metal/metal clad with precious metal
			910221	Wrist-watches other than electrically operated, whether/not incorporating a stop-watch facility, with auto. winding, other than with case of precious metal/metal clad with precious metal
			910229	Wrist-watches other than electrically operated, whether/not incorporating a stop-watch facility (excl. with auto. winding) other than with case of precious metal/metal clad with precious metal

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Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			910291	Pocket-watches & other watches (excl. wrist-watches), incl. stop-watches, electrically operated, other than with case of precious metal/metal clad with precious metal
			910299	Pocket-watches & other watches (excl. wrist-watches), incl. stop-watches (excl. electrically operated), other than with case of precious metal/metal clad with precious metal
	9103	no	910310	Clocks with watch movements (excl. of 91.04), electrically operated
	9105	no	910511	Alarm clocks, electrically operated
			910521	Wall clocks, electrically operated
			910591	Clocks (excl. alarm clocks, wall clocks), electrically operated
	9108	no	910811	Watch movements, complete & assembled, electrically operated, with mechanical display only/with a device to which a mechanical display can be incorporated
			910812	Watch movements, complete & assembled, electrically operated, with opto-electronic display only
			910819	Watch movements, complete & assembled, electrically operated, n.e.s. in 91.08
	9109	no	910911	Clock movements, complete & assembled, electrically operated, of alarm clocks
			910919	Clock movements, complete & assembled, electrically operated, other than of alarm clocks
Scales	8423	no	842310	Personal weighing machines, incl. baby scales; h-hold. scales
3. IT and telecommunications equipment				
<i>Centralised data processing:</i>				
Mainframes	8471	yes	847180	Other units of automatic data processing machines, exclud. 8471.50, 8471.60, 8471.70.
Minicomputers	8471	yes	847180	Other units of automatic data processing machines, exclud. 8471.50, 8471.60, 8471.70.
Printer units	8443	no	844331	Machines which perform two/more of the functions of printing, copying/facsimile transmission, capable of connecting to an automatic data processing machine/to a network
			844332	Other printers, copying machines & facsimile machines, whether/not combined , exclud the ones which perform two/more of the functions of printing, copying/facsimile transmission; capable of connecting to an automatic data processing machine/to a network
			844339	Other printers, copying machines & facsimile machines, whether/not combined , excl. 8443.31 & 8443.32
			844391	Parts & accessories of printing machinery used for printing by means of plates, cylinders & other printing components of heading 84.42

Annex B - Using the UN Comtrade database for e-waste assessments

Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			844399	Other parts & accessories for printing machinery excl. 8443.91
<i>Personal computing:</i>				
Personal computers (CPU, mouse, screen and keyboard included)	8471	yes	847141	Other automatic data processing machines : Comprising in the same housing at least a central processing unit & an input & output unit, whether/not combined
Laptop computers (CPU, mouse, screen and keyboard included)	8471	yes	847130	- Portable automatic data processing machines, weighing not more than 10 kg, consisting of a least a central processing unit, a keyboard & a display
Notebook computers	8471	yes	847130	- Portable automatic data processing machines, weighing not more than 10 kg, consisting of a least a central processing unit, a keyboard & a display
Notepad computers	8471	yes	847130	- Portable automatic data processing machines, weighing not more than 10 kg, consisting of a least a central processing unit, a keyboard & a display
Printers	8443	no	<i>show above</i>	
Copying equipment	8443	no	<i>show above</i>	
Electrical and electronic typewriters	8469	yes	846900	Typewriters other than printers of heading 84.43; word-processing machines.
Pocket and desk calculators	8470	yes	847010	Electronic calculators capable of operation without an external source of electric power & pocket-size data recording, repr. & displaying machines with calculating functions
			847021	Digital auto. data processing machines other than those of 8470.10, incorporating a printing device
			847029	Digital auto. data processing machines other than those of 8470.10, not incorporating a printing device
			847030	Calculating machines (excl. of 8470.10-8470.29)
			847050	Cash registers
			847090	Other electronic calculating machines, n.e.s. in 84.70
and other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means	8471	yes	847149	Other automatic data processing machines , presented in the form of systems.
			847150	Processing units other than those of sub-heading 8471.41/8471.49, whether/not containing in the same housing one/two of the following types of unit : storage units, input units, output units
			847160	Input/output units, whether/not containing storage units in the same housing
			847170	Storage units
			847190	Magnetic/optical readers, machines for transcribing data onto data media in coded form & machines for processing such data, n.e.s.

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Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
	8473	yes	847310	Parts & accessories (excl. covers, carrying cases & the like) suit. for use solely/principally with the machines of 84.69
			847321	Parts & accessories (excl. covers, carrying cases & the like) suit. for use solely/principally with the electronic calculating machines of 8470.10/8470.21/8470.29
			847329	Parts & accessories (excl. covers, carrying cases & the like) suit. for use solely/principally with the machines of 84.70 other than for those headings incl. in 8473.21
			847330	Parts & accessories of the machines of heading 84.71
			847340	Parts & accessories of the machines of heading 84.72
			847350	Parts & accessories equally suitable for use with machines of two/more of the headings 84.69 to 84.72
User terminals and systems	8471	yes	-	
Facsimile	8472	no	847210	Duplicating machines
Telex	8472	no	847210	Duplicating machines
Telephones	8517	yes	851711	Line telephone sets with cordless handsets
Pay telephones	8517	yes	-	
Cordless telephones	8517	yes	851718	Other telephone sets, incl. telephones for cellular networks/for other wireless networks, other than 8517.11 & 8517.12
Cellular telephones	8517	yes	851712	Telephones for cellular networks/for other wireless networks, other than Line telephone sets with cordless handsets
Answering systems	8519	no	851950	Telephone answering machines
and other products or equipment of transmitting sound, images or other information by telecommunications	8517	yes	851761	Base stations for transmission/reception of voice, images/other data, incl. apparatus for communication in a wired/wireless network (such as a local/wide area network)
			851762	Machines for the reception, conversion & transmission/regeneration of voice, images/other data, incl. switching & routing apparatus
			851769	Other apparatus for transmission/reception of voice, images/other data, incl. apparatus for communication in a wired/wireless network (such as a local/wide area network) , other than 8517.61 & 8517.62

Annex B - Using the UN Comtrade database for e-waste assessments

Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			851770	Parts of telephone sets, incl. telephones for cellular networks/for other wireless networks; other apparatus for the transmission/reception of voice, images/other data, incl. apparatus for communication in a wired/wireless network (such as a local/wide ar
<i>Not present in the directive</i>	8534	yes	853400	Printed circuits
<i>Not present in the directive</i>	8542	yes	854231	Electronic integrated circuits, processors & controllers, whether/not combined with memories, converters, logic circuits, amplifiers, clock & timing circuits,/other circuits
			854232	Electronic integrated circuits, memories
			854233	Electronic integrated circuits, qmplifiers
			854239	Other Electronic integrated circuits, other than Amplifiers/Memories/Processors & controllers
			854290	Parts of electronic integrated circuits
4. Consumer equipment				
Radio sets	8527	yes	852712	Pocket-size radio cassette-players
			852713	Radio-broadcast receivers capable of operating without an external source of power, combined with sound recording/repr. apparatus (excl. of 8527.12)
			852719	Radio-broadcast receivers capable of operating without an external source of power (excl. of 8527.12 & 8527.13)
			852721	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles...combined with sound recording/reproducing apparatus
			852729	Radio-broadcast receivers not capable of operatingwithout an externalsource of power,of a kind used in motor vehicles,incl.apparatuscapable of receiving also radio-telephony/radio-telegraphy,other(excl.of 8527.21)
			852791	Other reception apparatus for radio-broadcasting, combined with sound recording/reproducing apparatus.
			852792	Other reception apparatus for radio-broadcasting, not combined with sound recording/reproducing apparatus but combined with a clock.
			852799	Other reception apparatus for radio-broadcasting, excl. 8527.91 & 8527.92
Television sets	8528	yes	852841	Cathode-ray tube monitors , of a kind solely/principally used in an automatic data processing system of heading 84.71

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Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			852849	Other cathode-ray tube monitors , not of a kind solely/principally used in an automatic data processing system of heading 84.71
			852851	Other monitors, of a kind solely/principally used in an automatic data processing system of heading 84.71
			852859	Other monitors, not of a kind solely/principally used in an automatic data processing system of heading 84.71
			852861	Projectors, Of a kind solely/principally used in an automatic data processing system of heading 84.71
			852869	Projectors, not of a kind solely/principally used in an automatic data processing system of heading 84.71
			852871	Reception apparatus for television, Not designed to incorporate a video display/screen
			852872	Other colour reception apparatus for television, whether/not incorporating radio-broadcast receivers/sound/video recording/reproducing apparatus,
			852873	Other reception apparatus for television, whether/not incorporating radio-broadcast receivers/sound/video recording/reproducing apparatus, black & white/other monochrome.
	8540	yes	854011	Cathode-ray television picture tubes, incl. video monitor cathode-ray tubes, colour
			854012	Cathode-ray television picture tubes, incl. video monitor cathode-ray tubes, black & white/other monochrome
			854020	Television camera tubes; image converters & intensifiers; other photo-cathode tubes
			854040	Data/graphic display tubes, colour, with a phosphor dot screen pitch smaller than 0.4mm
			854050	Data/graphic display tubes, black & white/other monochrome
			854060	Cathode-ray tubes n.e.s. in 85.40
			854071	Magnetrons
			854072	Klystrons
			854079	Microwave tubes n.e.s. in 85.40
			854081	Receiver/amplifier valves & tubes
			854089	Valves & tubes n.e.s. in 85.40
			854091	Parts of cathode-ray tubes
854099	Parts of the tubes of 85.40 other than cathode-ray tubes			
Videocameras	8525	yes	852550	Transmission apparatus for radio-broadcasting/television

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Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			852560	Transmission apparatus for radio-broadcasting/television incorporating reception apparatus
			852580	Television cameras, digital cameras & video camera recorders
Video recorders	8521	yes	852110	Video recording/repr. apparatus, whether/not incorporating a video tuner, magnetic tape-type
			852190	Video recording/repr. apparatus other than magnetic tape-type, whether/not incorporating a video tuner
Hi-fi recorders	8518	yes	851810	Microphones & stands therefor
Audio amplifiers	8518	yes	851821	Single loudspeakers, mounted in their enclosures
			851822	Multiple loudspeakers, mounted in the same enclosure
			851829	Loudspeakers n.e.s. in 85.18, whether/not mounted in their enclosures
			851830	Headphones & earphones, whether/not combined with a microphone, & sets consisting of a microphone & one/more loudspeakers
			851840	Audio-frequency electric amplifiers
			851850	Electric sound amplifier sets
Musical instruments	9207	yes	851890	Parts of the apparatus & equip. of 85.18
			920710	Keyboard instr. other than accordions, the sound of which is produced/must be amplified, electrically
			920790	Musical instr. (excl. keyboard instruments other than accordions), the sound of which is produced/must be amplified, electrically
And other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications	8519	no	851920	Apparatus operated by coins, banknotes, bank cards, tokens/by other means of payment
			851930	Turntables (record-decks)
			851981	Other sound recording/reproducing apparatus, using magnetic, optical/semiconductor media, other than 8519.20, 8519.30, 8519.50
			851989	Other sound recording/reproducing apparatus, other n.e.s. in Ch. 85.19
	8522	yes	852210	Pick-up cartridges for use solely/principally with the apparatus of 85.19-85.21
			852290	Parts (excl. pick-up cartridges) & accessories suit. for use solely/principally with the apparatus of 85.19-85.21
	8523	yes	852321	Magnetic media for the recording of sound/of other phenomena, but excl. products of Ch. 37., cards incorporating a magnetic stripe

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Category of the EU Directive	HS Classification			
	HS Group	Entire Group ?	Commodity Nr.	Commodity name
			852329	Magnetic media for the recording of sound/of other phenomena, but excl. products of Ch. 37., other than cards incorporating a magnetic stripe
			852340	Optical media for the recording of sound/of other phenomena, but excl. products of Ch. 37.
			852351	Semi-conductor media, solid-state non-volatile storage devices, for the recording of sound/of other phenomena, but excl. products of Ch. 37.
			852352	Semi-conductor media, "Smart cards" for the recording of sound/of other phenomena, but excl. products of Ch. 37.
			852359	Other semi-conductor media, for the recording of sound/of other phenomena, but excl. products of Ch. 37., other than "Smart Cards" & Solid-state non-volatile storage devices
			852380	Discs, tapes, solid-state non-volatile storage devices, "smart cards" & other media for the recording of sound/of other phenomena, whether/not recorded, incl. matrices & masters for the production of discs, but excl. products of Ch.37., other n.e.s.
	8526	yes	852610	Radar apparatus
			852691	Radio navigational aid apparatus
			852692	Radio remote control apparatus
	8541	yes	854110	Diodes (excl. photosensitive/light emitting diodes)
			854121	Transistors (excl. photosensitive transistors), with a dissipation rate of <1W
			854129	Transistors (excl. photosensitive transistors), other than those with a dissipation rate of <1W
			854130	Thyristors, diacs & triacs (excl. photosensitive devices)
			854140	Photosensitive semiconductor devices, incl. photovoltaic cells whether/not assembled in modules/made up into panels; light emitting diodes
			854150	Semiconductor devices n.e.s. in 85.41
			854160	Mounted piezo-electric crystals
	854190	Parts of the devices of 85.41		

Annex C: Questionnaire for Private Consumers (Households)

Date:	Location:	Interviewer:
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Interview introduction
<p>I am (name of interviewer) coming from</p> <p>We are collecting data on e-waste generation and management in order to</p> <p>Can we ask you some questions about e-waste? / Thank you for participating in our survey</p>

Interviewed person	
Name	
Suburb	
City & State	<input type="checkbox"/> rural area <input type="checkbox"/> urban area
Telephone	
E-mail	

0. Introducing question
<p><i>(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.)</i></p> <p>Do you know what e-waste or waste of electrical and electronic equipment is?</p> <p><i>(describe to interviewed person what e-waste is, if necessary....)</i></p>

1. Questions about awareness and behaviour			
1.1	<p>Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?</p>	<input type="checkbox"/> YES <input type="checkbox"/> NO	
1.2	<p>a) Do waste collectors come and pick up waste at your door? Do they pick up e-waste too?</p> <p>b) Type of waste collection? (e.g. informal, private or municipal collection)</p>	<p>a)</p> <input type="checkbox"/> YES, everything <input type="checkbox"/> YES, but no e-waste <input type="checkbox"/> NO	b)
1.3	<p>c) Is the current e-waste collection convenient to you?</p> <p>d) What could be improved?</p>	<p>a)</p> <input type="checkbox"/> YES <input type="checkbox"/> NO	b)

2. Number (#) of electrical and electronic equipment in the household

How many appliances of each electric and electronic product do you have in your household
(in use & stored)?

Large household appliances (category 1)	
Product	#
Fridges*	
Air conditioners*	
Washing machines*	
Freezers	
Clothes dryers	
Electric heaters	
Dish washers	
Grillers	
Electric/Gas stoves	
(Steam-)Ovens	
Electric hot plate	

Small household appliances (category 2)	
Product	#
Irons*	
Kettles*	
Blenders*	
Microwaves*	
Hair dryers	
Mixers	
Fans	
Vacuum cleaners	
Carpet sweepers	
Toasters	
Popcorn makers	
Rice cooker	
Water dispenser	
Cables	
Extension boxes (?)	
Soldering iron	
Electric lawn-mowers	
(Alarm) Clocks	

IT and telecommunications equipment (category 3)	
Product	#
PCs* (central unit)	
CRT monitors*	
LCD monitors*	
Laptops*	
Mobile phones*	
Phones	
Printers	
Copy machines	
Scanners	
Fax machines	
Modems	

Consumer equipment (category 4)	
Product	#
TVs (CRT)*	
TVs (flat panel)*	
Radios*	
Stereos*	
DVD players	
VCR players (video-cassette recorder)	
MP3-players	
Cameras	
Game consoles	

Lighting equipment (category 5)	
Product	#
Light bulbs*	
Fluorescent tubes*	
Long life light bulbs (energy saving)	
Rechargeable lamps	

Batteries	
Product	#
Accumulators	
Car batteries	
One-way batteries	

Other _____	
Product	#

* **Tracer products:** *The selection of tracer products should take into account the specific characteristics of the country or region in scope*

3. Tracer products																	
		3.1 Purchase and use of tracer products:							3.2 Disposal of tracer products: How do/did you dispose your electric and electronic products? (please tick)								
		<i>(If there is more than one device per product in a household, please list each device individually)</i>															
Category	Product	Where was it bought? (e.g. supermarket, second hand market, friends, etc.)	In what condition did you buy it? N - new U – used+working B - broken	How many years have you used the product?	How many years do you intend to further use it?	In what condition was the product at the end of life? W - working B - broken F - broken but fixable	How many years did you store the product before disposal?	Sell to a second hand dealer	Give or sell to a scrap dealer	Dispose with household waste	Hand over to e-waste collection	Put on the street	Store at home	Sell to individual	Donate	Other	
1	Fridge																
1	Air conditioner																
1	Washing machines																
1																	
1																	
2	Iron																
2	Kettle																
2	Blender																
2	Microwave																
2																	
2																	
3	PC (central unit)																
3	CRT monitor																

3	LCD monitor																
3	Laptop																
3	Mobile phone																
3																	
3																	
4	TV (CRT)																
4	TV (flat panel)																
4	Radio																
4	Stereo																
4																	
4																	
5	Light bulb																
5	Fluorescent tube																
5																	
5																	
	Other																

4. General information

4.1	<p>Would you give out your e-waste to the waste collectors for free if you could be sure that the waste will be well taken care of in a way that is useful and that does not pollute the environment?</p> <p style="text-align: center;"> <input type="checkbox"/> YES <input type="checkbox"/> NO </p>
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4.2	<p>Do you have further comments or suggestions concerning e-waste management?</p>
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4.3	<p>How many persons live in your household? (please tick)</p>				
	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3-4 <input type="checkbox"/>	5-8 <input type="checkbox"/>	more than 8 <input type="checkbox"/>

4.4	<p>What is the monthly income in the household? (please tick) <i>(in local currency \$)</i></p>				
	< 200 \$ <input type="checkbox"/>	200 – 500 \$ <input type="checkbox"/>	500 – 1'000 \$ <input type="checkbox"/>	1'000 – 2'000 \$ <input type="checkbox"/>	> 2'000 \$ <input type="checkbox"/>

Note: the income classes must be adapted to the official national income classification

Interview closure

- **Thank you for participating in this survey**
- *The interviewer could also provide information about when & where the results of the survey will be available (if this is the case)*

Annex D: Questionnaire for Corporate and Institutional Consumers

Date:	Location:	Interviewer:
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Interview introduction
<p><i>In the beginning of the interview, the interviewer should localize the person which is responsible for the management of electrical and electronic equipment (EEE) or the waste/e-waste management in the organization.</i></p> <p>I am (name interviewer) coming from</p> <p>We are collecting data on e-waste generation and management in order to</p> <p>Can we ask you some questions about e-waste? / Thank you for participating in our survey</p>

General information about organization	
Name of organization	
Type of organization	<input type="checkbox"/> Government <input type="checkbox"/> Education <input type="checkbox"/> Private company <input type="checkbox"/> NGO <input type="checkbox"/> other:
Address / City	
Main activity	
Number of employees	
Name and function of contact person	
Telephone	
E-mail	
Is your organization ISO 14001 certified? <i>(ISO 14001 is an international environmental certification)</i>	<input type="checkbox"/> YES <input type="checkbox"/> NO

0. Introducing question

(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.)

Do you know what e-waste or waste of electrical and electronic equipment is?

(describe to interviewed person what e-waste is, if necessary....)

1. Questions about awareness and behaviour

	Question	Answer	Enhance the replies with comments, suggestions, details, etc.
1.1	Are you aware about the environmental hazards caused by discarded electronic equipment?	<input type="checkbox"/> YES <input type="checkbox"/> NO	
1.2	Are you aware that some electronic parts may be profitably recycled?	<input type="checkbox"/> YES <input type="checkbox"/> NO	
1.3	Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?	<input type="checkbox"/> YES <input type="checkbox"/> NO	
1.4	Does your organization have a policy or strategy for the management of e-waste?	<input type="checkbox"/> YES <input type="checkbox"/> NO	
1.5	Does your organization keep inventories of the electric and electronic equipment it discards / stores?	<input type="checkbox"/> YES <input type="checkbox"/> NO	

2. Number (#) of electrical and electronic equipment in the organization

a) How many appliances of each product do you totally have in your organization (in use and stored)?

b) How many of them are not in use (stored)?

IT and telecommunications equipment (category 3)

Product	a) total	b) not in use
PCs* (central unit)		
CRT monitors*		
LCD monitors*		
Laptops*		
Mobile phones*		
Landline phones*		
Printers*		
Copy machines*		
Scanners		
Fax machines		
Modems		

Large household appliances (category 1)

Product	a) total	b) not in use
Fridges*		
Air conditioners*		

Small household appliances (category 2)

Product	a) total	b) not in use
Kettles		
Microwaves		
Fans		
Water dispenser		

Consumer equipment (category 4)

Product	a) total	b) not in use
TVs (CRT)*		
TVs (flat panel)*		
Radios*		
Video projector		
DVD players		
Cameras		

Lighting equipment (category 5)

Product	a) total	b) not in use
Light bulbs		
Fluorescent tubes		
Long life light bulbs (energy saving)		
Rechargeable lamps		

Other _____

Product	a) total	b) not in use

* **Tracer products:** The selection of tracer products should take into account the specific characteristics of the country or region in scope

3. Tracer products																
		3.1 Purchase and use of tracer products						3.2 Disposal of tracer products: What does your company do with the electrical and electronic equipment which is not of use anymore? (please tick)								
Category	Product	Where does your organization buy its products? (e.g. supermarket, second hand market, friends, etc.)	How many new appliances does your organization buy per year	In what condition do you buy it? N - new U – used+working B - broken	How many years do you intend to use the product?	In what condition was the product at the end of life? W - working B - broken F - broken but fixable	How many years did you store the product before disposal?	Sell to a second hand dealer	Give or sell to a scrap dealer	Dispose with household waste	Hand over to e-waste collection	Put on the street	Store at home	Sell to individual	Donate	Other
	In general															
3	PC (central unit)															
3	CRT monitor															
3	LCD monitor															
3	Laptop															
3	Mobile phone															
3	Phone															
3	Printer															
3	Copy machine															
1	Fridge															
1	Air conditioner															
4	TV (CRT)															
4	TV (flat panel)															

4	Radio																
	Other:																

4. General questions			
	Question	Answer	<i>Enhance the replies with comments, suggestions, details, etc.</i>
4.1	Are you aware of what happens to the equipment you have discarded?	<input type="checkbox"/> YES <input type="checkbox"/> NO	
4.2	From your point of view, what are the main obstacles for a proper e-waste treatment? <i>(e.g costs, lack of infrastructure and/or policy within your company, lack of legislation, absence of recycling solutions, absence of collection system, etc.)</i>		
4.3	What should be done to facilitate e-waste management (to your organization)?		
4.4	Would you be willing to pay for your equipment to be collected and treated?	<input type="checkbox"/> YES <input type="checkbox"/> NO	If yes: at what conditions? <i>(e.g. pickup service, guarantee of proper disposal, etc.)</i>
4.5	General remarks		

Interview closure

- **Thank you for participating in this survey**
- *The interviewer could also provide information about when & where the results of the survey will be available (if this is the case)*

Annex E: Questionnaire for Importers and Producers of EEE

Date:	Location:	Interviewer:
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Interview introduction
<p><i>Before the beginning of the interview, the interviewer should localize the person which gathers the numbers about imported (or produced) electric and electronic equipment in the company.</i></p> <p>I am (name interviewer) coming from We are collecting data on e-waste generation and management in order to Can we ask you some questions about e-waste? / Thank you for participating in our survey</p>

General information about company	
<input type="checkbox"/> Import and/or <input type="checkbox"/> Production of electrical and electronic equipment (EEE)	
Name of company	
Address / City	
Main activity	
Number of employees	
Year of foundation	
Name and function of contact person	
Telephone	
E-mail	
Is your institution ISO 14001 certified? <i>(ISO 14001 is an international certification for an environmental management system)</i>	<input type="checkbox"/> YES <input type="checkbox"/> NO

0. Introducing question

(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.)

Do you know what e-waste or waste of electrical and electronic equipment is?

(describe to interviewed person what e-waste is, if necessary....)

1. Questions about awareness and behaviour

	Question	Answer	Enhance the replies with comments, suggestions, details, etc.
1.1	Are you aware about the environmental hazards caused by discarded electronic equipment?	<input type="checkbox"/> YES <input type="checkbox"/> NO	
1.2	Are you aware that some electronic parts may be profitably recycled?	<input type="checkbox"/> YES <input type="checkbox"/> NO	
1.3	Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?	<input type="checkbox"/> YES <input type="checkbox"/> NO	

	<input type="checkbox"/> others:
--	----------------------------------

3. General questions			
	Question	Answer	<i>Enhance the replies with comments, suggestions, details, etc.</i>
3.1	Is the principle “Extended Producer Responsibility” (EPR) known in your company?	<input type="checkbox"/> YES <input type="checkbox"/> NO	if yes: could you describe it shortly?
3.2	Is your company member of any association or body of importers and/or producers of electrical and electronic equipment (EEE)?	<input type="checkbox"/> YES <input type="checkbox"/> NO	if yes: name of body/association?
3.3	Is your company member of any association or body which is in charge of a proper e-waste management (collection & recycling)?	<input type="checkbox"/> YES <input type="checkbox"/> NO	if yes: name of body/association?
3.4	Please describe your company’s strategy to collect & recycle the e-waste generated by its customers?		
3.5	From your point of view, what are the main obstacles for a proper e-waste treatment?		
3.6	From your point of view, what should be done to facilitate e-waste management?		
3.7	Would you be willing to pay for a service/organisation which collects and treats the e-waste generated by your customers? <input type="checkbox"/> YES <input type="checkbox"/> NO		

	If yes: at what conditions? <i>(e.g. pickup service, guarantee of proper disposal, reliability, etc.)</i>
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1.5	General remarks
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Interview closure	
	<ul style="list-style-type: none">• Thank you for participating in this survey• <i>The interviewer could also provide information about <u>when & where</u> the results of the survey will be available (if this is the case)</i>

Annex F: Questionnaire for Recyclers and Refurbishers

Date:	Location:	Interviewer:
--------------	------------------	---------------------

Interview introduction
<p><i>Before the beginning of the interview, the interviewer should localize the person which is responsible for the recycling operations of the company.</i></p> <p>I am (name interviewer) coming from We are collecting data on e-waste generation and management in order to Can we ask you some questions about e-waste? / Thank you for participating in our survey</p>

General information about company	
Name of company	
Address / City	
Number of employees	
Year of foundation	
Name and function of contact person	
Telephone	
E-mail	
Main activity	
Which e-waste activities does the company carry out?	<input type="checkbox"/> Collection <input type="checkbox"/> Dismantling/Recycling <input type="checkbox"/> Refurbishment <input type="checkbox"/> other:
Is your company ISO 14001 certified? <i>(ISO 14001 is an international certification for an environmental management system)</i>	<input type="checkbox"/> YES <input type="checkbox"/> NO

0. Introducing question
<p><i>(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.)</i></p> <p>Do you know what e-waste or waste of electrical and electronic equipment is? <i>(describe to interviewed person what e-waste is, if necessary....)</i></p>

2. Collection of (waste) electrical and electronic equipment	
Question	Answer
<p>2.1</p> <p>By which strategies and channel does your company collect e-waste?</p> <p><i>Which stakeholders are involved? Responsibilities? etc.</i></p>	
<p>2.2</p> <p>In terms of amounts, which one is the most important strategy/channel?</p>	
<p>2.3</p> <p>Do you cooperate with other companies/authorities for collection purposes?</p>	<p><input type="checkbox"/> YES if yes: which ones? details?</p> <p><input type="checkbox"/> NO</p>
<p>2.4</p> <p>Which company transports the materials during collection?</p>	
<p>2.5</p> <p>What are the main obstacles for a proper e-waste <u>collection</u>?</p>	

3.2 Material fractions arising from WEEE

- a) Which material fractions arise from your company's recycling activities?
- b) What does your company do with each material fraction? (treatment/destination)
- c) Passing on the respective fraction to a further treatment, disposal, refining, etc.: is this associated with an income or with costs for your company, or does this happen for free? (please tick)
- d) In case of income / costs: could you indicate an average price you get / pay

a)	b)	c)	d)
<i>Material fraction</i>	<i>Treatment / destination (e.g. indicate company, market, type of treatment etc.)</i>	<i>income/costs</i>	<i>price (indicate unit)</i>
<i>Note: don't forget to write down the units of the indicated numbers!</i>			
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	
		<input type="checkbox"/> income <input type="checkbox"/> costs <input type="checkbox"/> free	

General questions about recycling/treatment of e-waste		
3.3	<p>Which processes does your company carry out?</p> <p><input type="checkbox"/> Sorting of products</p> <p><input type="checkbox"/> Manual dismantling</p> <p><input type="checkbox"/> Shredding</p> <p><input type="checkbox"/> Separation of (shredded) fractions</p> <p><input type="checkbox"/> Cable stripping/granulation</p> <p><input type="checkbox"/> Burning (e.g. cables, cases)</p> <p><input type="checkbox"/> Leaching (e.g. printed wiring boards)</p> <p><input type="checkbox"/> other:</p>	
3.4	<p>How many workers are engaged in the recycling operation?</p>	
3.5	<p>What environmental measures does your company undertake to prevent the release of hazardous substances?</p>	
3.6	<p>Which health and safety measures undertakes the company?</p>	

4.3	By which channels does your company sell the refurbished products?	
4.4	What is done with parts or products which cannot be used for refurbishment?	
4.5	How many workers are engaged in the refurbishment operation?	

5. General questions			
	Question	Answer	<i>Enhance the replies with comments, suggestions, details, etc.</i>
5.1	Apart from e-waste, which other materials is your company working with?		<i>e.g. scrap metals, paper, plastic, etc.</i>
5.2	Is your company working on a formal basis or is it an informal company? <input type="checkbox"/> formal <input type="checkbox"/> informal		
5.3	Is your company member of any association or body of recyclers?	<input type="checkbox"/> YES <input type="checkbox"/> NO	if yes: name of body/association?
5.4	Does your company cooperate with other companies or authorities in order to collect and recycle e-waste?	<input type="checkbox"/> YES <input type="checkbox"/> NO	if yes: name? details?
5.5	From your point of view, what are the main obstacles for a proper e-waste <u>treatment</u>?		
5.6	From your point of view, what should be done to facilitate e-waste management?		
5.7	Are you satisfied with the current financing mechanisms of e-waste management? <input type="checkbox"/> YES <input type="checkbox"/> NO		
	If no: what should be improved? <i>(e.g. fee, regulation, corporate responsibility (EPR), etc.)</i>		

5.8	General remarks
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Interview closure
<ul style="list-style-type: none">• Thank you for participating in this survey• The interviewer could also provide information about <u>when & where</u> the results of the survey will be available (if this is the case)

Annex G

Weight and composition of selected tracers and categories

Weight

Item	Weight (kg)	Source
Category 1: Large household appliances		
Washing machine	65	(Huisman, Magalini et al. 2008)
Tumble dryer	49	(Künzler Bossert & Partner GmbH 2001)
Dish washer	50	(Huisman, Magalini et al. 2008)
Refrigerator	35	(Huisman, Magalini et al. 2008)
Fridge/Freezer (in 1 device)	35	(Huisman, Magalini et al. 2008)
Freezer	65	(Künzler Bossert & Partner GmbH 2001)
Category 2: Small household appliances		
Microwave	15	(Huisman, Magalini et al. 2008)
Electric cooker	46	(Künzler Bossert & Partner GmbH 2001)
Vacuum cleaner	8	(Künzler Bossert & Partner GmbH 2001)
Iron	1	(Huisman, Magalini et al. 2008)
Kettle	1	(Huisman, Magalini et al. 2008)
Toaster	1	(Huisman, Magalini et al. 2008)
Mixer	1	(Huisman, Magalini et al. 2008)
Hair dryer	1	(Huisman, Magalini et al. 2008)
Electric heater	5	(Huisman, Magalini et al. 2008)
Category 3: Information and communication technologies		
Desktop Computer	9.9	(Eugster, Hischier et al. 2007)
Laptop Computer	3.5	(SWICO Recycling Guarantee 2006) / ecoinvent v2.0
CRT Screen	14.1	(Laffely 2007)/ (Zumbuehl 2006)
LCD Screen	4.7	(SWICO Recycling Guarantee 2006) / ecoinvent v2.0
Mouse	0.05	Estimate / ecoinvent v2.0
Keyboard	1	Estimate / ecoinvent v2.0
Printer	6.5	(Laffely 2007)/
Mobile Phone	0.1	Estimate
Mobile Phone charger	0.1	Estimate
Telephone	1	(Huisman, Magalini et al. 2008)
Category 4: Consumer electronics		
Television (CRT)	31.6	(Zumbuehl 2006)

Annex G – Weight and composition of selected tracers and categories

Item	Weight (kg)	Source
Video recorder / DVD player	5	(Huisman, Magalini et al. 2008)
Hi-Fi system	10	(Huisman, Magalini et al. 2008)
Radio	2	(Huisman, Magalini et al. 2008)
Category 6: Electrical and electronic tools		
Electric drill	2	(Huisman, Magalini et al. 2008)
Power saw	2	(Huisman, Magalini et al. 2008)
Lawn mower	5	(Huisman, Magalini et al. 2008)

Composition

The following table presents an estimation of the average composition of four categories in weight %. (Source: Mueller and Widmer, 2009)

Material	Large household appliances	Small household appliances	ICT and consumer electronics	Lighting equipment
Iron	43	29	36	n.a.
Aluminium	14	9.3	5.0	14
Copper	12	17	4.0	0.22
Lead	1.6	0.57	0.29	n.a.
Cadmium	0.014	0.0068	0.018	n.a.
Mercury	3.8E-05	1.8E-05	7.0E-05	0.020
Gold	6.7E-07	6.1E-07	2.4E-04	n.a.
Silver	7.7E-06	7.0E-06	1.2E-03	n.a.
Palladium	3.0E-07	2.4E-07	6.0E-05	n.a.
Indium	0	0	5.0E-04	5.0E-04
Plastics with brominated flame retardants	0.29	0.75	18	3.7
Plastics	19	37	12	n.a.
Lead glass	0	0	19	0
Glass	0.017	0.16	0.30	77
Other	10	6.9	5.7	5.0
Total	100.00	100.00	100.00	100

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Annex H

Example of overview of legal texts related or influencing e-waste management

Law or Regulation	Major Content	Influence on e-waste management	Status /date
Solid Waste Pollution Prevention and Control Law (NPC)	Stipulations on the management of solid waste pollution, not limited to e-waste. Disposal of municipal and industrial solid waste, reuse and recycle of solid waste.		Effective from April 1, 1996
Cleaner Production Promotion Law (NPC)	Pollution prevention and reduction in the whole life cycle of products		Effective from January 1, 2003
Notification on the Import of the Seventh Category of Waste (SEPA)	Ban on the import of the seventh category of waste. Some specific e-waste is not included.		Effective from February 1, 2000
Notice on Strengthening the Environmental Management of e-Waste (SEPA)	Calls for strengthening the environmental management of e-waste to ensure environmental sound practices in waste collection and treatment		Issued August 26, 2003
Ordinance on the Management of Waste Household Electrical and Electronic Products (NDRC)	Responsibilities of different parties in waste household electrical and electronic products collection and treatment.		Incorporated in the 2006 legislation plan of the State Council
Measures for the Administration of Prevention and Treatment of Pollution by Electronic Information Products (MII)	Restrictions on the use of hazardous substances; 'green' product design; provision of information on the components, hazardous substances and recycling.		Issued early 2006; will be enforced since March 1, 2007
Waste Home Electronic Appliance and Electrical Pollution Prevention and Control Technical Policy (SEPA)	Technical policies for pollution prevention and control on home electronic appliance and electrical waste		Under drafting
Technical Standards for the Treatment of e-Waste (SEPA)	Technical standards for the collection, transportation, storage, dismantling, treatment and disposal of e-waste		Under drafting

Annex J

Checklist for establishing / analysing legislation on e-waste

Question	Options	Tools / examples	Strength	Weakness
What is the goal of an e-waste legislation?	Reduce hazardous processing of e-waste			
	Promote reuse			
	Promote recycling			
	Waste prevention and better product design			
What is the scope of the legislation?	Only a few specific products with the most hazards			
	Only a few categories of products			
	All electrical and electronic products			
Who is a producer?	The brand owner			
	The manufacturer			
	The importer			
	The distributor			
	All of the above			
How should responsibility be allocated? (assuming producer responsibility)	Individually			
	Collectively			
	Not at all			
Who is responsible for collection?	Producer			
	Retailer			
	Municipality			
	Recycler			
	Consumer			
Who is responsible for system organisation and operation?	Producer			
	Retailer			
	Government			
	Recycler			

Annex J – Checklist for establishing / analysing a legislation on e-waste

Question	Options	Tools / examples	Strength	Weakness
Who is responsible for control and audit of...				
... the entire system?				
... the environmental aspects?				
... the financial aspects?				
Who is responsible for the setting of the standards?				
What are the costs involved in the entire system?				
What are the current laws for waste management/ treatment/ environmental legislation?				

Annex K

Example of Stakeholder Overview

The actors involved in the CRT flows within the Cape Town Metropolitan Area are shown in the figure below. Since there is no CRT manufacturer in South Africa, all CRTs either from computer monitors or TVs are imported to South Africa.

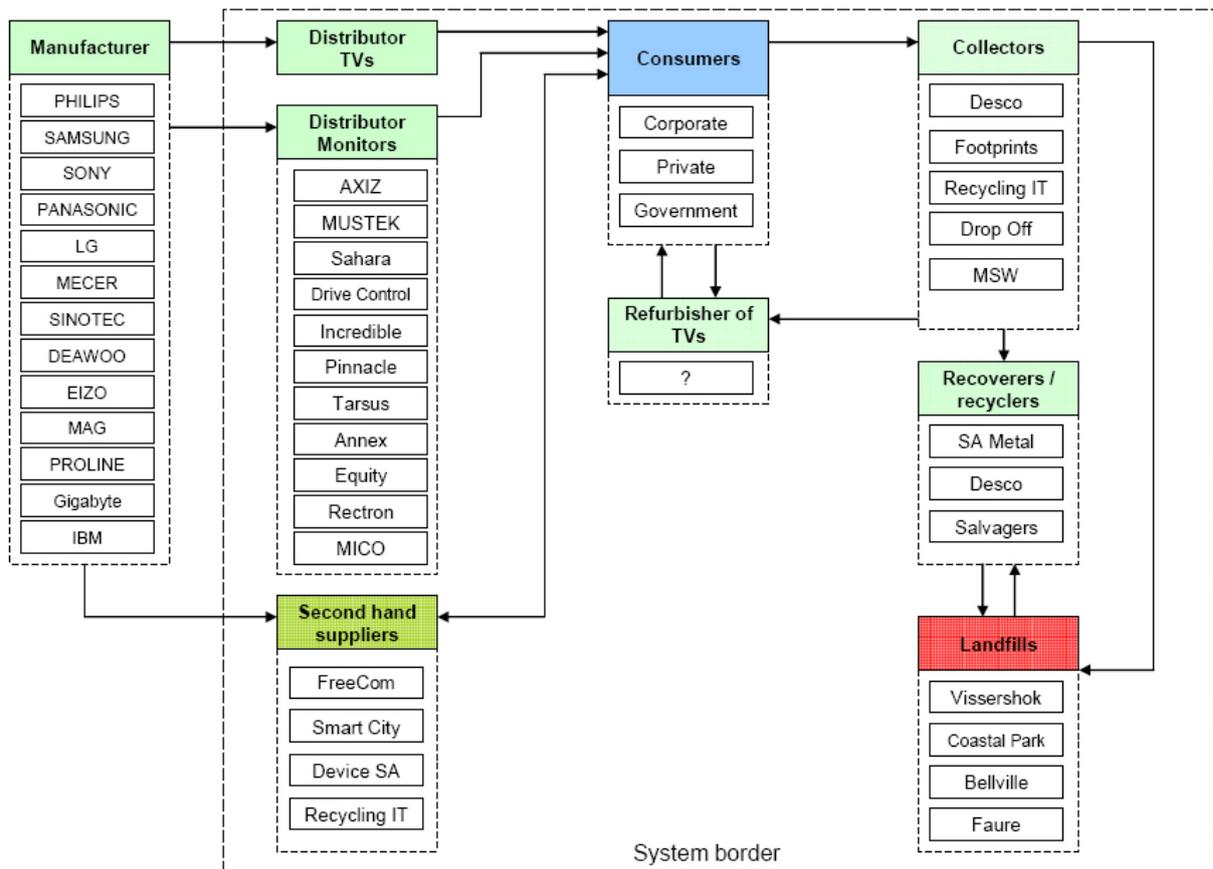


Figure 1: System picture with the players involved and their relationship to each other in the massflows of computer monitors and TV of the Cape Town Metropolitan Area.

Annex L

Balance and parametric equations for the mass flow model

The following example shows how the parametric equations of a mass flow model can be set up.

Definitions

Processes: P_i

Flows: F_{ij} , $i = \text{origin}, j = \text{destination}$

Stock: S_i

All Processes, Flows and Stocks are depicted in Figure 1.

Model Variables

1. Processes

- Process 1 = Material supply. Includes component manufacturer (P_{1a}), component importer (P_{1b}) and product manufacturer/assembler (P_{1c})
- Process 2 = retailers. Includes official and "grey" markets.
- Process 3 = Consumers. Includes Households and small and medium businesses (P_{3a}), and IT industry, large businesses, administration, etc (P_{3b})
- Process 4 = Repair
- Process 5 = Pre-recycling. Includes Scrap dealers (P_{5a}), Sorting and dismantling (P_{5b}), and refurbishing (P_{5c})
- Process 6 = Recycling. Includes CRT (P_{6a}), PCB (P_{6b}), Capacitor (P_{6m}), Battery (P_{6l}), External cables (P_{6c}), Brominated plastics (P_{6d}), Internal cable (P_{6e}), plastic (P_{6f}), copper (P_{6h}), precious metals (P_{6j}), aluminium (P_{6i}), non ferrous metals (P_{6n}), ferrous metals (P_{6f}).
- Process 7 = disposal

2. Flows

Main flows

F_{01} = Raw material. Outside the system. Used by component manufacturers.

F_{12} = Flow of assembled goods, from companies to retailers.

F_{17} = Flow of waste material produced during processing. Directly to disposal.

F_{23} = Sales of goods from retailers to consumers.

F_{34} = Number of goods sent for repair.

F_{35} = Flow of obsolete goods sent to recycling or reuse.

F_{43} = Repaired goods going back to customers.

F_{45} = Un-repairable goods sent to recycling or reuse.

F_{47} = Waste produced during repair. Directly to disposal.

F_{52} = Recovered components or equipments good for re-use and sold as second-hand.

F_{56} = Sorted materials sold to different recycling units.

F_{61} = Recycled materials sold as raw material.

Annex L – Balance and parametric equations for the mass flow model

F_{62} = Recycled materials directly sold on the market.

F_{67} = Waste produced during recycling processes sent to disposal.

Detailed flows

Just as some processes may be detailed into sub-processes, some related flows may be detailed into detailed flows.

F_{23} is the sum of the two following flows:

F_{23a} = Sales of goods from retailers to small consumers.

F_{23b} = Sales of goods from retailers to bulk consumers.

F_{35} is the sum of the two following flows:

F_{3a5} = Flow of obsolete goods from small consumers, sent to recycling or reuse.

F_{3b5} = Flow of obsolete goods from bulk consumers, sent to recycling or reuse.

F_{52} is the sum of the two following flows:

F_{5b2} = Recovered components good for re-use.

F_{5c2} = Refurbished goods sold to the second-hand market.

3. Stocks and stock variations

S_1 = Materials stocked in the manufacturing companies.

ΔS_1 = Variation of stock

S_2 = Goods stocked in retailer stores.

ΔS_2 = Variation of stock

S_3 = Stock of goods at consumers. Number of goods in households, used in industry, etc.

ΔS_3 = Variation of stock. Defined as the difference between the penetration rate and obsolescence rate.

S_4 = Materials stocked in the service centres.

ΔS_4 = Variation of stock.

S_5 = Materials and goods stocked in scrap dealers, dismantlers, etc.

ΔS_5 = Variation of stock

S_6 = Materials stocked in the recycling processes.

ΔS_6 = variation of stock.

S_7 = Materials stocked in dump yards, landfills, etc.

ΔS_7 = Variation of stock.

Mathematical model

Mass Balance Equations:

General mass balance equation: $\Delta S = \sum F_{in} - \sum F_{out}$

Process 1: $F_{01} + F_{61} - F_{12} = \Delta S_1$
 Process 2: $F_{12} + F_{52} + F_{62} - F_{23} = \Delta S_2$
 Process 3: $F_{23} + F_{43} - F_{34} - F_{35} = \Delta S_3$
 Process 4: $F_{34} - F_{43} - F_{45} = \Delta S_4$
 Process 5: $F_{35} + F_{45} - F_{52} - F_{56} = \Delta S_5$
 Process 6: $F_{56} - F_{61} - F_{62} - F_{67} = \Delta S_6$
 Process 7: $F_{17} + F_{47} + F_{67} = \Delta S_7$

Parametric Equations:

$F_{23a} = k_a * F_{23}$, k_a : % sales to households
 $F_{23b} = k_b * F_{23}$, k_a : % sales to bulk consumers
 $F_{34} = k_c * S_3$, k_a : rate of repair
 $F_{3a5} = k_d * S_{3a}$, k_a : household obsolescence rate
 $F_{3b5} = k_e * S_{3b}$, k_a : corporate obsolescence rate
 $F_{45} = k_f * F_{34}$, k_a : non repairable rate
 $F_{5b6} = k_g * F_{5a5b}$, k_a : fraction of materials sent to recycling
 $F_{5b5c} = k_h * F_{5a5b}$, k_a % functional components reassembled in second-hand equipments
 $F_{5b2} = k_i * F_{5a5b}$, k_a % functional components directly sold to second-hand market
 $F_{5b6a} = k_j * F_{5b6}$, k_a : % to CRT recycling
 $F_{5b6b} = k_k * F_{5b6}$, k_a : % PCB recycling
 $F_{5b6c} = k_l * F_{5b6}$, k_a : % capacitors recycling
 $F_{5b6d} = k_m * F_{5b6}$, k_a : % battery recycling
 $F_{5b6e} = k_n * F_{5b6}$, k_a : % external cable recycling
 $F_{5b6f} = k_o * F_{5b6}$, k_a : % brom. plastics recycling
 $F_{5b6g} = k_p * F_{5b6}$, k_a : % internal cable recycling
 $F_{5b6h} = k_q * F_{5b6}$, k_a : % plastic recovery
 $F_{5b6i} = k_r * F_{5b6}$, k_a : % copper recovery
 $F_{5b6j} = k_s * F_{5b6}$, k_a : % precious metal recovery
 $F_{5b6k} = k_t * F_{5b6}$, k_a : % aluminium recovery
 $F_{5b6l} = k_u * F_{5b6}$, k_a : % non-ferrous metal recovery
 $F_{5b6m} = k_v * F_{5b6}$, k_a : % iron recovery

Annex L – Balance and parametric equations for the mass flow model

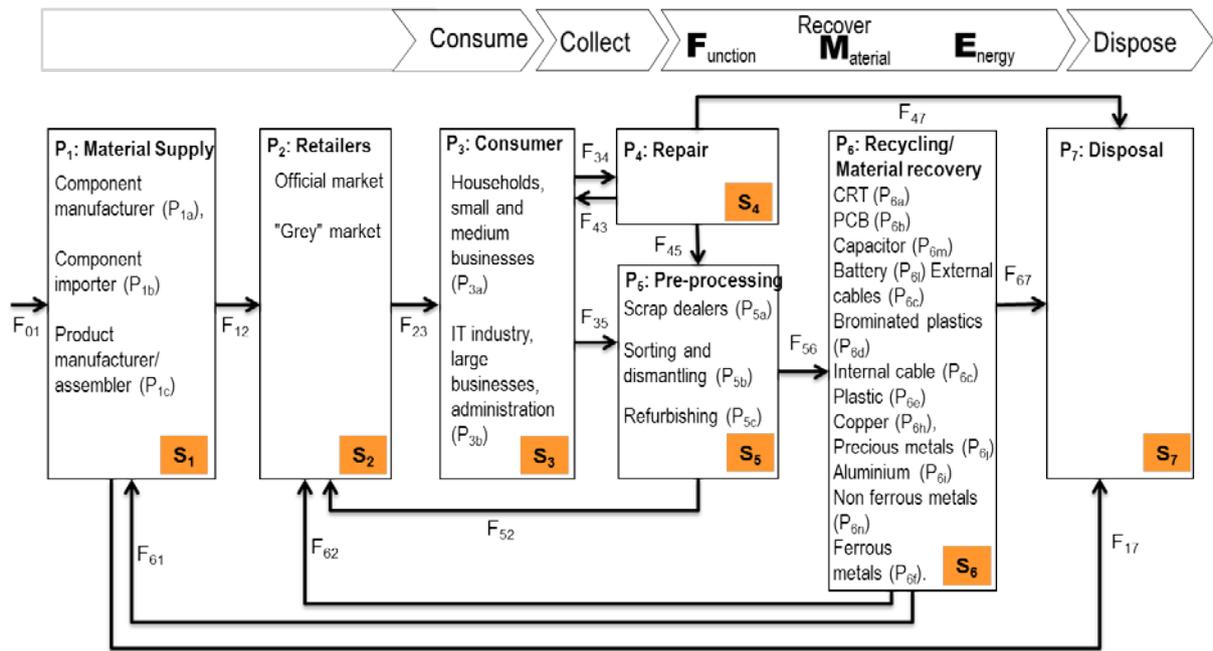


Figure 1: Processes, Flows and Stocks of the above example.

Annex M

Quantitative assessment of e-waste flows

For effective cost calculation, WEEE management and recycling systems need to know how the volumes of WEEE will develop in the future. To depict or estimate quantities of WEEE, numerous methods have been applied. Many of them are modified static input output models. Lohse basically distinguishes between two models: the 'consumption and use method' and the 'market supply method'. Both methods assume a medium life-span for EEE and calculate the yearly output of WEEE with the additional data (Lohse et al. 1998).

'consumption and use method'

The 'consumption and use method' assumes a basket of EEE-commodities per household. For each product, an assumed weight is multiplied by the total number of households. By dividing this amount by the life-span, the expected annual WEEE potential is received. This method was applied to estimate the potential of WEEE generation in The Netherlands (Bureau B&G 1993).

'consumption and use method'

$$\text{WEEE generation per year} = \frac{m_n * hh * r_n}{ls_n}$$

with:

m_n medium weight per appliance n

hh number of household

r_n saturation rate with appliance n per household

ls_n medium life span of appliance n

'market supply method'

The 'market supply method' uses data on production and sales. By extrapolating the assumed life-span backwards in time, the WEEE potential is estimated from historical production and sales figures. In some studies this calculation was corrected by imports and exports data. The WEEE potential on weight basis is calculated by multiplying the number of appliances in each product group by their average weights.

For saturated markets where only product replacement occurs, the medium life-span of a product becomes irrelevant. If the 'market supply method' is applied to such situations, the numbers of obsolete appliances equals the numbers of sales minus the number of reused items.

The 'market supply method' and modified versions of it have been widely applied (ZVEI 1993, Streicher-Porte et al. 2005, Jain and Sareen 2006, Streicher-Porte 2006) and others.

'market supply method' (Nathani 1998)

$$\text{WEEE generation } (t) = N_N(t - l_{s_n})$$

$$N_N(t) = N_{NP}(t) + N_{Im}(t) - N_{Ex}(t)$$

with

$N_N(t)$: National sales of EEE of certain category in year t

l_{s_n} : medium life-span of new product

$N_{NP}(t)$: National production EEE of certain category in year t

$N_{Im}(t)$: Imports of EEE of certain category in year t

$N_{Ex}(t)$: Exports of EEE of certain category in year t

'time step method'

In addition to the 'market supply method', the European Environmental Agency also applied the 'time step method'. This involved to calculate the material flow of five different EEE categories in the former 15 EU countries. In the 'time step method' the amount of WEEE generation is calculated based on private and industrial stocks of two consecutive years and sales data. In case the stock increases the first term of the equation becomes negative. This method only applies to the calculation of identical or similar products with similar material composition. Mayor changes such as replacements of CRT monitors with LCD monitors are difficult to describe with the 'time step method'.

'time step method' (IMS 1991) cited in (Müller and Giegrich 2005)

$$\text{WEEE generation } (t) = [\text{stock}(t-1) - \text{stock}(t)] + \text{sales}(t)$$

'Carnegie Mellon method'

Matthew extended the 'market supply method', assuming a typical lifetime data for recycling and storage phases of EEE appliances. This so called 'Carnegie Mellon method' was applied to estimate the generated waste amount from PCs in the USA. According to this study, about 150 million PCs would be land filled in 2005 (Matthews et al. 1997). He introduced a cascade of processes consisting of 1. use of new products, 2. reuse of used products and 3. storage of used products. This resulted in three stocks which determine the WEEE generation during a specific year. The transfer parameters from one stock to another were kept constant. The same method was applied again in 2003, though with slightly altered parameters

'Carnegie Mellon method' (Matthews et al. 1997)

$$\text{WEEE generation } (t) = N_N(t - l_{s_n}) + N_R(t - l_{s_r}) + N_S(t - l_{s_s})$$

$$N_N(t) = N_{NP}(t) + N_{Im}(t) - N_{Ex}(t)$$

with

$N_N(t)$: National sales of EEE of certain category in year t

$N_R(t)$: Number of reused EEE of certain category in year t

$N_S(t)$: Number of stored EEE of certain category in year t

l_{s_n} : medium life-span of new product

l_{s_r} : medium life-span of reused product

l_{s_s} : medium storage period of obsolete product

All other parameteres are the same as introduced under 'time step method'

Annex M – Assessment of e-waste flows

Figure 13 shows the cascade flow of the 2003 study, illustrating the percentages in each stock from the original input (Matthews and Matthews 2003). Most notably, between 1997 and 2003 study, the lifetime estimates of new products and the percentage of PCs going to 'landfill' and 'recycling' varied. This resulted in the medium life-span of a PC being decreased from ten to nine years. This cascade model is ideal for the extensive examination of individual products, although one does need more specific data on consumer behaviour (such as life-spans) and country specific data (such as recycling percentages). This method has also been applied to estimate future volumes of generated WEEE in different kinds of appliances; -e.g. televisions, washing machines, air conditioners, refrigerators and PCs in the Philippines (Peralta and Fontanos 2006).

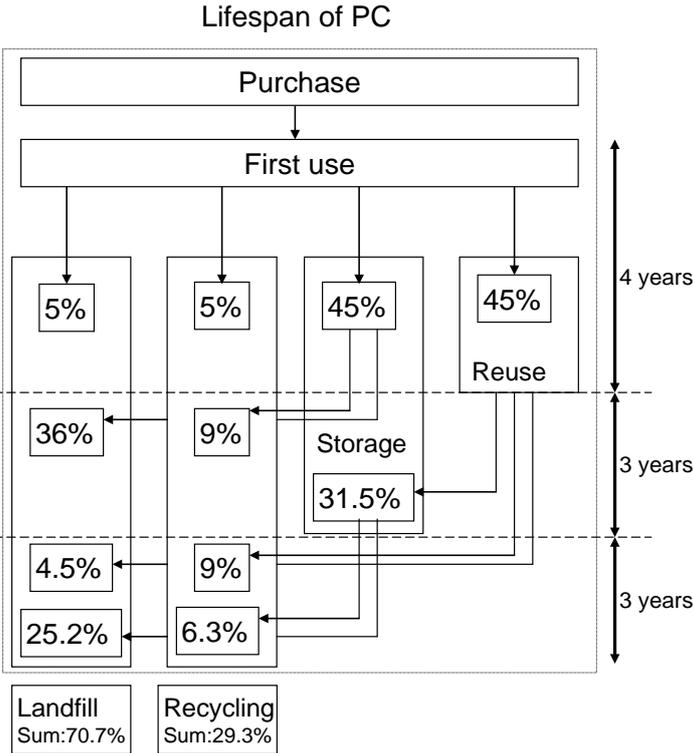


Figure 1: Pathway of a PC from purchase to end of life (data taken from Matthews et al 2003)

The calculation results of the different methods vary considerably. Apart from the methodological differences of the methods applied, they differ in their coverage of single appliances, single categories of appliances or the whole range of EEE. The studies also differ in their focus on private and/or corporate WEEE, the assumed saturation rates, and other parameters.

Source:

Martin Streicher-Porte. 2006. Material Flow Analysis and economic evaluation as tools for system design in recycling of waste from electrical and electronic equipment. Special focus on the recycling of personal computers. Dissertation: ETH No. 16957. SWISS FEDERAL INSTITUTE OF TECHNOLOGY ZURICH.

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Annex N

Detailed guideline for the assessment of social impacts

The following questions are a more detailed guideline for the evaluation of social impacts than you find in the assessment methodology. The questions should be answered, regarding the five major e-waste sub-sectors *Collection, Refurbishment, Dismantling, Material recovery, Final disposal*.

Impacts on	Question
Impacts on employees	<ul style="list-style-type: none"> • Describe major health and safety risks for workers in the different e-waste sub-sectors <ul style="list-style-type: none"> ○ Lay out the bases of this judgement (e.g. visible risks, systematic health surveys, widespread symptoms of occupational diseases) ○ Estimate the share of workers being affected by these risks in each sub-sector. ○ Describe measures to protect workers' health (e.g. masks, special training) • Describe the organisation and official status of employment in the different sub-sectors <ul style="list-style-type: none"> ○ Are enterprises usually registered or informal? ○ Describe the typical size-structure of the enterprises in each sub-sector. ○ Elaborate on the workers' possibility to take influence on their working conditions (e.g. working hours, holidays, health and safety issues, unionisation) • Check on the gender, ethnic and age composition of the workforce in each sub-sector <ul style="list-style-type: none"> ○ Share of women in each sub-sector ○ Share of women in qualified positions (Definition of "qualified position": The position requires at least reading, writing, mathematic and/or enhanced mechanical skills) ○ Share of minority ethnic groups in relation to the local population picture ○ Predominant age structure • Check whether there are cases of people being employed involuntary or by means of coercion <ul style="list-style-type: none"> ○ Special attention on vulnerable groups (e.g. illegal migrants) that might be commercially exploited • Cases of children working in the e-waste sector <ul style="list-style-type: none"> ○ Describe typical tasks for children in the e-waste sector ○ Indicate whether these activities are considered a risk to health and safety ○ Describe the age structure of the children working in the e-waste sector ○ Elaborate on working hours and general working condition of children in the e-waste sector (wages, housing, possibility to visit school, catering...)

<p>Impacts on employees</p>	<ul style="list-style-type: none"> • Lay out the wage structure of the typical types of employment in each sub-sector <ul style="list-style-type: none"> ○ State whether employees are compensated according to waste volumes treated, by hours of work, or by a fixed wage-level ○ Calculate average and lowest wage levels per hour / per day / per month. ○ Calculate wage-level per unit [ton] of e-waste treated in each sub-sector (IMPORTANT: Even if workers are compensated based on hours worked, it is also needed to analyse the labour costs per tonnes of e-waste) ○ Elaborate on additional benefits by working in the e-waste sector (e.g. free catering, free housing, possibility to sell refurbished products) ○ Indicate whether the sector provides a steady or interrupted source of income for workers • Evaluate on the length of a typical working day and working month in each sub-sector <ul style="list-style-type: none"> ○ Working hours per day ○ Rest periods or typical breaks per working day ○ Number of working days per week / month ○ Number of paid / unpaid days off (holidays) per year • Evaluate on the typical duration of employment in each sub-sectors <ul style="list-style-type: none"> ○ Indicate typical reasons for ending an employment relation in the sector (e.g. better job opportunities in other sectors, workers are dismissed because of low work performance) ○ Judge on the sector's dynamics: Is the sector likely to provide more or less jobs in the future? • Evaluate on social security schemes of each sub-sector <ul style="list-style-type: none"> ○ How many workers are covered by basic social security schemes in each sub-sector? (Health, unemployment, old-age- and disability-pension, maternity). ○ Are these social security schemes granted by the government or the employer? • Evaluate on the social recognition of employment in the different e-waste sub-sectors <ul style="list-style-type: none"> ○ What sub-sectors are perceived as dirty or unfavourable work by the employees themselves?
<p>Impacts on local communities</p>	<ul style="list-style-type: none"> • Describe the geographic setting of major e-waste treatment facilities and sites <ul style="list-style-type: none"> ○ Are major collection points, refurbishment-, recovery- or disposal sites located in or nearby populated areas or agricultural land? ○ If yes: Describe the socioeconomic set-up of the settlement (economic basis, typical kind of housing-structure, population density (above / below local average), distance to e-waste treatment sites). • Describe major health and safety risks for the local population by each sub-sector <ul style="list-style-type: none"> ○ Lay out the bases of this judgement (e.g. visible risks, systematic health surveys, widespread symptoms of e-waste related diseases) ○ Estimate the number of residents being affected by these risks. ○ Describe measures by the community, the government and the industry to protect the residents' health. • Estimated the local economic importance of each e-waste sub-sector

Annex N – Social Impacts

	<ul style="list-style-type: none"> ○ Number and share of local population active in / dependent on the e-waste sector ○ Description of the sector's role in local social and economic development (e.g. stimulating local economic growth, resulting hindrances for other economic activities) ○ Local perception of the e-waste sector (e.g. predominantly beneficial, regarded with suspicion)
<p>Impacts on society</p>	<ul style="list-style-type: none"> • Absolute number of jobs provided by each sub-sector and the total e-waste sector in the country • Indicate risks of corrupt practices in the industry based on expert judgement, qualitative interviews and / or press reporting • Estimate the sectors' contribution to the national economy <ul style="list-style-type: none"> ○ Estimate the sector's monthly / annual value creation based on data for revenues by the sale of refurbished equipment and recovered parts and materials. • Indicate whether the sector was subject to any political dispute leading to conflicts <ul style="list-style-type: none"> ○ Also check whether the e-waste sector was part of larger conflict cases (e.g. conflict over land-use-changes or massive pollution of agricultural land due to industrialisation)
<p>Additional information</p>	<p>This information can be derived from the collected data. Since these indicators are crucial for further impact analysis and data interpretation, the calculation should be made transparent. Furthermore the accuracy of the calculation should be cross-checked by two different calculation methodologies</p> <ul style="list-style-type: none"> • Number of working hours per unit of e-waste treated in each sub-sector (e.g. 5.5 h/t in e-waste collection) <ul style="list-style-type: none"> ○ First calculation method on national scale: Number of workers x number of working hours per worker / amount of e-waste ○ Second calculation method on individual scale: Median of data on individual basis: Amount of e-waste treated by one worker in a certain time • Labour costs per unit of e-waste treated in each sub-sector (e.g. 8 \$/t in e-waste collection) <ul style="list-style-type: none"> ○ First calculation method on national scale: (total annual sector revenues – estimated investments and running costs for material, rent, taxes...) / total annual amount of e-waste ○ Second calculation method on individual scale: Median of data on individual basis: Wage per day / amount of e-waste treated per day

Annex O

Example of downstream market infrastructure

The following table presents a summary of recycling options in a developing country for different waste streams generated by a personal computer.

Material fraction	Recycling and disposal in Country	Possible downstream partners	Comments
Plastic	partially		Needs investments for upgrading the local recyclers Selling the fraction generates income
Ferrous metals	yes		Selling the fraction generates income
Aluminum	yes		Selling the fraction generates income
Copper	partially		Cable dismantling technique unclear (possibility that cables are burned for copper recovery) Selling the fraction generates income Exporting bears the danger of stimulating copper robbery
Printed wiring boards (PWB containing precious metals)	no	Not available in Uganda, export to Europe or Asia.	Although PWB need to be transported to the next harbour it is expected that the sale of these fraction to a global refinery can generate income Finding a partner e.g. in a neighbouring country could be an advantage.
CRT tubes (containing lead, beryllium, phosphor, etc.)	no	Needs a hazardous waste treatment facility (special incineration or controlled landfill) which is not available Export to Europe	Metal smelters might be able to use CRT glass partially as a substitute for sand as a fluxing material. However the environmental impacts of such a solution would have to be evaluated carefully. A metal smelter might take the tubes for free. Otherwise the tubes need to

Annex O – Example of downstream market infrastructure

Material fraction	Recycling and disposal in Country	Possible downstream partners	Comments
			be exported to specialized recycling companies e.g. in Europe, which is costly.
Hazardous fraction (PCB in capacitors, mercury in backlights, batteries)	no	Needs a hazardous waste treatment facility (special incineration or controlled landfill) which is not available, smaller capacitors and batteries can be left on the PWB when sold to international smelters. Export to Europe	Needs either investment into a local hazardous waste treatment facility or needs to be exported to specialized facilities abroad (e.g. to Europe)

Annex P

The Durban Declaration on e-Waste Management in Africa

The Durban Declaration on e-Waste Management in Africa

We, the participants at the e-waste workshop held during WasteCon2008 in Durban South Africa, signatories of this declaration,

- (i) recognise the importance of optimizing the life cycle of electric and electronic equipment (EEE), e.g., by improving supply chains, optimising life spans, closing material loops and reducing contamination;
- (ii) are concerned about environmental and health issues related to current recycling and disposal practices of waste electric and electronic equipment (WEEE or e-waste);
- (iii) are aware of the global socio-economic opportunities which processing e-waste presents;
- (iv) are concerned about growing global disparities due to unequal access to EEE (e.g. in the case of Information and Communication Technologies resulting in a 'digital divide');
- (v) are aware of the importance that public perception has towards a sustainable solution of the e-waste problem; and
- (vi) recognise the importance of local, regional and global partnerships between companies, governmental and non-governmental organisations and academic institutions in addressing the e-waste problem.

(in agreement with the MoU of "Solving the e-Waste Problem" StEP)

We have elaborated on the main issues related to an improvement of the current e-waste management practices encountered on the African continent. Based on our experiences from Kenya, Morocco, Senegal, South Africa and Uganda we feel the issues are sufficiently generic and of equal concern to the other African countries. We discussed possible ways and means to tackle the issues. We avoided the formulation of ready made implementable solutions as it was agreed that every country requires its own process to define a roadmap related to specific projects. Our suggested recommendations are as follows:

- improve cooperation among stakeholders (a) by ensuring the right level of African representation in relevant international fora (e.g. StEP, PACE), (b) by establishing African regional platforms and/or an e-waste forum in cooperation with established African networks and international bodies such as the African Roundtable on Sustainable Consumption and Production (ARSCP) and the European WEEE forum, and (c) by identifying with relevant initiatives, learning from them and utilising their expertise;
- establish an institutional framework (a) by initiating a suitable process that will accommodate negotiation amongst relevant stakeholders within local, national, regional and global levels, and (b) by identifying and/or creating appropriate institutions to allocate the responsibilities, objectives and schedules within the e-waste sector;
- create awareness at all levels of governance and the general public (a) by making information available through appropriate means (e.g. websites, training, campaigns), and (b) by identifying and targeting the right audience with tailored solutions (e.g. schools, vocational/technical institutes, the informal sector, governments, and the general public) towards commitment to sustainable e-waste management;

Annex P – Durban declaration

- support markets (a) by identifying, quantifying, and evaluating existing down-stream material markets and alternative material flows, (b) by sharing of information on new technologies for optimised resource recovery, and (c) by promoting fair local e-waste markets wherever possible;
- collect and manage data (a) by establishing a process for data acquisition which allows for design, monitoring and control of e-waste management, (d) setting up a mechanism for continuous update of these data, and (c) by using data for transparent decision making and system improvements;
- develop a legal framework (a) by reviewing existing legislations in order to enforce sound e-waste management, (b) by highlighting permitting or licensing requirements for improved compliance to existing legislation, (c) by promoting policies that meet the minimum of legislative requirements, (d) by implementing a system of minimum requirements, and (e) by amending existing waste management legislation to allow for a regulation on e-waste management;
- develop a qualified and efficient e-waste recycling sector (a) by documenting tested and best available processes and practises, (b) by developing and improving skills and competencies through training, (c) by satisfying the need for business models to ensure appropriate investments on the right technological and geographical level, (d) by connecting existing and new processes in the e-waste stream in so-called green e-waste channels, and (e) by ensuring continuous improvement of the infrastructure through the establishment of standards and auditing procedures.

In order to formulate National Action Plans we recommend applying the process as applied in the pilot initiatives in Kenya, Morocco, Senegal, South Africa and Uganda, i.e. evolving mechanisms and strategies for developing and implementing the following activities:

- (i) creating a National working group including all relevant stakeholders;
- (ii) integrating the work of the working group with that of existing international networks;
- (iii) conducting a baseline assessment and publicly share the data;
- (iv) proposing a roadmap based on the findings of the national work group;
- (v) examine synergies with neighbouring countries;
- (vi) developing feasibility studies;
- (vii) implementation and evaluation of pilot activities.

The subsequent implementation of the National Action Plan results in a formalised and sustainable e-waste management system.

The signatories, Durban 9 October 2008:

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