Where are WEee in Africa?

FINDINGS FROM THE BASEL CONVENTION E-WASTE AFRICA PROGRAMME

BASEL CONVENTION

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List of abbreviations

BCCC	Basel Convention Coordinating Center
BCRC	Basel Convention Regional Center
BDEs	Brominated diphenyl ethers
CFCs	Chlorofluorocarbons
COP	Conference of the Parties
CRT	Cathode-ray tube
ECOWAS	Economic Community of West African States
EEE	Electrical and electronic equipment
EMPA	Swiss Federal Laboratories for Materials Science and Technology
ESM	Environmentally sound management
EU	European Union
GDP	Gross Domestic Product
HCFCs	Hydrochlorofluorocarbons
ICT	Information Communication Technology
IMPEL	European Union Network for the Implementation and Enforcement of Environmental Law
ITU	International Telecommunication Union
LASEPA	Lagos State Environmental Protection Agency
LAWMA	Lagos Waste Management Authority
MPPI	Mobile Phone Partnership Initiative
NESREA	National Environmental Standards and Regulations Enforcement Agency
NVMP	Dutch Recyclers Association
OECD	Organisation for Economic Cooperation and Development
Öko-Institut	Institute for Applied Ecology
PACE	Partnership for Action on Computing Equipment
PBBs	Polybrominated biphenyls
PBDEs	Polybrominated diphenyl ethers
PCBs	Polychlorinated biphenyls
POPs	Persistent Organic Pollutants
PWB	Printed wiring board
SAICM	Strategic Approach to International Chemicals Management
SBC	Secretariat of the Basel Convention
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WEEE	Waste electronic and electrical equipment

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Glossary of terms[1]

- **Bamako Convention**
  Convention on the Ban of the Import into Africa and the Control of the Transboundary Movement and Management of Hazardous Wastes within Africa; adopted in 1991 and entered into force in 1998.
- **Basel Convention**
  Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; adopted in 1989 and entered into force in 1992.
- **Component**
  Element with electrical or electronic functionality connected together with other components, usually by soldering to a printed wiring board, to create an electronic circuit with a particular function (for example, an amplifier, radio receiver or oscillator).
- **Competent authority**
  One governmental authority designated by a Party to be responsible, within such geographical areas as the Party may think fit, for receiving the notification of a transboundary movement of hazardous wastes or other wastes, and any information related to it, and for responding to such a notification, as provided in Article 6 (Article 2, paragraph 6 of the Convention).
- **Computing Equipment**
  Computing equipment includes: personal computers (PCs) and associated displays, printers and peripherals, personal desktop computers, including the central processing unit and all other parts contained in the computer; personal notebooks and laptop computers, including the docking station, central processing unit and all other parts contained in the computer; computer monitors, including the following types of computer monitors: (a) cathode-ray tube, (b) liquid crystal display, (c) plasma, computer keyboard, mouse, and cables; the following types of computer printers: (a) dot matrix, (b) ink jet, (c) laser, (d) thermal, and (e) including any computer printers with scanning or facsimile capabilities, or both.
- **Direct re-use**
  Continued use of electrical and electronic equipment and components by another person without the necessity of repair, refurbishment, or (hardware) upgrading, provided that such continued use is for the original intended purpose of the equipment and components.
- **Disposal**
  Any operations specified in Annex IV of the Basel Convention (Article 2, paragraph 4 of the Convention).
- **EEE**
  Electrical and electronic equipment. Equipment which is dependent on electric currents or electromagnetic fields in order to work properly.
- **End-of-life EEE**
  Individual equipment that is no longer suitable for use, and which is intended for dismantling and recovery of spare parts or is destined for material recovery and recycling or final disposal. It also includes off-specification or new equipment which has been sent for material recovery and recycling, or final disposal.

[1] This list has been composed for the purpose of this publication and should not be considered as being legally binding. Nor have these terms been agreed internationally. The purpose of the glossary of terms is to assist readers to better understand certain terminology. Where applicable, the terms in this glossary correspond with the glossary of the Mobile Phone Partnership Initiative (MPPI) and the Partnership for Action on Computing Equipment (PACE). The PACE Guidance Document on the Environmentally Sound Management of Used and End-of-Life Computing Equipment (including the glossary) in particular its sections 1, 2, 4, and 5 was adopted at COP 10 in October 2011. Section 3 dealing with transboundary movements will be taken into account in the further development of the technical guidelines on transboundary movement of e-waste.

- **ESM**
  Environmentally sound management. Taking all practicable steps to ensure that used equipment and/or e-wastes are managed in a manner which will protect human health and the environment.
- **Essential key function**
  The originally intended function(s) of a unit of equipment or component that will satisfactorily enable the equipment or component to be re-used.
- **E-waste or WEEE**
  Electrical and electronic equipment that is no longer suitable for use or that the last owner has discarded.
- **Final disposal**
  Relevant operations specified in Annex IV A of the Basel Convention.
- **Focal Point**
  The entity of a Party, referred to in Article 5 of the Basel Convention, which is responsible for receiving and submitting information as provided for in Articles 13 and 16 of the Convention.
- **Fully functional**
  Equipment is fully functional when it has been tested and demonstrated to be capable of performing the essential key functions it was designed to perform.
- **Illegal traffic**
  Any transboundary movement of hazardous wastes or other wastes as specified in Article 9 of the Basel Convention.
- **Inspection**
  A process of careful examination. In most cases it is carried out physically. The purpose is to gather proof and evidence of non-compliance in order to impose a fine or to file a court case.
- **Material Recovery**
  Relevant operations specified in Annex IV B of the Basel Convention.
- **MEA**
  Multilateral Environmental Agreement, for example, Rotterdam Convention, Basel Convention, Bamako Convention.
- **Mobile phone**
  (sometimes called a cellular phone or cell phone): portable terminal equipment used for communication and connecting to a fixed telecommunications network via a radio interface (taken from International Telecommunication Union K.49 (00), 3.1). Modern mobile phones can receive, transmit and store: voice, data, and video.
- **Notification procedure**
  Procedure of prior informed consent requiring the notifier to obtain consent from the relevant competent authorities prior to export by completing notification and movement documents as outlined in Basel Convention and European Waste Shipments Regulation.
- **Penetration rate**
  Installed units of EEE per capita
- **PIC procedure**
  Procedure based on prior informed consent, also known as the notification procedure (see above).
- **Recycling**
  Relevant operations specified in Annex IV B of the Basel Convention.
- **Recovery**
  Relevant operations specified in Annex IV B of the Basel Convention.

- **Refurbishment**
  Process for creating refurbished or reconditioned equipment including such activities as cleaning, data sanitization, and (software) upgrading.
- **Repair**
  Process of fixing specified faults in equipment to enable the equipment to be used for its original intended purpose.
- **Re-use**
  Process of using again used equipment or a functional component from used equipment in the same or a similar function, possibly after refurbishment, repair or upgrading.
- **Risk Profiling**
  Using various methods (such as the use of intelligence and analysis of statistical data) to identify the likelihood of a container containing waste and/or a company illegally exporting waste.
- **Rotterdam Convention**
  Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; adopted in 1998 and entered into force in 2004.
- **State of export**
  A Party to the Basel Convention from which a transboundary movement of hazardous wastes or other wastes is planned to be initiated or is initiated.
- **State of import**
  A Party to the Basel Convention to which a transboundary movement of hazardous wastes or other wastes is planned or takes place for the purpose of disposal therein or for the purpose of loading prior to disposal in an area not under the national jurisdiction of any State.
- **Stockholm Convention**
  Stockholm Convention on Persistent Organic Pollutants; adopted in 2001 and entered into force in 2004.
- **Transboundary movement**
  Any movement of hazardous wastes or other wastes from an area under the national jurisdiction of one State to or through an area under the national jurisdiction of another State or to or through an area not under the national jurisdiction of any State, provided at least two States are involved in the movement.
- **Treatment**
  Any physical, chemical or mechanical activity in a facility that processes computing equipment including dismantling, removal of hazardous components, material recovery, recycling or preparation for disposal.
- **Used EEE**
  Used electrical and electronic equipment. Equipment which its owner does not intend to use any longer, which is fully functional and which is not classified as e-waste.
- **Waste(s)**
  Substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law (Article 2, paragraph 1 of the Basel Convention).
- **Waste generator**
  Anyone whose activities produce waste.
- **WEEE-Directive (2002)**
  Directive (EC) 2002/96 of the European Parliament and the Council on Waste Electrical and Electronic Equipment.
- **Waste Shipments Regulation**
  Regulation (EC) 1013/2006 of the European Parliament and the Council on Shipments of Waste.

Executive summary

Growing role of ICT in Africa

Information Communication Technology (ICT) has revolutionized modern living, international business, global governance, communication, entertainment, transport, education, and health care. This has been driven by unprecedented high volumes of production and usage of consumer electronic products, in particular, personal computers, mobile phones, and television sets. Access to ICT has been identified as an indicator of a country's economic and social development. The difference in access to ICT between developed and developing countries is commonly referred to as the "digital divide". Africa has been undergoing rapid ICT transformation in recent years, attempting to bridge this divide by importing second-hand or used computers, mobile phones, and TV sets from developed countries. The countries of the region, however, lack the infrastructure and resources for the environmentally sound management (ESM) of electrical and electronic waste (e-waste) arising when such imports reach their end-of-life.

What is in e-waste?

The uncontrolled large quantities of e-waste generated by this electrical and electronic equipment (EEE) are of particular concern as EEE contains hazardous substances (e.g. heavy metals such as mercury and lead, and endocrine disrupting substances such as brominated flame retardants). On the other hand, EEE also contains materials of strategic value such as indium and palladium; and precious metals such as gold, copper and silver: these can be recovered and recycled, thereby serving as a valuable source of secondary raw materials, reducing pressure on scarce natural resources, as well as minimizing the overall environmental footprint.

Trends of EEE imports, use, and e-waste generation in West Africa

National e-waste assessments prepared in Benin, Côte d'Ivoire, Ghana, Liberia, and Nigeria investigated the situation with regard to e-waste looking into, *inter alia*, trends of EEE imports, use and e-waste generation. These trends are analyzed in the scope of more general economic and societal indicators, taking into account factors such as the Human Development Index, electrification rate, GDP per capita and the number of mobile phone subscribers and internet users.

The use of EEE is still low in Africa compared to other countries in the world, but it is growing at a staggering pace. In the last decade for instance, the penetration rate of personal computers has increased by a factor of 10, while the number of mobile phone subscribers has increased by a factor of 100. The penetration rate[2] signifies that due to the intense trade of used EEE, people have better access to lower priced EEE. From this perspective, the import and trade of used EEE is in support of the UN Millennium Development Goals as a means to foster the use of ICT for sustainable development.

Aside from domestic consumption, the e-waste problem in West Africa is exacerbated by an ongoing stream of used EEE from industrialized countries. Although the majority of this imported equipment is destined for re-use after

[2] For countries in which national e-waste assessment were undertaken, the use of EEE varies between 4.6 kg (Liberia), 4.8 kg (Côte d'Ivoire), 6.3 kg (Benin), 41 kg (Ghana), and 44 kg (Nigeria) per inhabitant.

testing and repair, there are significant volumes that prove unsuitable for re-use and further add to local e-waste generation. Statistical data and field research suggest that West Africa serves as the major trading route of used EEE into the African continent, with Ghana and Nigeria as the main import hubs.

Despite difficulties in obtaining data on new and used EEE as statistical data does not distinguish between these two categories of products, the studies in Ghana, for example, revealed that in 2009 around 70% of all imports were used EEE. 30% of the used EEE imported was determined to be non-functioning (hence should have been defined as e-waste): half of this amount was repaired locally and sold to consumers and the other half was un-repairable.

It is unclear how much of the remaining imported used EEE functioned for a reasonable time after it was sold. This so called "near-end-of-life" equipment can be another major source of e-waste which was imported into West African countries as equipment but turned into waste in a relatively short time. However, it is assumed that in 2010 between 50 - 85% of e-waste was domestically generated out of the consumption of new or used EEE of good quality with a reasonable life-span. For the five selected West African countries, this is between 650,000 and 1,000,000 tonnes of domestic e-waste generated per annum, which at a certain point needs to be managed.

Countries with high imports of used EEE, like Ghana and Nigeria, generate the highest volumes of e-waste. This is due to the direct import of non-functioning and non-repairable used EEE or e-waste and the lower life-span of (functioning) used EEE compared to new EEE. It should be mentioned that in absolute numbers, Nigeria dominates the region in the total amount of used and new EEE imports, total number of EEE in use and the subsequent total amount of e-waste generated. Collection rates vary among the countries and reach up to 95% in the case of Ghana. Almost all of the collected material reaches the informal recycling sector.

Impacts of recycling practices on human health, the environment and climate change

Informal activities in the e-waste recycling chain are present in all of the countries studied and include collection, manual dismantling, open burning to recover metals and open dumping of residual fractions. While in some countries these activities are performed by individuals with a low material throughput (Benin and Liberia), Côte d'Ivoire, Ghana and Nigeria reveal an organized informal sector with medium to high volumes of processed materials (e.g. steel, aluminum and copper).

Emissions from informal recycling activities are problematic in these countries and their impacts on human health and the environment are evident. The major environmental and human health impacts from recycling practices in West Africa result mainly from the processes of dismantling, material recovery and final disposal. During collection, refurbishment and repair of EEE, negative impacts are present, but are generally at a significantly lower level. The burning of cables is seen as one practice with the most direct severe impact on human health and the environment. Bearing in mind that cable burning from EEE disassembly most probably occurs in all West African countries, this is a major source of dioxin emissions.

A whole range of valuable metals like palladium, gold, silver, indium and germanium that are contained in EEE are lost if not recovered at an early stage of waste treatment. Current recycling practices mainly focus on the recovery of steel, aluminum and copper and are quite inefficient for other metals.

Primary production, i.e. mining, concentrating, smelting and refining, especially of precious and rare metals, is energy intensive and has a significant impact on climate change as a result of high carbon dioxide (CO_2) emissions. "Mining" our old computers to recover the metals contained therein – if performed in an environmentally sound

manner – requires only a fraction of this energy input. Furthermore, the environmentally sound management of end-of-life refrigerators, air conditioners and similar equipment is significant in mitigating the climate change impacts as the ozone depleting substances in these devices, such as chlorofluorocarbons and hydrochloroflyorocarbons, have a high global warming potential.

Socio-economic aspects of the e-waste sector in Ghana and Nigeria

Another important aspect of e-waste is found in its socio-economic dimension. In-depth socio-economic studies were carried out in Nigeria and Ghana to investigate the operations and sustainability impacts of the refurbishing and e-waste recycling sectors. In addition, currently practiced recycling technologies were compared with best available technologies and analyzed on the basis of their applicability in the West African context. As a result, "best applicable technologies"[3] were proposed for implementation in Nigeria and Ghana. Here, particular emphasis was on systems and technologies that yield multiple gains in the field of environmental protection, working conditions and employment creation, as well as in general economic terms.

The research revealed that there are some specific similarities between the refurbishing and recycling sectors in Nigeria and Ghana. In both countries, there is a well-organized repair and refurbishing sector that is focused on used equipment either from imports or from domestic sources such as businesses and households. In both Accra (Ghana) and Lagos (Nigeria), this refurbishing sector generates income for more than 30,000 people. The refurbishing sector operates partly under formal conditions as many of the enterprises that serve this sector are registered with the local authorities and pay taxes to local and regional administrations.

In contrast, collection and recycling of e-waste is almost exclusively carried out by non-registered individuals widely referred to as "scavengers". In Nigeria and Ghana, informal collection and recycling is mostly carried out by migrants from the rural areas in the north of the respective countries, where populations have few alternatives to small-scale agriculture and where rainfall variability causes food shortages.

Research also focused on the conditions of workers in the e-waste sector. For example, in the informal collection and recycling of e-waste, daily revenues vary greatly from between US$ 0.22 and US$ 9.50. This income has, in most cases, to be shared with other family members and is only earned on economically active days and not during periods of sickness or other emergencies. Therefore, it is concluded that a significant segment of e-waste workers in Nigeria and Ghana live below the internationally defined poverty line of US$ 1.25 per day. In the refurbishing sector, salaries range between US$ 2.20 and US$ 22 per day. Here, the highest incomes are achieved by workshop owners, while employees typically earn less than US$ 4.00 per day.

The comparison of currently practiced recycling technologies with best available recycling technologies showed that there is considerable potential for improvement in the field of ICT recycling. For example, in the countries studied, discarded equipment such as desktop PCs are mainly dismantled to recover steel, aluminum and copper. However, precious metals contained in printed wiring boards (PWBs) of such equipment are rarely collected and when they are, are sold below world market prices to traders that organize exports to Asian recycling facilities.

Hence there is an opportunity for West African countries to gather higher volumes of PWBs in order to be able to participate in a fair international commodity trade. In the recycling of ICT equipment, adequate volumes and

[3] For the purpose of this publication, the term "best applicable technology" is used instead of the commonly used term "best available technology (BAT)". The term "best applicable technology" means a technology, including skills and processes, which is best suited to the West African context. In terms of conventional terminology, "best applicable technology" might not be equivalent to "best available technology (BAT)".

quality levels can be achieved by manual dismantling and without significant investment in processing machinery. Appropriate health and safety measures for those involved in recycling, as well as environmentally sound practices, should be ensured. Thus optimized ICT recycling could be a key area of sustainable e-waste management in Nigeria and Ghana that has the potential to reduce environmental impacts, as well as generating jobs and sustainable incomes.

Flows of EEE and e-waste between Europe and West Africa

As part of the overview of the trade chain of used EEE between developed countries and West Africa, the studies also examined flows of EEE (and in some cases e-waste) between selected European countries and West Africa.

When analyzing the pathways of used EEE in Europe from the formal to the informal sector, it was found that brokers and traders are key players in this regard. Generally, the EEE export market is quite diverse, ranging from small family-based networks to large and well-organized trading firms. Often, immigrants or temporary residents from African countries engage in creating small trading businesses serving the European – African trade routes. Traders of used vehicles also play a role in this trade as used EEE and e-waste is often co-loaded with used cars and trucks destined for export to West Africa.

The ports of Amsterdam and Antwerp were used as examples of gateways for used EEE. In both ports, used EEE is often declared as “second-hand goods”, “private goods”, “for charities”, “for personal use”, “miscellaneous” and “effets personnels” (referring to EEE as second-hand goods, etc.). In order to disguise illegal exports, even the labeling of used EEE itself is sometimes manipulated (e.g. false codes for used refrigerators or removal of generators of used refrigerators in order to classify them as “not-containing CFCs”) and customs declarations are given to the competent authorities only on the day the ocean carrier is to leave the port. In Antwerp, there are even agents specialized in the export of used EEE. Both the Dutch and Belgian port authorities emphasize that personnel and financial limitations are severe obstacles to achieving better export control of the problematic shipments of used and end-of life EEE.

This study offers interesting findings on flows of used EEE and e-waste between Europe and West Africa. For example, Nigeria was found to be the most dominant importing country of EEE and vehicles (both new and used), followed by Ghana, whereas the UK is the dominant exporting country for EEE, followed with a large gap by France and Germany.

Transboundary movements of used EEE and e-waste

Transboundary movements of e-waste are subject to the control mechanism under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. E-waste is listed in Annex VIII as A1180 (hazardous waste) and Annex IX as B1110 (non-hazardous waste) of the Convention. According to its provisions, transboundary movements of hazardous wastes can only take place after the prior informed consent procedure has been followed and all states involved have given their consent to the transboundary movement. Shipments which do not meet these requirements are illegal and such traffic is criminalized under the Convention. In addition, the provisions of the Waste Shipment Regulation of the European Union label the export of waste with hazardous characteristics from Europe to any non–OECD country as illegal.

In the case of transboundary movements of used EEE and e-waste, there are several challenges related to the enforcement of Basel provisions. This includes the challenges of clear distinction between used EEE and e-waste and between hazardous and non-hazardous waste, as well as the overall challenge of monitoring and enforcing the Basel Convention and the Waste Shipment Regulation.

Conclusions and recommendations

Knowledge generated through the numerous studies and activities of the E-waste Africa project is presented in the form of conclusions and recommendations primarily for stakeholders in the project partner countries, but also for stakeholders in other African countries and those who are concerned with the e-waste issue and are interested in seeking sustainable solutions.

One major challenge for West African countries is to prevent the import of e-waste and near-end-of-life equipment without hampering the socio-economically valuable trade of used EEE of good quality. In addition, high volumes of domestically generated e-waste require well-functioning local take-back and recycling systems. Challenges include the establishment of appropriate collection strategies, ensuring that high volumes of valuable and non-valuable waste fractions are collected equally and that those fractions reach appropriate treatment and disposal facilities. In addition, connecting informal collectors to a formal recycling structure is pivotal, along with appropriate capacity building and training.

Locally adapted recycling technologies for West Africa should make use of the abundant labor force instead of deploying expensive shredding and sorting machinery. To ensure a maximum yield of valuable recycling fractions, West African recyclers should be encouraged to interlink with international recycling companies and networks to develop market outlets for their pre-processed e-waste fractions for a maximized return of value for secondary raw materials. A sustainable e-waste management system would also need an adequate financing scheme, a level playing field and appropriate market incentives. It is thought that similar to policies in OECD countries, e-waste recycling systems in Africa could be developed in line with the principle of Extended Producer Responsibility.

Chapter 1. Introduction

1.1 The expanding role of ICT in Africa

Information Communication Technology (ICT) has revolutionized modern living, international business, global governance, communication, entertainment, transport, education, and health care. This has been driven by unprecedented high volumes of production and usage of consumer electronic products, in particular, personal computers, mobile phones, and television sets. Access to ICT has been identified as an indicator of a country's economic and social development.


Credit: Togo

At the World Summit on the Information Society held in Tunis in November 2005, delegates of 174 countries, including 50 African countries, agreed that ICTs can support economic, social and cultural development and reaffirmed that "everyone can benefit from the opportunities ICTs can offer, by recalling that governments, as well as private sector, civil society and the United Nations and other international organizations, should work together to improve access to information and communication infrastructure and technologies […]".

Africa has been undergoing rapid ICT transformation in recent years, attempting to bridge the "digital divide" by importing second-hand or used computers, mobile phones, and TV sets from developed countries. This transformation has been supported by drastic changes in the sector such as privatization of the main public operators, an investment boom in mobile networks, the introduction of new private operators and the development of new technologies particularly well suited for the African environment. The Secretary-General of the International Telecommunications Union (ITU), Dr. Hamadoun Touré, believes that access to broadband technology is the key to the continent's advancement.

As a consequence of the ICT expansion in Africa, the consumption of electrical and electronic equipment (EEE) is increasing rapidly all over Africa. This rapid advancement has led to corresponding increases in volumes of e-waste. E-waste or waste electronic and electrical equipment (WEEE)[4], is equipment that is no longer suitable for use, and which is intended for dismantling and recovery of spare parts or is destined for material recovery and recycling or final disposal. It also includes off-specification or new equipment which has been sent for material recovery and recycling, or final disposal.

High volumes of e-waste, together with the absence of environmentally sound management systems for this particular waste stream, have manifold impacts on the environment, local communities and the economic system. While in some countries in West Africa obsolete EEE undergoes some basic form of recycling, many e-waste

[4] Terms "e-waste" and "WEEE" are used inter-changeably throughout this publication.

fractions cannot be managed properly, which has led to the accumulation of large volumes of hazardous waste in and around major refurbishing and recycling centers. Furthermore, some recycling practices – like the open burning of cables and plastic parts – can lead to severe emissions of pollutants, such as heavy metals and dioxins.

Electrical and electronic equipment contains a whole range of valuable metals like copper, palladium, gold, silver, indium and germanium that are lost if not recovered at an early stage of waste treatment. Current recycling practices mainly focus on the recovery of steel, aluminum and copper, and can be quite inefficient for other metals. On a global perspective, this loss of scarce metals has to be compensated for by intensified mining activities, which again leads to severe sustainability impacts in mining areas worldwide.

When e-waste is managed in an environmentally sound manner, aside from the positive impact on resource management, it also contributes to reducing greenhouse gas emissions. Primary production, i.e. mining, concentrating, smelting and refining, especially of precious and rare earth metals, is energy intensive and hence has a significant impact on climate change as a result of high emissions of carbon dioxide (CO_2). "Mining" our old computers to recover the contained metals – if done in an environmentally sound manner – needs only a fraction of this energy input (Hagelüken & Meskers 2008). Furthermore, the environmentally sound management of end-of-life refrigerators, air conditioners and similar equipment is significant in mitigating the climate change impact as the ozone depleting substances in these devices, such as CFCs and HCFCs, have a high global warming potential.

Apart from domestic consumption, the e-waste problem is aggravated by an ongoing stream of used and obsolete electrical and electronic equipment to West Africa from industrialized countries. Although the majority of this imported equipment is destined for re-use after testing and repair, there are significant volumes that prove unsuitable for re-use and further add to local e-waste generation.

Lastly, collection, refurbishing and recycling of all types of electrical and electronic equipment has become an important economic activity providing income for thousands of small, partly informal enterprises in urban West Africa. Considering the high unemployment rate, it becomes clear that any reform of the sector requires a careful investigation of its environmental, economic and social impacts.

1.2 Policy and legislation relevant to e-waste at the international and regional levels

At the international and regional levels, efforts have been made to adopt policies and legislation addressing e-waste. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention), is the most relevant existing international agreement to address efforts to deal with the e-waste challenge, especially with regard to e-waste going for recycling, recovery and disposal.

The Basel Convention is the only global treaty controlling transboundary movements and requiring the environmentally sound management of hazardous and other wastes[5]. E-waste is listed in Annex VIII as A1180 (hazardous waste) and Annex IX as B1110 (non-hazardous waste) of the Convention. Specifically, e-wastes are characterized as hazardous wastes under the Convention when they contain components such as accumulators and other batteries, mercury switches, glass from cathode-ray tubes (CRTs) and other activated glass, PCB-containing capacitors or when contaminated with cadmium, mercury, lead or PCBs. In addition, precious metal

[5] "Other wastes" are wastes covered under Annex II of the Basel Convention which include wastes collected from households and residues arising from the incineration of household wastes.

ash from the incineration of printed wiring boards, LCD panels and glass waste from CRTs and other activated glasses are characterized as hazardous wastes. The plastics associated with e-wastes may also be covered under Annex II of the Basel Convention which addresses household wastes.

Since 2002, the Conference of the Parties (COP) to the Basel Convention has recognized e-waste as a priority issue and has adopted measures to address it, including the establishment of unique public-private partnership programmes on mobile phones and computing equipment. In 2006, the eighth meeting of the COP adopted the Nairobi Declaration on the Environmentally Sound Management of Electrical and Electronic Waste which called for more structured and enhanced efforts towards achieving global solutions for management of e-waste problems.

There was a general understanding that any solution addressing e-waste issues needs to consider a life-cycle approach. This was also recognized by the second session of the SAICM International Conference on Chemicals Management in May 2009 when the issue of "hazardous substances within the life cycle of electrical and electronic products" was adopted as one of the four emerging policy issues by the omnibus resolution II/4.

Another global treaty which addresses some aspects of e-waste management is the Stockholm Convention on Persistent Organic Pollutants, 2001 (POPs). Several persistent organic pollutants regulated under this Convention have been widely used in the manufacture of components of electrical and electronic equipment, namely those made of plastic. Under the Stockholm Convention, articles containing such chemicals have to be identified and disposed of in an environmentally sound manner upon becoming waste. In addition, several other chemicals which are regulated by the Stockholm Convention, in particular dioxins and furans, are generated unintentionally through the open burning of e-waste. The Convention requires the adoption of a number of measures to reduce the total releases of such chemicals (see also section 2.4 of chapter 2).

At the regional level, the Bamako Convention on the Ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, 1991 (Bamako Convention) serves as a treaty of African nations prohibiting the import of any hazardous, including radioactive, waste. The Convention was negotiated by twelve nations of the Organization of African Unity at Bamako, Mali, in January 1991, and entered into force in 1998.

The Bamako Convention uses a format and language similar to that of the Basel Convention, but it is broader as it incorporates the prohibition of all imports of hazardous waste into those countries which are Parties. Additionally, unlike the Basel Convention, Bamako does not exclude certain hazardous wastes (e.g. radioactive wastes).

Progressive legislation regulating e-waste has been adopted in the European Union (EU). EU legislation restricting the use of hazardous substances in electrical and electronic equipment (Directive 2002/95/EC) and promoting the collection and recycling of such equipment (Directive 2002/96/EC) has been in force since 2005. The first Directive requires heavy metals such as lead, mercury, cadmium, and hexavalent chromium, and two types of flame retardants (polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE)) to be substituted by safer alternatives. The latter Directive provides for the creation of collection schemes whereby consumers return their used e-waste free of charge. The objective of such schemes is to increase the recycling and/or re-use of such products.

1.3 Brief information on the E-waste Africa programme

The preliminary results and findings presented in this publication have been generated in the framework of the Basel Convention E-waste Africa programme, which aims at enhancing the environmental governance of e-wastes and creating favourable social and economic conditions for partnerships and small businesses in the recycling

sector in Africa. The initial phase of the programme consists of the E-waste Africa project and complementary activities triggered by the project and implemented by partner organizations. Following completion of the E-waste Africa project, follow-up activities are expected to be carried out supporting countries in the region to address e-waste issues.

The overarching goal of the E-waste Africa project is to enhance the capacity of West Africa and other African countries to tackle the growing problem of e-waste and thereby protect the health of citizens, particularly children, while providing economic opportunities. Specifically, the project aims to improve the level of information available on flows of EEE and e-waste imported into West African countries; assess the baseline situation in terms of amounts of EEE imports, EEE in use and e-waste in partner countries, as well as environmental impacts of the e-waste sector; study the social-economic aspects of the increasing volumes of used EEE and e-waste; and strengthen national capacities to monitor and control transboundary movements of e-waste and to prevent illegal traffic.

The project consists of four components:

I. A study on flows of used and end-of-life e-products imported into Benin, Côte d'Ivoire, Ghana, Liberia and Nigeria, from European countries;
II. National assessments on used and end-of-life equipment and national environmentally sound management plans;
III. A socio-economic study on the e-waste sector in Nigeria and a feasibility study of international cooperation between African SMEs and European recycling companies; and
IV. Development of an enforcement programme in Benin, Egypt, Ghana, Nigeria and Tunisia in order to prevent illegal transboundary movements of e-waste and to improve the control and monitoring of these movements.

The timeframe of the project is from November 2008 to March 2012. The financial support for the project was kindly provided by the European Commission, the governments of Norway, the United Kingdom of Great Britain and Northern Ireland, and the Dutch Recyclers Association (NVMP).

The project is implemented by the Basel Convention Coordinating Centre (BCCC-Nigeria) and the Basel Convention Regional Centre (BCRC-Senegal), in cooperation with partners including: the Swiss Federal Laboratories for Materials Science and Technology (EMPA), the Institute for Applied Ecology (the Öko-Institut), the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the Partnership for Action on Computing Equipment (PACE). The Secretariat of the Basel Convention (SBC) is responsible for overall project coordination.

The following countries in West Africa participated in the project: Benin, Côte d'Ivoire, Ghana, Liberia, and Nigeria. In addition, Egypt and Tunisia took part in the enforcement-related project activities (see map on page 40).

For more detailed information about the E-waste Africa programme, and for specific studies and reports prepared in the scope of the project, visit the Basel Convention website: www.basel.int.

Chapter 2. Baseline findings on e-waste in West Africa

2.1 Country characteristics

The African continent faces many developmental challenges including access to clean and safe water and sanitation, development of infrastructure for dealing with solid waste, improving maternal health and reducing infant mortality, and the creation of employment opportunities.

The five West African countries that are part of the E-waste Africa project are classified as countries with low human development (UNDP 2010). Factors such as unemployment, high illiteracy levels, impoverishment amongst large sectors of the populace, lack of access of the populace to electricity, water, housing, adequate sanitation facilities (such as toilets and landfills) and transportation, as well as poor healthcare facilities, are seen to be common to these countries, although economic conditions differ to some extent. For example, according to the Human Development Index (HDI), Ghana is placed 130, Benin 134, Nigeria 142, Côte d'Ivoire 149 and Liberia 162, of the 169 classified countries (UNDP 2010). With respect to Gross Domestic Product (GDP) per capita, Nigeria shows the highest with US $2,082 per capita, followed by Côte d'Ivoire (US$ 1,651), Benin (US$ 1,468), Ghana (US$ 1,452) and Liberia (US$ 388) (World Bank 2010).

Variations also exist in economic conditions within the countries themselves. Most regions in the south with their large cities are economically stronger with high income levels compared to those in the northern, mostly rural parts of the countries. This creates a significant rural-urban migration, which in turn results in overcrowding of the cities in the south. This migration, together with general population growth, intensifies poverty levels in these five countries where many people live on less than two dollars per day (see table 1).

Improved electrification rates and rising living standards of some income classes have led to an increased use of electrical and electronic equipment such as refrigerators, televisions and computers. Mobile phones are already the most common communication equipment and are highly dispersed among all income classes.

Internet penetration in Africa is still relatively low: while the population of the continent equals to 13% of global population, only 5.6% of the population in Africa uses internet compared to the world average of 26.6%. However, between 2000 and 2008, the number of users in Africa grew by a staggering 1.100% compared to the rest of the world's 332.6%. Thus presently Africa is estimated to have one of the highest growth rates in internet usage (Osibanjo 2009).

Table 1: Development indicators for West Africa (2006 - 2010)

	Benin	Côte d'Ivoire	Ghana	Liberia	Nigeria
Land area (km2)*	115,000	322,000	228,000	96,000	911,000
Total population (mln)*	8.7	20.8	23.8	3.8	154.7
Rural population (%)*	59	52	50	40	52
Urban population (%)*	41	48	50	60	48
Number of households (mln)	N/A	3.6	5.5	0.7	28.9
Household size (persons)	N/A	5.8	5.0	5.5	5.0
Population below international poverty line (Population below $1 per day / population below $2 per day) (%)*	47 / 75	15 / 48	30 / 40	84 / 95	64 / 84
Electrification rate (%)	25	55	65	N/A	46
Human development index (HDI) / Ranking out of 169	0.435 / 134	0.397 / 149	0.467 / 130	0.300 / 162	0.423 / 142
Gross domestic product (GDP) (USD, bln)*	6.68	23.4	16.1	0.870	212
GDP per capita (USD)*	771	1137	690	229	1402
GDP (PPP) per capita (USD)*	1468	1651	1452	388	2082
Internet users per 1000 people**	18	32	42	5.5	73

* The World Bank 2010
** ITU 2008

2.2 E-waste volumes

The amount of EEE consumed in Africa might seem negligible compared to the rest of the world. Estimations of the African share of global consumption point towards approximately 1.5% in the case of personal computers (Mueller et al. 2009). Nevertheless, a comparatively low share of EEE can produce significant amounts of waste electrical and electronic equipment. On top of e-waste generated from domestic consumption, a considerable amount is – intentionally or unintentionally – imported via the trade of used EEE (Schmidt 2006). There has been considerable media attention based on a few reports pointing to this issue, especially in Nigeria (Puckett et al. 2005) and Ghana (Brigden et al. 2008). In addition, the studies executed under the umbrella of the E-waste Africa project, as well as other African assessments (Magashi and Schluep 2011; Wasswa and Schluep 2008; Finlay and Liechti 2008), have shown that Africa's consumption of EEE is growing fast, which will in turn increase the amount of e-waste generated in the future (Schluep, Hagelueken, et al. 2009).

2.2.1 Imports of new and used EEE

Most of the consumed EEE is imported into West Africa, while there are only some assembling companies, for example, in Nigeria (BCCC-Nigeria et al. 2011). Quantitative data for EEE is summarized in Table 2 based on the respective e-waste country assessment reports. As national and international import statistics do not distinguish between new and used EEE imports, special field investigations were conducted, concentrating on assessing the import flow of used and end-of-life EEE into West Africa. The studies for Ghana revealed that in 2009, around 70% of all imports were used EEE (Prakash et al. 2011). 30% of second-hand imports were estimated to be non-functioning (therefore e-waste): half of this amount was repaired locally and sold to consumers and the other half was unrepairable. In the case of Ghana, this was about 40,000 tonnes of e-waste in 2010.

A field investigation in Nigerian ports shows that the share of used EEE imports is about half of what was found in Ghana (35%) (BCCC-Nigeria et al. 2011). However this data was gathered at a time when stronger enforcement by the Nigerian government made it less attractive to import used EEE. Hence it is thought that the share of used EEE imports could have been in a similar range as Ghana in the years before. This is supported by statistical data from 2000 – 2010, which suggests that Nigeria saw a peak of category 4 equipment in particular (e.g. TVs: see table 3 for EEE categories) from 2006-2009, with a clear drop in 2010. This pattern goes hand in hand with a peak of end-of-life CRT TVs in OECD countries, due to the switch from analog to digital, and lower priced flat panel TVs. It may be the case that more stringent import restrictions in Nigeria starting in 2010 resulted in higher imports of used EEE in other West African countries, especially Ghana. In absolute numbers, however, given the significantly larger size of its population, Nigeria clearly dominates the region in the total amount of used and new EEE imports.

In Benin and Côte d'Ivoire, imported amounts of EEE are lower, as well as the share of used EEE. Varying between 30% for Benin and 48% for Côte d'Ivoire, field investigations have shown that about half of the imported used EEE is actually non-functional and non-repairable, thus defined as import of e-waste. Liberia, generally seeing few imports, seems to receive relatively less used EEE with a share of 10%. Rough estimations for computer imports into other African countries, such as Morocco (Laissaoui and Rochat 2008; GIZ 2010), South Africa (Finlay and Liechti 2008), Tanzania (Magashi and Schluep 2011) and Uganda (Wasswa and Schluep 2008), indicate an even lower share of used EEE of between 8–15%. These numbers suggest that West Africa serves as the major trading route of used EEE into the African continent, with Ghana and Nigeria as the main import hubs.

An analysis of containers of used EEE for categories 2-4 imported into Nigeria was conducted for 3 months (March-July, 2010) monitoring shipment manifests and providing shipping information for about 176 containers. Results reveal that almost 60% of the containers of used EEE came in from the UK, with Felixtowe being the dominant exporting port. More than 75% of all containers came from Europe, approximately 15% from Asia, 5% from African ports (mainly Morocco) and 5% from North America. A similar distribution could be observed in Ghana, where 85% of used EEE imports originated in Europe, 4% in Asia, 8% in North America, and 3% from other destinations. Results suggest that, while Europe still dominates the trade, Asia is slowly becoming more important as an exporting region of used EEE to Africa.

Table 2: Quantitative data for EEE in Benin, Côte d'Ivoire, Ghana, Liberia[6] and Nigeria related to EEE imports, use and e-waste generated

Country	Year	Imports of EEE		EEE in use		E-waste generated	
		tonnes/ year	thereof used EEE	tonnes	kg/ inhabitant	tonnes/ year	thereof collected
Benin	2009	16'000	30%	55'000	6.32	9'700	N/A
Côte d'Ivoire	2009	25,000	48%	100,000	4,8	15,000	N/A
Ghana	2009	215,000	70%	984,000	41.0	179,000	172,000
Liberia	2009	3,500	10%	17,000	4.6	N/A	N/A
Nigeria	2010	1,200,000	35 - 70%	6,800,000	44.0	1,100,000	N/A

Note: The data presented is based on the e-waste country assessment reports of the respective countries: Benin (CSEE et al. 2011), Côte d'Ivoire (CECAF et al. 2011), Ghana (Green Advocacy et al. 2011), Liberia (N.C. Sanitor's & Strother et al. 2011), Nigeria (BCCC-Nigeria et al. 2011)

2.2.2 EEE in use

The use of EEE, in particular ICT equipment, is still low in Africa compared to other countries in the world, but it is growing at a staggering pace. For example, according to World Bank (World Bank 2010) and ITU data (ITU 2008) in the last decade, the penetration rate of personal computers has increased by a factor of 10, while the number of mobile phone subscribers has increased by a factor of 100.

The per capita use of EEE varies between 4.6 kg (Liberia) and 44 kg (Nigeria) per inhabitant (Table 2). It is interesting to note that Ghana and Nigeria have a penetration rate almost as high as more developed countries like Morocco and South Africa, although their development status (for example, measured by GDP) is much lower. This is an indication that, due to the intense trade of used EEE, people in Ghana and Nigeria have better access to lower priced ICT equipment. From this perspective, the import and trade of used EEE is in support of the UN Millennium Development Goals as a means to foster ICT for development.

Taking Nigeria as an example, it can be observed that on the basis of weight, large household appliances account for more than 50% of the EEE in use for private consumers (Figure 1). ICT equipment (category 3, see table 3) is the dominant category with institutional (government) and corporate (industry) consumers and represents about 73% of the EEE in use. It was also observed that the vast amount of the EEE in use (category 1-4) is held by private consumers (95% of the weight). Looking at ICT equipment only, the distribution shifts to 70% for private and 30% for institutional and corporate consumers.

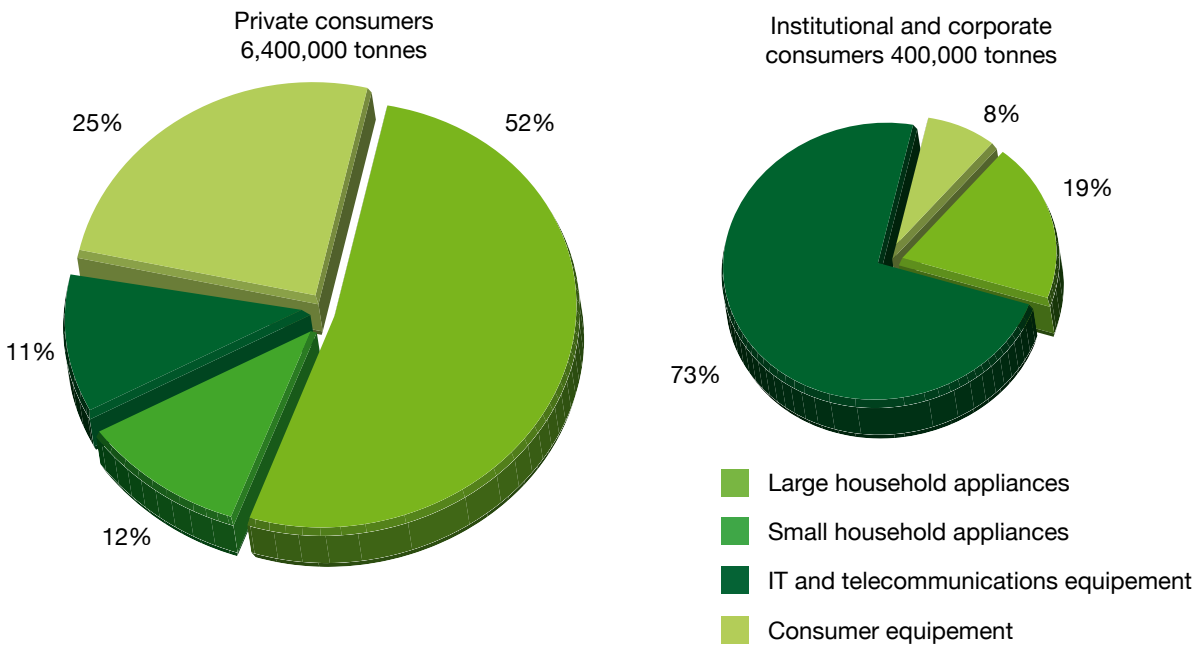
[6] In Liberia, the scope of the assessment was narrower than in other project countries and therefore more limited data on EEE imports, use and e-waste is available.

Table 3: Penetration rate of selected EEE (in installed units per capita)[7]

	Cat.[1)]	Benin	Côte d'Ivoire	Ghana	Liberia	Nigeria
Refrigerator	1	0.06	0.04	0.26	0.03	0.16
Air Conditioner	1	N/A	N/A	0.09	0.03	0.12
Iron	2	0.04	N/A	0.19	0.02	0.14
Kettle	2	0.04	N/A	0.12	0.005	0.11
Personal Computer	3	0.04	0.1	0.08	0.005	0.13
Mobile Phone	3	0.53	0.62	0.72	0.16	0.60
TV	4	0.04	0.05	0.20	0.01	0.25
Radio / Hifi	4	0.13	0.22	0.28	0.05	0.36

1) Categories according to the EU WEEE Directive (European Union 2003): large household appliances (cat. 1), small household appliances (cat. 2), IT and telecommunications equipment (cat. 3), consumer equipment (cat. 4).

Figure 1: Weight distribution of EEE in use by e-waste category for private and institutional/corporate consumers in Nigeria



[7] There are other categories of EEE, such as flashlights (or lights using batteries), which are not covered in the scope of the study. However there are indications from some countries (e.g. Liberia) that high volume of imports of mal-functioning and low-quality flashlights and subsequently waste of this type of EEE is a cause for concern.

2.2.3 E-waste generated

Estimations for e-waste generated are given in Table 2. Countries with high imports of used EEE, like Ghana and Nigeria, generate relatively high volumes of e-waste. This is due to the direct import of non-functioning and non-repairable used EEE and the lower life-span of (functioning) used EEE compared to new EEE. With an estimated 1.1 million tonnes of e-waste generated per year, Nigeria has to deal with the majority of the e-waste in the region. It should be noted that these absolute numbers are theoretical figures representing the amount of appliances becoming obsolete: the actual volumes reaching the waste stream depends on the efficiency of collection. Collection rates vary among the countries and reach up to 95% in the case of Ghana. Almost all of the collected material reached the informal recycling sector in countries participated in the study. Taking Ghana as an example, around 20,000 tonnes, or 15% of e-waste reaching the informal recycling sector originated from the trade of e-waste, with its origin in developed countries. At least another 60%, or 110,000 tonnes, was e-waste generated out of EEE imported, refurbished, if necessary, and consequently sold and consumed in Ghana as used products. This leaves less than 25%, or 42,000 tonnes, of e-waste generated from equipment, which was originally bought as new products in Ghana.

The high collection rate in Ghana is due to the informal sector being very active in e-waste recycling, which is triggered by the high volumes of traded used EEE. This pattern can also be observed in Nigeria, where the importance of the role of the informal sector in treating e-waste is comparable. Even though Côte d'Ivoire has an important informal sector as well, the field study suggests that only small amounts of e-waste is collected from consumers and large volumes of e-waste remains with consumers in stock. It seems that the existing informal sector in Abidjan mainly focuses on repair and refurbishment, and that only the residual fraction that is unrepairable is sold as scrap to foreign dealers. In Benin and Liberia, the informal e-waste sector is relatively small and focuses on the re-use of scrap metals for producing kitchenware, tools, etc.

2.3 Impacts of current recycling practices

2.3.1 Current recycling practices

Informal activities in the e-waste recycling chain are present in all countries and include collection, manual dismantling, open-burning to recover metals and open-dumping of residual fractions. While in some countries these activities are performed by individuals with a low material throughput (e.g. in Benin and Liberia), Côte d'Ivoire, Ghana and Nigeria reveal an organized informal sector with medium to high volumes of processed materials (e.g. steel, aluminum and copper). Informal recycling locations are often found adjacent to markets for used EEE. A known example is Alaba International Market and Ikeja Computer Village in Lagos, Nigeria (Öko-Institut et al. 2011) (see more information in section 3.2, chapter 3). In Ghana and Nigeria, rather high collection rates are achieved by the informal collectors with the economic benefit from both the re-use and material value from e-waste. Most of the e-waste is sold to informal recyclers, which prioritize reclamation of the valuable components and substances from the recycling process.

Sorting of cables prior to copper recovery.

Informal recycling processes apply manual dismantling with simple tools like hammers, screwdrivers, chisels etc. as the

primary treatment to physically separate the heterogeneous materials and components. After dismantling and pre-processing, components with a re-use value are sometimes sold to repair shops for further sale on the second-hand market. The remaining valuable components containing copper, aluminium, steel and wiring boards are classified for further treatment or export. Open-burning is widely used in all studied African countries to recover metals, such as copper, steel, and aluminium from wires and other EEE components. Apart from anecdotal evidence, no indication was found of further "refining" techniques, such as de-soldering of printed wiring boards (PWB) and subsequent leaching of gold. However, open-dumping of residual fractions such as CRT-glass and plastics is evidenced in all countries.

Formalized processes in the e-waste recycling chain are only about to develop in the form of initial manual dismantling pilot projects (Ghana and Nigeria) or are planned (Benin and Côte d'Ivoire) through either private initiatives or development cooperation projects. All of them at least partially rely on financial start-up funding, which is not yet secured. More costly treatment processes, such as degassing CFCs and HCFCs from cooling and freezing appliances and CRT recycling are not available in West Africa. Only in Ghana there is a project commissioned by the United Nations Development Programme (UNDP) aiming to set up a refrigerator collection and recycling system to recover and destroy CFCs. In most countries, formal refining processes exist for metallic fractions like steel and aluminium. This ranges from rather simple re-melting operations to larger metal smelters and refineries. Metallic scraps from e-waste are usually treated in these facilities, together with mixed metal scraps from other sources or sometimes with mining concentrates.

2.3.2 Environmental impacts

Emissions from informal recycling activities have already been assessed in many studies (Sepúlveda et al. 2010) and their impacts on the environment (Nnorom et.al 2010) and health are evident. Major impacts from current recycling practices in West Africa result mainly from the processes of dismantling, material recovery and final disposal. During collection as well as refurbishment or repair of EEE, negative impacts can partly occur, but are generally at a significantly lower level. Recycling activities often take place on unfortified ground where harmful substances released during dismantling are directly discharged to the soil. Burning copper cables and wires, as well as monitor and TV casings, creates an accumulation of ash and partially burned materials at the burning sites. Insulating foam from dismantled refrigerators, primarily CFC-containing polyurethane, or old car tyres are often used as the main fuels for the fires (Prakash et al. 2010), contributing to acute chemical hazards and long-term contamination at the burning sites, as well as emitting ozone depleting substances and greenhouse gases into the atmosphere.

Burning cables, monitor and TV casings leads to severe emissions of harmful substances.

A sampling campaign carried out by the Greenpeace Research Laboratories in Accra, Ghana, at the main informal recycling sites (Agbogbloshie and Korforidua) revealed that copper, lead, tin and zinc concentrations in soil and ash samples are over one hundred times higher than typical background levels (Brigden et al. 2008). Increased levels of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) found in breast milk samples in Accra, Ghana, were also linked to informal e-waste recycling activities (Asante et al. 2011).

As the practice of burning of cables is seen as one of the most direct severe impacts on human health and the environment, a small survey was conducted in the Greater Accra Region, in order to estimate the resulting dioxin emissions (Prakash et al. 2010). Based on site inspections at the four main informal burning sites, it was estimated that approximately 625 tonnes of cables were burnt per year. About 10-20 % of these cables were associated with e-waste, while the rest originated mainly from old vehicles. The estimation of dioxin emissions to air from

open burning of cables was based on the "Standardized Toolkit for Identification and Quantification of Dioxin and Furan Release" (UNEP 2005) and resulted in source strength of ~3 g / year. Compared with the European dioxin air emission inventory for 2005 (Quass, Fermann, and Broeker 2004), this equals to 0.15 – 0.3 % of total dioxin emissions, 1.5 – 3 % of dioxin emissions from municipal waste incineration or 7.5 – 15 % of dioxin emissions from industrial waste incineration. Bearing in mind that cable burning most probably occurs in all African countries, this should be considered as a major source of dioxin emissions.

2.4 Policy and Legislation

As of 2010, none of the countries in the West Africa region had adopted specific national legislation or other measures dealing with e-waste. However, a few countries had developed, or were considering drafts for specific e-waste related policies and legislation. As a result, Nigeria adopted specific EEE regulations in 2011. Furthermore as part of the E-waste Africa project activities, national e-waste strategies have been drafted in Benin, Côte d'Ivoire, Ghana, and Nigeria. Some references to e-waste were also introduced within amendments to existing environmental and general waste management legislation or regulations in the past two to three years.

The absence of specific primary legislation dealing with e-waste does not imply that countries have not implemented regulations or other measures addressing hazardous substances or wastes, or their management and disposal. Answers are certainly found in laws governing topics like the environment, water, air, waste, hazardous substances, as well as health and safety measures. As a general pattern seen in all countries, each law examines the issue from a different perspective, thereby creating a plethora of measures that may be duplicative or contradictory, or leaving gaps, which makes coordinated implementation difficult. A further difficulty is the fact that these laws are enforced by different government departments and agencies or levels of government, so there is no uniform approach to dealing with e-waste or, for that matter, hazardous wastes in general.

All partner countries mentioned in this chapter are Parties to the Basel, Rotterdam and Stockholm conventions and have agreed to be bound by and comply with the obligations under the conventions. Benin and Cote d'Ivoire are also Parties to the Bamako Convention, whereas Ghana, Liberia and Nigeria are signatories to this convention.

For countries following a monist legal system (e.g. Benin and Cote d'Ivoire) international treaties that have been ratified by them have the status of national legislation, without the need for transposition into national law. For other countries that operate under a dualist legal system (e.g. Ghana, Liberia, and Nigeria), specific laws and regulations incorporating the provisions of international law into domestic law must be adopted. In both cases, national implementation of the above-mentioned conventions remains a challenge as specific laws and/or regulations implementing or supporting the implementation of the Basel, Rotterdam, and Stockholm conventions are yet to be adopted in countries.

The implementation of the Basel Convention in particular would support countries' efforts to regulate transboundary movements of hazardous wastes and other wastes, which would apply to e-waste, including the possibility to prohibit all imports of e-waste, and to manage e-waste in an environmentally sound manner. The implementation of the Stockholm Convention would also have implications for the sound management of e-waste. Some POPs regulated by the Convention have been extensively used in EEE components made of plastic and in PWBs as well as in the number of applications used in the EEE industry (e.g. photoresistant and anti-reflective coatings and etching agents for semi-conductors, and liquid crystal displays). There are also unintentionally released POPs created by open-burning and operations of fossil fuel-fired utilities and industrial boilers. The Stockholm Convention calls on governments to develop and implement strategies for identifying stockpiles, products and articles containing POPs. Once identified, these need to be managed in an environmentally sound manner and disposed of in such a way that their POPs content is destroyed or irreversibly transformed.

The general status of policy and legislation with relevance to e-waste is presented for each country below.

2.4.1 Benin

Benin has no specific legal instruments relating to e-waste management. However, policies and laws relating to waste management in general do exist, as well as a broad national legal and institutional framework, which could be used to support future e-waste-related laws and regulations.

The Environmental Action Plan and the National Environmental Management Plan define broad principles for waste management, in particular regarding the decentralisation of competences and giving municipalities the authority to collect and manage wastes.

Benin's national inventory of hazardous wastes does not mention e-waste specifically, thus no particular attention has been paid to this issue so far.

2.4.2 Côte d'Ivoire

The legal framework currently allows for a number of controls, especially concerning illegal imports of e-waste, but is clearly not sufficient for the environmentally sound management of e-waste. Responsibilities of stakeholders are not defined, so that opportunities for the development of formal recycling channels are lacking.

Currently, a number of policy and legal instruments apply directly or indirectly to e-waste management. The National Environmental Action Plan adopted in 1996 and the National Sustainable Waste Management Strategy adopted in 2002 provide some tools for waste management, but do not address hazardous wastes specifically, nor e-waste management.

The most relevant measure implemented for managing e-waste is the Hazardous Waste Management Plan of the Abidjan district, adopted by the Government of Cote d'Ivoire in October 2009, following the tragic dumping of toxic wastes in 2006. Though the plan does not specifically mention e-waste, it provides interesting tools that would apply, such as a waste market place and guidelines for the take-back and valorisation of wastes.

In the context of the ongoing 'Probo Koala' project being undertaken by the Government of Côte d'Ivoire, the Secretariat of the Basel Convention and other partners, national legislation is being reviewed, drafted and implemented so as to strengthen the national capacity to control transboundary movements of hazardous chemicals and wastes. This project will contribute to the implementation of existing international agreements dealing with chemicals and hazardous wastes to which Côte d'Ivoire is Party i. e. the Basel Convention, the Rotterdam Convention and the Stockholm Convention[8] . It will also address measures to improve coordination and synergies at the national level with respect to chemical safety policy. It is expected that the project will lead to the adoption of revised national legislation and regulations addressing obligations related to hazardous waste (and consequently, e-waste) and chemicals management as stipulated in the Basel Convention and other relevant international agreements.

2.4.3 Ghana

There are a number of laws and regulations that have some relevance to the control and management of hazardous wastes (including e-waste) in Ghana, but they do not address the dangers posed to humans and the environment. The existing law in Ghana that could best form the basis for e-waste management is the Environmental Protection Agency Act, 1994 (Act 490). Section 2 of the Act requires that *inter alia:* (i) standards and guidelines relating to the pollution and the discharge of toxic wastes and the control of toxic substances are prescribed; (ii) activities and

[8] The project is also aimed at strengthening the capacity of Côte d'Ivoire to control transboundary movements of hazardous chemicals and wastes in the context of the International Health Regulations (WHO, 2005) and management of slops or residues controlled under Annexes I and II of the Convention for the Prevention of Pollution from Ships (MARPOL).

the generation, treatment, storage, transportation and disposal of industrial wastes are coordinated and controlled; and, (iii) the volumes, types, constituents and effects of waste discharges, emissions, deposits or other sources of pollutants and/or substances which are hazardous or potentially dangerous to the quality of life, human health and the environment are controlled. Section 10 of the Act establishes the Hazardous Chemicals Committee tasked with monitoring the use of hazardous chemicals by collecting information on the import, export, manufacture, distribution, sale, use and disposal of such chemicals. Although this Act does not make specific reference to e-waste, it provides a framework for the management of hazardous substances.

New specific regulations with relevance to EEE and e-waste are the LI 1932 Energy Efficiency Regulations, 2008 (Prohibition of Manufacture, Sale or Importation of Incandescent Filament Lamp, Used Refrigerator, Used Refrigerator-Freezer, Used Freezer and Used Air-Conditioner). This prohibits the import as well as the sale and distribution of used refrigerators, freezers and air-conditioners. The enforcement of these regulations at this moment remains challenging.

2.4.4 Liberia

Liberia has no specific legal instruments relating to e-waste management. However, policies and legislation relating to waste management in general do exist, as well as a broad national legal and institutional framework for the development, adoption and enforcement of such measures.

The Act creating the Environmental Protection Agency requires an environmental impact assessment of all activities, decisions, programmes, projects and policies, which may have significant impacts – beneficially and adversely – on human health and the environment. The National Environmental Policy of Liberia provides a broad framework for the proper and responsible management of natural resources and the protection of human health and the environment. Part IV of the Environmental Protection and Management Law provides for the establishment of standards by the Agency, including water and air quality, toxic chemicals and pesticides (including POPs), hazardous wastes and materials and waste management.

2.4.5 Nigeria

Among the existing legislative and regulatory framework related to e-waste in Nigeria, the Harmful Waste (Special Criminal Provisions) Act Cap H1 LFN 2004 has a strong influence in regulating e-waste management. The law prohibits the carrying, depositing and dumping of harmful wastes on any land and territorial waters. It prohibits certain activities generating harmful wastes, and lists such activities.

The Act is linked to two other key regulations. The National Environmental Protection (Waste Management) Regulations S.I.15 of 1991 regulate the collection, treatment and disposal of solid and hazardous wastes from municipal and industrial sources. The National Environmental (Sanitation and Wastes Control) Regulation S.I.28 of 2009 applies to issues of environmental sanitation and all categories of wastes, including e-wastes. It regulates the adoption of sustainable and environmentally friendly practices in environmental sanitation and waste management, so as to minimize pollution. Furthermore, it obliges all manufacturers and importers of various brands of products to comply with a product stewardship programme and an extended producer responsibility programme. In particular, this Regulation provides for e-waste to be subject to extended producer responsibility programmes from 2011.

Based on the above-mentioned measures, the National Environmental Standards and Regulations Enforcement Agency (NESREA) drafted regulations, which may be cited as the National Environmental (Electrical/Electronics Sector) Regulations S.I. No. 23 of 2011. The principal objective of these regulations is to prevent and minimize pollution from all operations and ancillary activities of the EEE sector to the Nigerian environment. The regulations are based on a life-cycle approach and are intended to cover all aspects of the EEE sector from cradle to grave, thus also including e-waste. NESREA also developed a guide for importers of used EEE into Nigeria, which contains the guiding principles, requirements for import of used EEE, and the description of items that are not allowed to be imported to Nigeria. According to this guide, all importers of used EEE in Nigeria are required to register with NESREA.

Chapter 3. Socio-economic impacts of the e-waste sector in Nigeria and Ghana

3.1 Introduction to the socio-economic study

In order to provide a sound basis for decision-making, in-depth socio-economic studies were carried out in Nigeria and Ghana[9] that elaborate on the operations and sustainability impacts of the refurbishing and e-waste recycling sectors in both countries. In addition, currently practiced recycling technologies were compared with best available technologies and both were analyzed on the basis of their applicability in the West African context. As a result, "best applicable technologies" (see footnote 3) were proposed for implementation in Nigeria and Ghana. Here, particular emphasis was on systems and technologies that yield multiple gains in the field of environmental protection, working conditions and employment creation, as well as in general economic terms.

This approach is based on the consideration that solutions to the e-waste problem in West Africa do not only rely on combating illegal imports, but also on ways to improve the end-of-life management of domestically generated e-waste.

A refurbisher of computing equipment.

In addition, the transformation from current crude recycling technologies to more sustainable e-waste management needs initial support that enables multiple gains for all actors involved in e-waste management. In particular, gains must be realized for the informal sector that controls large segments of collection, refurbishing and recycling activities and which will play a decisive role in implementing any future e-waste management systems. Starting with such core recycling activities, the general acceptance of e-waste related policies and strategies could be enhanced. Furthermore, they could help to pave the way for sound and coherent e-waste policies in West Africa.

[9] The study in Nigeria was conducted within the E-waste Africa project. A similar study in Ghana was prepared using the same methodology outside the project scope with support from the VROM-Inspectorate and the Dutch Association for the Disposal of Metal and Electrical Products (NVMP).

3.2 *The structure of the refurbishing and e-waste recycling sectors in Nigeria and Ghana*

The research revealed that there are some particular similarities between the refurbishing and recycling sectors in Nigeria and Ghana. In both countries, there is a well-organized repair and refurbishing sector focusing on used equipment either from imports or from domestic sources such as businesses and households. This sector is again stratified in various sub-sectors, according to the types of equipment repaired and refurbished (e.g. cooling and freezing equipment, computing equipment, TVs, mobile phones, small household equipment). In fact, these activities are only indirectly linked to the e-waste recycling sector, as the business outputs are functioning products rather than raw materials. Nevertheless, the sector produces significant amount of e-waste, as often old devices are used as sources of spare parts and later discarded.

The city of Accra indicating the hotspot of e-waste activities.

In Accra (Ghana) and Lagos (Nigeria), this refurbishing sector provides income to more than 30,000 people. In particular in Lagos, two refurbishing clusters – Ikeja Computer Village and Alaba International Market – achieved high levels of professionalism and gained regional importance by supplying refurbished equipment not only to Nigerian households, but also to other West and Central African countries. Together, these two markets feature about 5,500 small enterprises with around 15,000 technicians and sales personnel. Many of these workers have a comparably high education and most of them went through a sector-specific apprenticeship system lasting between two and five years. It is notable that many of these enterprises are registered with the local authorities and pay taxes to local and regional administrations. Therefore, the refurbishing sector operates partly under formal conditions.

In contrast, collection and recycling of e-waste is almost exclusively carried out by non-registered individuals widely referred to as “scavengers”. These collectors use handcarts and go from household to household to collect metal containing wastes. Usually, collectors pay small amounts of money for each device. The collected materials are brought to scrap metal markets where they are dismantled to recover materials such as steel, aluminum and copper. These materials are collected and sold either directly to local industries like steel plants or aluminum remelters, or to traders who organize bulk sales to domestic or international refineries. Materials of no market value are disposed of in uncontrolled conditions or burned to reduce volumes.

It is noteworthy that most collectors and recyclers do not exclusively focus on e-waste, but on all kinds of metals containing wastes. Therefore, they do not consider themselves as “e-waste recyclers” but rather as “scrap metal workers”. In addition, there are few people who exclusively focus on collection or dismantling. Most individuals conduct both and are typically engaged in collection in the morning and in dismantling in the afternoon. In Nigeria

and Ghana, informal collection and recycling is mostly carried out by poor migrants from the rural areas in the north of the respective countries, where populations have few alternatives to small-scale agriculture and where rainfall variability cause food shortages. For these migrants, the scrap metal business is one of the few economic activities that can be taken up without prior training or investment. In addition, it enables rapid and regular access to cash, as the revenues from one day's work immediately materialize when the recycling products are sold to one of the local middlemen.

The city of Lagos indicating the main refurbishing and recycling clusters for used and obsolete EEE.

Formal e-waste collection exists in Lagos and is conducted by the Lagos Waste Management Authority (LAWMA) who also collects e-waste generated in Ikeja Computer Village. In addition, there is an e-waste collection system being implemented by the Lagos State Environmental Protection Agency (LASEPA) targeting e-waste from businesses. Most of the e-waste collected by LAWMA is transferred to municipal dumpsites where informal collectors sort out valuable fractions, including metal containing e-waste. The e-waste collected by LASEPA is stored awaiting future recycling solutions.

There is a difference in the geographical set-up of the scrap metal business between Accra and Lagos. While in Accra, metal containing waste is mostly transferred to the centrally located Agbogbloshie Scrap Metal Market, the collectors in Lagos use many small and medium-sized scrap metal markets distributed all across the city. The reason behind these structures is the difference in city size and distances (Accra: 2.3 million inhabitants; Lagos: 17.5 million inhabitants) and the circumstance that Agbogbloshie Scrap Metal Market provides enough space for all dismantling and disposal operations, which is not the case in any scrap metal market in Lagos.

3.3 Socio-economic impacts

In both countries, collection and recycling of e-waste is associated with severe health and safety risks for the engaged workers. These risks mainly stem from poor working conditions, including the necessity to handle heavy and sometimes sharp wastes, which frequently causes spinal injuries, cuts and infections. With respect to collection, the operation of simple handcarts in heavy road traffic is another leading cause of injury.

In addition, the exposure to hazardous substances in and around dismantling sites causes manifold health and safety risks for collectors, recyclers and neighboring communities. Hazardous substances are released during various dismantling and disposal operations and are particularly severe during the burning of cables to liberate copper and of plastics to reduce waste volumes (see also section 2.3.2 of chapter 2). Further health and safety risks originate from

the emissions from informal lead acid battery recycling, which is commonly practiced within the dismantling sites. Epidemiological data and human exposure data are lacking in this regard in West Africa.

Health and safety risks in the refurbishing sector are less severe. Nevertheless, many technicians are engaged in soldering operations using lead-containing solder paste over long periods each day. In addition, many technicians reported that they occasionally receive electrical shocks. Other health and safety risks are product or location specific. While refurbishers of printers are often exposed to toner dust, refurbishers not connected to a stable electricity supply (e.g. in Alaba International Market, Lagos) are dependent on generators, which are often placed in such a way that exhaust emissions negatively affect workplace air quality.

Working hours are particularly long in the informal collection and recycling of e-waste. Scrap metal workers typically work between 8.5 and 12 hours a day, 7 days per week. As there is no social security system apart from that provided by family structures, holidays or sick leave are unpaid. Daily revenues vary greatly between US$ 0.22 and US$ 9.50. Here, clear stratifications within the scrap metal business were identified: while collectors that are – due to financial limitations – forced to collect freely available waste (e.g. on waste dumps) find themselves at the lower income side, recyclers that have their own workshops to store and sell scrap metal are typically at the higher income side.

Although part of these figures might give the impression that the scrap metal business and e-waste recycling is quite lucrative in Nigeria and Ghana, it has to be considered that these revenues mostly have to be shared with other family members and that income is only earned on economically active days and not during periods of sickness or other emergencies. Therefore, it is concluded that a significant portion of e-waste workers in Nigeria and Ghana live below the internationally defined poverty line of US$ 1.25 per day.

Working conditions in the refurbishing sector are slightly less demanding with technicians typically working between 8 to 10 hours per day, 6 days per week. Sunday is usually a rest day. The salaries range between US$ 2.20 and US$ 22 per day. Here, the highest incomes are achieved by workshop owners, while employees typically earn less than US$ 4.00. Furthermore, numerous apprentices that work in the refurbishing sector do not receive regular salaries at all. Nevertheless, these apprentices are usually provided free food and accommodation. In addition, they receive a considerable start-up-payment after completion of their training.

While child labor is not common in the refurbishing sector it is observed in the scrap metal business. Collection and dismantling activities are carried out by children from the age of 12, however younger children from the age of 5 are sometimes engaged in light work, including dismantling of small parts and sorting of materials.

Interestingly, workers in the refurbishing sector are mostly positive about their jobs and consider them as “prestigious” and “high-tech”. In addition, most people claimed that their income would be sufficient to cater for all basic needs. Some apprentices, who do not yet have any regular income, are mostly positive about their career prospects and look forward to establishing their own business. However, some apprentices complained about not being paid, maintaining that they are hardly able to meet their basic needs.

E-waste collectors and workers are less positive about their jobs and mostly claim that their remuneration is not satisfactory. Nevertheless, most collectors and recyclers still consider themselves lucky to have at least one basic source of income.

Regarding value creation, in Ghana, for example, it was estimated that countrywide activities in refurbishing and scrap metal collection and recycling (including e-waste) generate between US$ 106 and 268 million (see table 4).

Table 4: Annual income of people engaged in the e-waste sector in Ghana (Öko-Institut et al. 2010)

	Refurbishers	Collectors	Recyclers	Total
Remuneration per month (in US$)	190–250	70–140	175–285	435–675
Remuneration per year (in US$)	2,280–3,000	840–1,680	2,100–3,420	5,220–8,100
Number of people engaged in refurbishing and e-waste recycling sector in Ghana	14,000–24,000	6,300–9,600		20,300–33,600
Income of those engaged in the e-waste sector per year (in US$)	Remuneration per year (in US$) multiplied by the number of people engaged in refurbishing and e-waste recycling sector in Ghana			105,966,000–268,128,000

3.4 Present and best applicable recycling technologies

The comparison of currently practiced recycling technologies with best available recycling technologies showed that there is considerable potential for improvement in the field of ICT recycling. For example, in the countries studied, discarded equipment such as desktop PCs is mainly dismantled to recover steel, aluminum and copper. However, precious metals contained in printed wiring boards (PWBs) of such equipment are rarely collected and when they are, are sold below world market prices to traders that organize exports to Asian recycling facilities.

Hence there is an opportunity for West African countries to gather higher volumes of PWBs in order to be able to participate in a fair international commodity trade. Appropriate volumes and quality levels can be achieved by manual dismantling and without significant investments in processing machinery. Appropriate health and safety measures for those involved in recycling as well as environmentally sound practices should be ensured. Thus optimized ICT recycling could be a core field of sustainable e-waste management in Nigeria and Ghana that has the potential to serve the multiple purposes of reducing environmental impacts, as well as generating jobs and sustainable incomes.

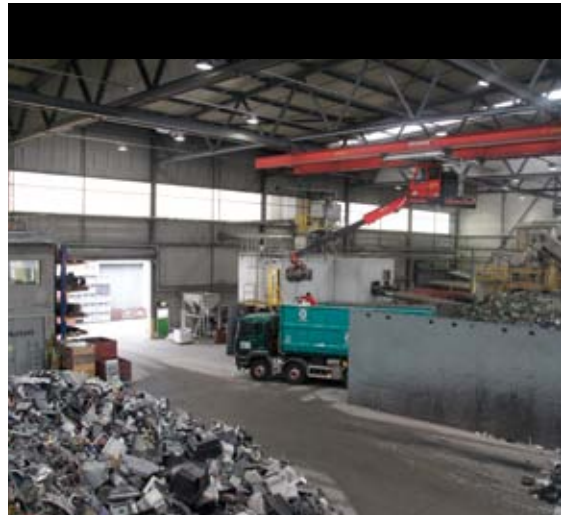
In addition, it is recommended that the existing house-to-house collection of e-waste is continued as this informal system achieves significantly higher collection rates compared to voluntary take-back systems in Europe. Key success factors of house-to-house collection are convenience for consumers, the fact that consumers receive money for their e-waste and the provision of basic income for many urban poor. Regarding collection systems, the key challenges in Nigeria and Ghana are not to establish competing parallel systems but to make sure that collected e-waste is steered to environmentally sound treatment operations.

Apart from an improved management of PWBs, e-waste management also has to be improved in the field of cable processing to avoid cable fires and in developing sound end-of-life solutions for non-valuable hazardous fractions such as plastics containing brominated flame retardants.

In the case of refrigerators, the comparison of currently applied recycling techniques and best applicable technologies revealed

Current techniques for refrigerator recycling.

that there are significant untapped environmental and, possibly, economic improvement potentials. These potentials can be realized by the recovery of CFCs and HFCs from cooling circuits and foams and subsequent destruction of these ozone depleting substances in dedicated facilities. Additionally, the sound management of hazardous components and a better utilization of the plastic fractions add to the benefits of sound refrigerator recycling. Economic benefits can be tapped if CFC- and HFC-recovery and destruction are marketed using one of the existing emission reduction certification schemes, such as the Carbon Action Reserve (CAR) or the Voluntary Carbon Standard (VCS).



A state-of-the-art recycling facility.

From an environmental perspective, best applicable technologies which would recover a minimum of 90% of total CFCs contained in cooling circuits as well as foams, would lead to proper management of two to seven tonnes of CO_2 per device. Together with better utilization of plastics, mainly polystyrene – a potential which is neglected in currently applied recycling technologies – revenues from CO_2 emission trading would yield much higher economic benefits. However, investment costs for setting up such facilities would range from around US$ 200,000 to 300,000 for basic machinery to recover CFCs from cooling circuits, to several million US$ for advanced recovery facilities.

In addition, the management aspects related to the export of CFCs and certification and compliance within the framework of emission trading schemes could be quite complex. Thus, the informal e-waste sector is probably not in the position to manage such a recycling system. However, this sector should still be engaged in the collection of obsolete refrigerators, their transport to the recycling facility and the manual recycling steps. In this way, formal recycling businesses could closely interlink with current informal e-waste recycling structures to avoid competition in acquiring obsolete refrigerators.

In addition to these recycling approaches, regulations and financing options are urgently required to achieve sustainable e-waste management in Nigeria and Ghana. This is illustrated by a case study on cathode-ray tube televisions and monitors, which make up a significant share of West Africa's e-waste stream. While informal recyclers operate profitably by extracting copper and other valuables from tubes, they dispose of all valueless fractions on unregulated dumpsites. These fractions comprise of various hazardous substances such as leaded CRT-glass, internal phosphorous coatings (which contain pollutants such as cadmium) and plastic fractions (containing flame retardants). In contrast to currently practiced recycling techniques, environmentally sound operations would have to identify solutions for all of these fractions, which are almost certainly associated with costs. Therefore, environmentally sound operations may not be economically viable unless appropriate policy measures and financing mechanisms are introduced.

Chapter 4. From Europe to Africa: flows of used electronic and electrical equipment and e-waste

4.1 Introduction: e-waste generated in Europe

In Europe, the annual generation of waste electrical and electronic equipment is estimated at 9 million metric tonnes out of which only 3 million tonnes is collected in the official collection systems of the EU Member States (WEEE-Forum 2010). This means that a significant share of generated e-waste leaves formally regulated e-waste schemes. While a share of this leakage –in particular small-sized EEE – is disposed of together with household waste, management of another share of this used equipment is postponed as users continue to store these devices in their homes. Another share by-passing the formal collection schemes is gathered by "informal" collectors who then sell scrap directly to recyclers so it gets recycled nevertheless, but is not accounted for within statistics.

In addition, significant volumes of used and end-of-life equipment are diverted from end-of-life management systems in Europe and exported to developing countries and countries with economies in transition as used EEE.

While used EEE – depending on its quality and functionality – is widely considered as products and can in principle be traded internationally without limitations, non-functioning EEE which is destined for final disposal or recycling instead of re-use is classified as hazardous waste under the Basel Convention. This means that shipments of such non-functioning equipment between the Parties of the Basel Convention need to comply with a number of conditions and are subject to prior written notification from the exporting country and prior written consent from the importing and, if appropriate, transit countries. In practice, some shipments are declared as shipments of used goods, disregarding functionality or quality aspects of the traded goods.

The following sections summarize the research conducted in the context of the E-waste Africa project on the trade of used and end-of-life EEE between selected European and West African countries.

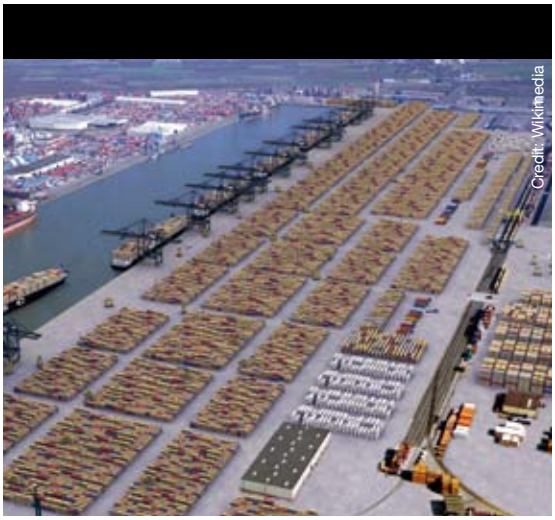
4.2 Trade of EEE and used EEE: leakage pathways from the formal to the informal sector

In European countries, e-waste collection from private households is not organized uniformly and varies from country to country and from municipality to municipality. In many regions, private consumers can discard EEE by ordering a community pick-up service or by using scheduled bulky waste pick-up. In the latter case, it can be informal collectors who pick up bulky waste from households in order to select and withdraw goods with value for export or parts of EEE with a high material value.

Another potential diversion of used goods is informal traders that wait outside formal collection points and ask people discarding EEE whether they can have it for free.

Furthermore, a certain share of used goods may enter the informal sector after they reach collection points. In many cases the collected equipment is not directly sold to recycling companies, but instead handled by a variety of logistics companies and sub-contractors, and therefore there are possibilities for traders in this chain to divert equipment with re-use value for export.

Another significant pathway from the formal to the informal sector is the diversion of EEE from brokers and traders. Retailers and companies aiming to discard EEE, and who are not entitled to use free public collection systems, usually pass their used EEE and e-waste to brokers to organize its lawful end-of-life management. Despite the fact that under the WEEE Directive the responsibility for e-waste remains with retailers and commercial users, it can be assumed that they do lose track of these discarded goods and may not know their final disposal point, which in many cases can be outside of Europe.



Port of Antwerp, Belgium.

The above-mentioned trade is mainly driven by the re-use value of used EEE exported to West Africa, where used EEE achieve prices far above their intrinsic material value.

The brokers and traders are key players in this trade. Generally, this sector is quite diverse, ranging from small family-based networks to large and well-organized trading firms. Often, immigrants or temporary residents from African countries create small trading businesses within Europe to serve European – African trade routes. In addition, traders of used vehicles play an important role in this trade as used EEE and e-waste is often co-loaded with used cars and trucks destined for export to West Africa.

4.3 Example of Amsterdam and Antwerp ports as a gateway for used electrical and electronic equipment

The ports in Amsterdam, the Netherlands, and Antwerp, Belgium, are very different in terms of their structure and functionality. Amsterdam is a medium-sized port, ranking 12th within Europe, whereas Antwerp ranks 2nd in terms of tonnage traded (ESPO 2005). It should be noted that the most pertinent markets for the used EEE trade are the container market and the roll-on-roll-off (RoRo) market in the case of co-loading cars and trucks.

The Port of Amsterdam is the largest of the four Dutch North Sea Canal ports (Ijmuiden, Bev-erweijk, Zaandam, and Amsterdam) and the second largest port in the Netherlands. It serves as a port for several liner services from Europe to West Africa, in particular, to Ghana and Nigeria. The Port of Amsterdam is not as important as other European ports in terms of receiving containers in transit. On the other hand, within the city limits of Amsterdam, several locations are known where used EEE is loaded for export via the Port of Amsterdam. Amsterdam port facilities also include one terminal dedicated to the loading and unloading of cars. However, Amsterdam has been used mostly for exporting new cars (Koopmann Car Terminal), whereas another Dutch port – the Port of Vlissingen – is known to export predominately used cars.

According to the Dutch customs authority and the Ministry of Housing, Spatial Planning and the Environment (VROM)-Inspectorate, nearly 80% of the containers which were selected for inspection after a pre-screening process, have problematic contents or declarations (Öko-Institut et al. 2010).

The Port of Antwerp is the dominant Belgian port and an important gateway for trade with West Africa offering high capacities for both containers and car loading.

It is considered by government agencies to be more of a transit port, whereby containers and cargo are transported to the port by truck, rail, and barge and then loaded onto seagoing vessels (Öko Institut et al. 2010). Germany, and in particular Münster and Essen in the Ruhr-Region, is a major source of the cargo channeled through Antwerp, although cargo may originate from nearly any place in Europe, including the Netherlands, France, Switzerland, and Eastern European countries. Furthermore, Antwerp terminals also handle used cars in containers originating from the USA and destined for Africa (Öko-Institut et al. 2010).

The Belgian inspection authorities conduct many inspections on transiting goods through the Port of Antwerp. In 2008, approximately 1200 container checks were conducted of which 127 contained e-waste and 47 were sent back to the country of origin. Belgian customs authorities assume that 90% of illegal waste shipments are conducted by co-loading e-waste into used cars (Öko-Institut et al. 2010).

In both ports, used EEE is often declared as “second-hand goods”, “private goods”, “for charities”, “for personal use”, “miscellaneous” and “effets personnels” (referring to EEE as second-hand goods, etc.). In order to disguise illegal exports, even the labeling of used EEE may be manipulated in itself (e.g. false codes for used refrigerators or removal of generators of used refrigerators in order to classify them as “not containing CFCs”) and custom declarations are given to the competent authorities only on the day the ocean carrier is scheduled to sail. In Antwerp, there are even agents specialized in the export of used EEE (Öko-Institut et al. 2010). Both, the Dutch and Belgian port authorities emphasize that personnel and financial limitations are severe obstacles to achieving better control of exports of used and end-of life EEE. In addition, a clear distinction between used and end-of-life EEE is often difficult to determine in practice.

Furthermore, the container business is very flexible within Europe. If one port becomes congested or port fees rise significantly, containers can be easily shifted to other European ports. Similar behavior must be assumed if container controls for illegal waste shipments make one port unattractive for exporting used and end-of-life EEE. Therefore, effective control of e-waste exports requires a European-wide approach, which goes beyond the focus on individual ports.

Imported used and end-of-life EEE in Ghana.

4.4 The flow of goods from Europe to Africa: key findings

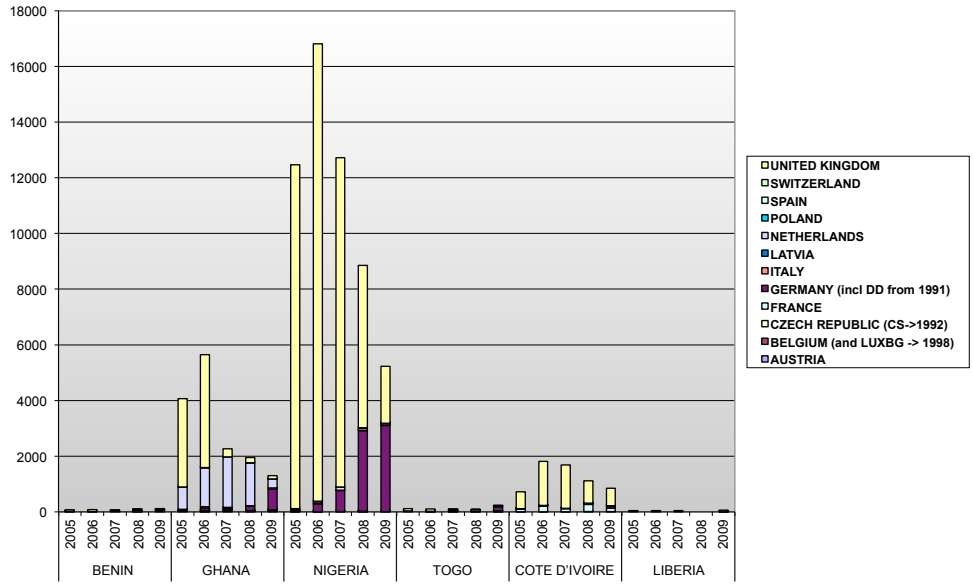
Due to the fact that a significant share of the exports of used and end-of-life EEE is incorrectly declared and recorded, finding reliable quantitative figures on the flows of used and end-of-life EEE from Europe to West Africa proved to be challenging. In addition, existing trade statistics do not differentiate between new and used equipment.

Nevertheless, an analysis of the existing trade data yields some indications on volumes and characteristics of the trade, which can be summarized as follows:

- Nigeria is the most dominant importing country for EEE and vehicles, followed by Ghana (figure 2. Note that this figure specifically refers to imports of television receivers and monitors).

- The UK is the dominant exporting country for EEE, followed with large gaps by France and Germany.

Figure 2: Seaborne import of television receivers and monitors in tonnes 2005-2009. Öko-Institut et al. 2010.



- Nigeria is the main recipient of used vehicles. Used vehicules often serve as 'transport packaging' for used and end-of-life EEE.

- Germany and Belgium are the dominant exporting countries for vehicles, followed by the UK and the Netherlands. Used and obsolete EEE are commonly co-shipped in vehicles.

- In the case of television receivers and monitors, it is apparent that German exports are sharply rising, while UK exports are declining. Both countries comprise nearly 100% of the television and monitor exports to West Africa.

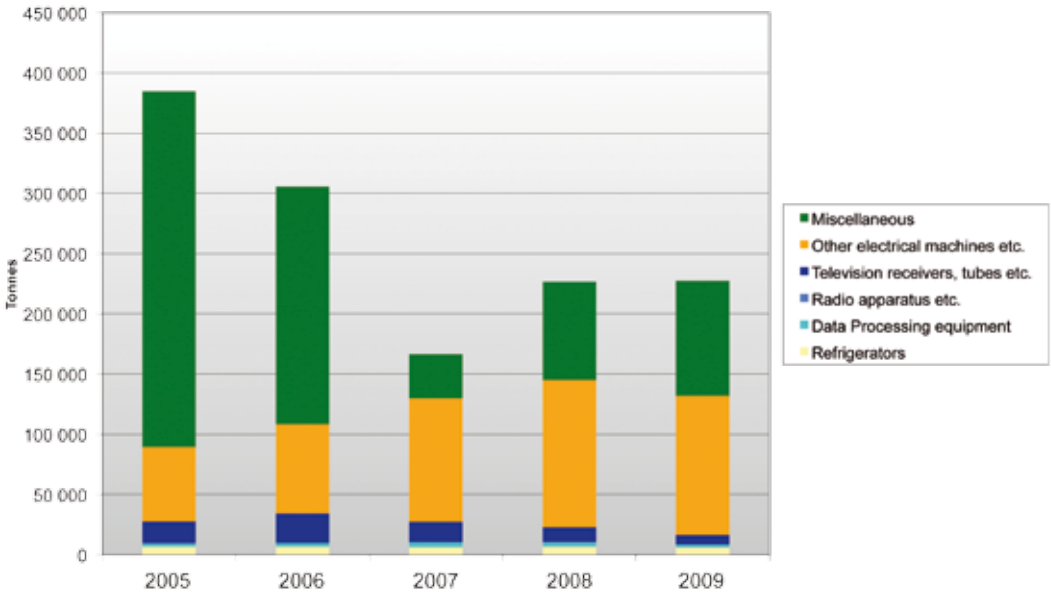
- The Netherlands' sharp decline of data processing equipment exports may indicate successful customs controls.

- Benin, Côte d'Ivoire and Togo generally show a high share of French imports, which may be explained by traditional relationships between the French-speaking countries.

- The case of export of refrigerators shows that countries other than those included in the scope of the study are relevant, e.g. Italy.

- An increase in inter-Sub-Saharan trade of EEE indicates that the port of entry does not necessarily match the final destination. This is also confirmed by the field studies in West Africa, which revealed that used EEE is often refurbished in specialized clusters, such as the Alaba International Market and the Ikeja Computer Village in Lagos, and then sold to traders from neighboring countries or beyond. Thus a regional approach may be required involving regional players, such as ECOWAS, in the environmentally sound management of e-waste, as well as in the control of illegal traffic in West and Central Africa.

Figure 3: Export of electrical, electronic and miscellaneous goods from EU27 to select West-African countries, 2005-2009. Öko-Institut et al. 2010.



- Miscellaneous goods are a significant share of the imports to West African countries. Since these types of shipments predominantly originate from Belgium and Spain, these two countries should further investigate the characteristics of such 'miscellaneous' goods (figure 3).

  In addition, the field studies conducted in West African countries completed this picture with the following findings:

- Many West African re-use markets prefer refrigerators and TVs from European countries, as power formats and broadcasting systems make the installation of these products much easier than those originating from North America. However, there is an indication that some countries, for example, Liberia, also import refrigerators and TV sets from the US because of the compatibility of the power and installation systems.

- In some West African countries, used EEE from Europe is perceived to have higher quality and durability as compared with lower priced new equipment imported from other regions.


Morocco
Algeria
Libya
Egypt
Western Sahara
(Occupied by Morocco)
Mauritania
Mali
Niger
Chad
Sudan
Eritrea
Djibouti
Cape Verde
Senegal
Gambia
Guinea Bissau
Guinea
Burkina Faso
Benin
Nigeria
Sierra Leone
Liberia
Cote d'Ivoire
Ghana
Togo
Cameroon
Central African Republic
Ethiopia
Somalia
Equatorial Guinea
Sao Tome & Principe
Gabon
Congo
Dem. Rep. Of Congo
Uganda
Kenya
Tanzania
Seychelles
Angola
Zambia
Zimbabwe
Mozambique
Madagascar
Comoros
Mauritius
Reunion
Namibia
Botswana
South Africa
Countries that participated in the E-waste Africa project

Chapter 5. Joining forces to prevent illegal transboundary movements of e-waste[10]

5.1 Challenges in monitoring and enforcing e-waste-related legislation

In the past decade, sales of electrical and electronic equipment have been steadily increasing on all continents while used televisions, computers, refrigerators and many other types of used electrical and electronic equipment have been exported from OECD-member countries, such as the European Union and the US, to non-OECD member countries. There are several factors contributing to the trade of used EEE. One important factor is the demand in the countries of import to have access to good quality second-hand equipment at an affordable price. A second factor is intentional and unintentional leakages of used EEE and e-waste from the formal to the informal sector in developed countries, possibly spurred on by stringent environmental legislation in the countries of export.

According to the provisions of the Basel Convention, transboundary movements of hazardous wastes can only take place after the prior informed consent procedure has been followed and all states involved have given their consent to the movement. Furthermore, the provisions of the Waste Shipment Regulation of the European Union label the export of waste with hazardous characteristics from Europe to any non OECD-country as illegal. There are several challenges that hinder the enforcement of these provisions.

A first challenge is related to definitional issues: is used EEE a second-hand good or a waste? Currently, the lack of clear, commonly agreed and binding criteria – whether at the international or national level - to distinguish second-hand EEE from e-waste hampers the work of enforcement officers, especially at the stage of screening documents that accompany the shipments of EEE and during visual inspections. Proving that a piece of used EEE is a second-hand good or e-waste is a time-consuming process that requires consultations between various stakeholders. There is ongoing work supported by SBC to develop technical guidelines on transboundary movements of e-waste, in particular regarding the distinction between waste and non-waste (latest draft version, February 2011). These technical guidelines were presented at COP 10 in October 2011 and further work is required prior to their adoption (possibly at COP 11 in 2013). In addition, some of the work undertaken under the Basel Convention Partnership Programme, particularly within the Mobile Phone Partnership Initiative (MPPI) and the Partnership for Action on Computing Equipment (PACE), should also help address this issue.

The second challenge is the issue of whether the particular waste is hazardous or non-hazardous. Although it can be assumed that, especially older EEE contains hazardous substances, it remains difficult to identify such substances in EEE, due to the costs and complexity of applying appropriate sampling, screening and analytical techniques as in certain cases internationally recognized sampling and testing standards are still lacking.

The third challenge is associated with selecting and targeting suspicious shipments of e-waste. In some cases, exporters of EEE do not declare the goods as waste, even though they should be considered waste (e.g. if the equipment is non-

[10] In addition to the West African countries of Benin, Ghana, and Nigeria, Egypt and Tunisia participated in the activities of this project component.

functional, is not properly packaged or is intended for disposal). Selecting the shipments to be inspected should be the result of a systemic process resulting from the analysis of collected information and intelligence, and the development of profiles. This approach requires knowledge and resources which may be lacking in West African countries.

The fourth issue arises in relation to ensuring that the waste is actually imported by the intended country and disposed of in an environmentally sound manner. Under the Basel Convention, competent authorities are responsible for receiving and responding to notifications, including on the completion of disposal as specified in the notification. However, one must acknowledge that there can be a gap between the paperwork and reality, thus the need for enforcement officers to step in. A good operational network of competent authorities and enforcement officers, both at the national and international levels, is a necessity. Such networks exist at the regional level, but a specific inter-continental network bringing together authorities from Europe and Africa to better prevent and combat illegal traffic of e-waste is still under development[11].

Lastly, lack of coordination at the national level poses problems not only in the area of enforcement of e-waste-related legislation, but also for the sound management of chemicals and waste in general. Preventing and detecting illegal traffic of hazardous waste requires the expertise of different ministries and agencies. Customs officers cannot combat illegal traffic alone. They have to rely on the relevant national environment agencies to provide them with the appropriate legal and technical information, equipment and facilities. Conversely, national environment agencies need the support of customs agencies. In the case of illegal traffic of e-waste, cooperation between environment agencies, customs, port authorities, and port police is crucial and mechanisms for cooperation and information exchange must be strengthened. Those agencies responsible for health and occupational safety issues and national security should also play a role in effective enforcement of laws and regulations preventing the illegal traffic of e-waste.

Training on environmentally sound recycling techniques.

5.2 Training activities on enforcement

In an effort to address the above-mentioned challenges, a number of enforcement training activities are included in the E-waste Africa project. The overall objective of these activities is to raise awareness of competent authorities and enforcement officers about the adverse impacts of illegal imports of e-waste on human health and the environment and to train authorities that are responsible for the monitoring and screening of the legal trade of used equipment and, conversely, for detecting and preventing illegal traffic of e-waste. At the meetings and trainings described below, both European and African authorities designed the functions of an international network of competent authorities and enforcement officers intended to facilitate the exchange of information on existing regulations and potential illegal shipments leaving Europe with African destinations. The participants supported the establishment of an enforcement network in Africa that would regularly meet and exchange information with similar networks in other UN regions.

[11] A communication tool and an e-waste enforcement network between partner countries in West Africa and European countries is being developed in the scope of the E-waste Africa project. Other activities aiming to improve enforcement of environmental legislation by setting up a sub-regional enforcement network in West Africa are underway.

5.2.1 Kick-off meeting "Clamping Down on Illegal Waste Shipments to Africa"

In November 2009, the training activities of the project were launched during a kick-off meeting on "Clamping Down on Illegal Waste Shipments to Africa" in Accra, Ghana. One of the aims of the meeting was to undertake a needs assessment in order to collect information regarding the current situation with respect to capacity, cooperation, legal powers and enforcement practices in Benin, Egypt, Ghana, Nigeria, and Tunisia. The purpose was to design a capacity-building programme in support of the enforcement of relevant international and regional legislation related to the import of e-waste in African countries.

Key issues identified at the workshop included the lack or absence of domestic legislation in some West African countries to provide customs and environmental officials with the necessary powers to request the take-back of illegally imported containers[12]; the need for a model of national law with a specific focus on e-wastes to be developed within the region; and the importance of good communication, collaboration and information sharing at the national and international levels which is essential for detecting and preventing illegal traffic of e-waste.

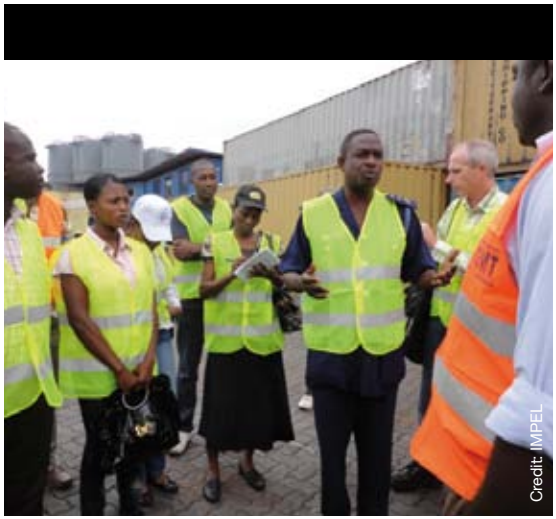
5.2.2 Train-the-trainers programme on inspection and enforcement in Europe

In September 2010, a two-week training event on e-waste management and the monitoring of transboundary movements of e-waste was organized in Europe for 19 African officials from Benin, Ghana, Nigeria and Egypt, as well as representatives from the BCCC-Nigeria and the BCRC-Egypt and BCRC-Senegal. The training was conducted by experts from IMPEL member countries (Belgium, Germany, the Netherlands, Norway and the United Kingdom) representing the ministries of the environment, inspectorates and customs authorities. Representatives from the private sector from Europe were also involved in parts of the training.

The training was set up in such a way as to familiarize the participants with the enforcement provisions of the Basel Convention, the European Waste Shipment Regulation and the Directive on Waste Electrical and Electronic Equipment. In addition, the global and European Union classification systems and regulatory regimes that are applicable to e-waste were presented at the event.

Besides theoretical sessions, the programme provided for practical exercises that were organized at the ports of Amsterdam and Rotterdam in the Netherlands, and at the port of Antwerp in Belgium. In addition, visits to e-waste collection and dismantling sites were arranged, where practical exercises focused on the classification of used EEE versus e-waste.

As the training was designed using the train-the-trainer concept, the programme also contained elements focusing on improving the training skills of government officials in partner countries.



Training: mock inspection.

5.2.3 National training workshops on inspection and enforcement in Africa

In 2011, a number of training workshops were organized to train representatives from environment authorities, inspectorates, customs, police and port authorities in selected African countries. The training workshops

[12] In countries operating under the monist legal system international law is directly applicable. However adoption of specific laws and regulations supporting the implementation of an international treaty is often required. For more information see section 2.4 of chapter 2.

focused, *inter alia*, on inspection and investigation, classification between used equipment and e-waste, and intervention. The workshops also included practical and simulation exercises, including a visit to a port where the participants discussed port procedures, inspections, safety matters and the identification of e-waste.

Besides acquiring better knowledge on how to monitor imports of used EEE and e-waste, the participants discussed the further development of an enforcement network supported by a communication and information exchange tool. Key staff from the authorities involved were identified to become a part of the enforcement network.

The first African national training workshop already took place in July 2011 in Tema, Ghana. The workshop was organized by the Environment Protection Agency of Ghana together with IMPEL, the BCCC in Nigeria, and SBC, in collaboration with Ghana Ports and Harbors Authorities, the Ghana Customs, Excise and Preventive Service and the Ports Environmental Network of Africa. Similar training workshops took place in Benin and Nigeria in September 2011 and in Egypt in October 2011.

The numerous training workshops and outreach activities organized in the scope of the project have raised awareness on e-waste challenges in the partner countries and, in some cases, contributed to the development of legislation aiming to tackle e-waste issues. For example, Nigeria has recently adopted National Environmental (Electrical/Electronics Sector) Regulations S.I. No. 23 of 2011 directly dealing with e-waste (see section 2.4.5, chapter 2) and the development of specific e-waste legislation in Ghana is under way. Furthermore, the awareness raising activities have helped strengthened the enforcement of the Basel Convention: between April and October, 2010 five ships from developed countries which carried containers with used TV sets, computers, refrigerators, monitors and vehicles co-loaded with used EEE, were intercepted in Lagos and Port-Harcourt, two busiest ports of Nigeria.

5.3 Training materials on enforcement of e-waste legislation

To support the training workshops, training materials on e-waste enforcement were prepared within the scope of the project. One of the key training materials, an e-waste inspection and enforcement manual, was pilot-tested during the trainings. The manual offers practical guidance and background information to regulatory and enforcement officers who deal with transboundary movements of used electrical and electronic equipment and e-wastes. While action by both the countries of export and import is important to effectively enforce the provisions of the Basel Convention, the manual primarily focuses on the countries of import.

Key themes addressed in the manual include communication and collaboration, port procedures, inspection and investigation, distinguishing between used EEE and e-waste, guidance on how to classify an inspected shipment, and intervention. The manual also provides for country-specific regulatory regimes and practices, with a focus on the countries participated in the enforcement programme of the E-waste Africa project.

The content of the manual is supported by photographs and examples of best practices. References to relevant initiatives and guidelines are also included, such as developments under the Mobile Phone Partnership Initiative and the Partnership for Action on Computing Equipment. The manual will be available in English and French on the website of the Basel Convention.

Chapter 6: Conclusions and recommendations

The baseline findings point towards several challenges for West African countries in managing e-waste. Specific challenges are related to the control of used EEE imports, collection strategies and sound technological recycling solutions, as well as support through policy, economic instruments, and legislation.

6.1 Imports

The studies conducted in five West African countries suggest that up to 70% of all imports are used EEE, with 30% of the used EEE imported being determined to be non-functioning (hence should have been defined as e-waste): half of this amount was repaired locally and sold to consumers and the other half was unrepairable. It is unclear how much of the remaining imported used EEE functioned for a reasonable time after it was sold. This so called "near-end-of-life" equipment can be another major source of e-waste which was imported into West African countries as equipment but turned into waste in a relatively short time. In absolute numbers, Nigeria dominates the region in the total amount of used and new EEE imports, total number of EEE in use and the subsequent total amount of e-waste generated.

Altogether it is roughly estimated that during the past few years, at least 250,000 tonnes of e-waste per annum "illegally" entered the ports of the five selected West African countries, namely Benin, Côte d'Ivoire, Ghana, Liberia, and Nigeria. This number is comparable to the total amount of e-waste generated in small European countries such as Belgium or the Netherlands, and equates to approximately 5% of all e-waste generated in the European Union.

In addressing this issue, one major challenge for West African countries is to prevent the import of e-waste and near-end-of-life equipment without hampering the meaningful and socio-economically valuable trade of used EEE of good quality. Refurbishing of EEE and the sale of used EEE is an important economic sector in some countries of West Africa (e.g. Ghana and Nigeria). It is a well-organized and dynamic sector that holds the potential for further industrial development. Indirectly, the sector has another important economic role, as it supplies low and middle income households with affordable ICT equipment and other EEE. In view of the sector's positive socio-economic performance, policy measures aiming to improve e-waste management in West Africa should refrain from the undifferentiated banning of second-hand imports and refurbishing activities, and strive for a co-operative approach inclusive of market and sector associations supporting the refurbishment of EEE.

This analysis is based on the data gathered through national e-waste assessments in Benin, Côte d'Ivoire, Ghana, Liberia, and Nigeria. Such data is important for national decision-makers to take informed policy and economic decisions in relation to e-waste. Therefore, efforts to retain and update data in relation to EEE imports and e-waste should be continued. Furthermore, other countries in the region should consider completing national e-waste assessments or surveys.

6.2 Collection and recycling

Even if the trade of used EEE is controlled, Benin, Côte d'Ivoire, Ghana, Liberia and Nigeria will still face major challenges in relation to proper management of domestically generated e-waste. It can be assumed that at least

50% of e-waste is generated by the consumption of new or used EEE of good quality with a reasonable life-span. In addition, up to 30% of waste originates from the consumption of EEE which was imported as used EEE of unclear quality. For the five selected West African countries, this is between 650,000 and 1,000,000 tonnes of domestically generated e-waste per annum, which at a certain point needs to be managed.

High volumes of domestically generated e-waste require well-functioning local take-back and recycling systems. Challenges include the establishment of appropriate collection strategies, ensuring that high volumes of valuable and non-valuable waste fractions are collected equally and that those fractions reach appropriate treatment and disposal facilities. In addition, connecting informal collectors to a formal recycling structure is pivotal, along with appropriate capacity building and training. Informal sector activities can provide a basis to develop a more advanced recycling industry, and generate income opportunities for impoverished parts of the population. Any strategy addressing e-waste management should therefore carefully consider the possible roles of the informal collection and dismantling sectors before establishing a parallel system in competition to these structures. In particular, it is recommended that those entities which are currently engaged in informal e-waste collection and pre-processing become officially acknowledged as key players in the recycling chain. To ensure that these operations are performed in an environmentally sound manner, it is vital to integrate health and safety precautions into informal practices, as well as to offer opportunities for the informal sector to gradually transform itself into a formalized structure.

Recycling activities with adverse impacts on human health and the environment, such as the open burning of cables, require the immediate attention of governments. As specialized recycling companies only operate on a very small-scale in West Africa, another challenge is to attract investments for sound and locally adapted recycling technologies. Taking socio-economic conditions into account, locally adapted recycling technologies for West Africa should make use of the abundant labor force, instead of deploying expensive shredding and sorting machinery. In addition, treatment possibilities for hazardous fractions need to be identified. Further refining processes – especially those for precious metals – need to be carried out in state-of-the-art facilities that are available in very few countries globally. To ensure a maximum yield of valuable recycling fractions, West African recyclers are encouraged to interlink with international recycling companies and networks to develop market outlets for their pre-processed e-waste fractions for a maximized return of value for secondary raw materials. This also requires government bodies to guarantee efficient and reliable handling of export licenses and other administrative procedures to facilitate exports of certain e-waste fractions.

Activities to further investigate options and arrangements for the sound recycling of e-waste need to be carried out in the form of pilot initiatives and specific studies on viable business models applicable to Africa.

6.3 Policy and legislation

It is an encouraging sign that Nigeria has adopted specific regulations for the management of e-waste, and that a similar development is underway in Ghana. In Benin, Côte d'Ivoire and Liberia, similar processes at the governmental level are yet to be initiated. The implementation and enforcement of this specific e-waste legislation in Nigeria and Ghana will bring its own challenges. It will be key to ensure that all actors will play by the same rules. In addition, existing policies and legal frameworks, particularly those related to the environment, waste management, and health and safety, need to be properly enforced, posing the additional challenge of coordination between different regulatory bodies.

A sustainable e-waste management system will require an adequate financing scheme, a level playing field and appropriate market incentives. It is thought that similar to policies in OECD countries, e-waste recycling systems in Africa could be developed under the principle of Extended Producer Responsibility (EPR). Producers and importers could be given the responsibility to manage the waste generated from their products. While the regulatory framework needs to be clear and precise in defining the obligations for the main actors, it should give producers and importers some flexibility in choosing their preferred approach to implementing a sustainable system.

When designing national EPR policies in Africa, issues such as to how to deal with illegally imported e-waste and counterfeit goods and who should be responsible for its recycling/disposal (and associated costs) should be carefully considered. In addition, establishing recycling facilities in West Africa which operate in accordance with international standards and practices and which could partner with producers would be vital when developing EPR systems.

In this regard, further projects and initiatives supporting the governments in West Africa, in addition to other African countries, to draft and adopt policies and legislation addressing e-waste challenges will be necessary.

An increase in inter-Sub-Saharan trade of EEE indicates that the port of entry is not necessarily the same as the final destination. Used EEE is often refurbished in specialized clusters and then sold to traders from neighbouring countries or beyond. Cooperation between African countries and the adoption of a regional approach (with involvement of sub-regional economic blocks such as the Economic Cooperation of West African Countries (ECOWAS)) supporting the environmentally sound management of e-waste, as well as control of illegal traffic in West and Central Africa, will be key in developing solutions to the e-waste problem in Africa.

6.4 Enforcement

As used and near-end-of-life equipment is a major source of equipment imported into West Africa which becomes waste in a relatively short period of time, effective control of imports of EEE should be exercised by governments through the adoption of a set of measures to strengthen implementation and enforcement of applicable legislation. While the adoption of policy and legislation regulating used EEE and e-waste, as well as the national implementation of international law (e.g. the Basel Convention), establishes the necessary regulatory regime, the implementation and enforcement of this legislation is a vehicle to achieve tangible success in this area. Effective enforcement of legislation and regulations, as well as the existing gaps in legal regimes supporting hazardous waste management in West Africa, remain a challenge.

Resource limitations are a serious obstacle to achieving better control of the problematic imports of used and end-of-life EEE. However, despite the financial limitations of enforcement authorities in West Africa and the fact that they face a broad range of issues such as the traffic of drugs, weapons, endangered species, etc., there are measures that can facilitate the enforcement of legislation to address e-waste challenges.

Coordination at the national level is essential, not only in the area of enforcement of e-waste-related legislation, but for sound chemicals and waste management in general. Preventing and detecting illegal traffic of hazardous waste requires the combined expertise of different ministries and agencies. Customs officers cannot combat illegal traffic alone. They rely on the relevant national environment agencies to provide them with the appropriate legal and technical information, equipment and facilities. Conversely, national environment agencies need the support of customs agencies. In the case of illegal traffic of e-waste, cooperation between environment agencies, customs, port authorities, and port police is crucial and mechanisms for cooperation and information exchange should be developed and operationalised. Health and occupational safety, as well as national security agencies, should also play a role in the effective enforcement of laws and regulations preventing illegal traffic of e-waste.

International cooperation between regulatory and enforcement authorities would allow the prevention and tracing of e-waste imports into West Africa. An operational international network of competent authorities and relevant enforcement entities is a necessity. Although successful examples of regional level networks do exist, an inter-continental, responsive and time-efficient enforcement network is still under development. Under the E-waste Africa project, a communication tool supporting an e-waste enforcement network between partner countries in Africa and Europe was developed. Efforts are now needed to build on and intensify this work between governments in Africa and Europe, with the support of the international community.

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