Independent Terminal Evaluation

Investment Promotion on Environmentally Sound Management of Electrical and Electronic Waste in East Africa with Focus on Ethiopia

UNIDO Project No: 120227

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO INDEPENDENT EVALUATION DIVISION

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EXECUTIVE SUMMARY

This evaluation has been conducted by an international consultant, Mr. Rudolf J. Stefec and a national consultant, Ms. Bezawit Eshetu Gizaw. The evaluation covers the whole project duration starting July 30, 2012 (project commencement date) to December 31, 2017 (project termination date).

The purpose of this Terminal Evaluation is to assess to what extent the project has achieved the expected results of addressesing the issue of e-waste management in Ethiopia by promoting environmental sound methods and state-of-the art technologies.

By most accounts, Ethiopia is a poor developing country struggling on many fronts of her development. The problems are not the same though all across this large country: in rural Ethiopia 96.3% are poor while in the urban areas the percentage of poverty is 46.4%; Addis Ababa has the smallest percentage of poverty at 20%. Manufacturing in Ethiopia, as in most of Africa, often has to contend with the very basics - held back by long-standing issues related to infrastructure, skills and institutions. There is significant potential, but still not globally competitive. Also, electricity access remains inadequate.

However, in marked contrast to the above critical observations, Addis Ababa - paralleled no doubt by other Ethiopian cities and towns - offers a rather positive picture: vibrant construction activity extends city-wide and entire squalid neighborhoods are being replaced by modern housing. Real GDP growth is expected to average 6.3% over 2017-21. Also the more detailed forecast summary for Ethiopia is fairly positive, with real GDP growth ranging from 5.7 to 7.0, at 6.7-7.9 annual consumer price inflation expected during this period. Ethiopia aims to achieve middle-income status by 2025.

The situation in the area of information and communications technology (ICT) is equally hopeful. The Ethiopian Government has made the development of ICT one of its strategic priorities, having recognized ICT as the key driver and facilitator for preparing Ethiopia's economy and society to enter the information age. The national operator, Ethio Telecom provides fixed, mobile, Internet and many value added services. There were 790 thousand fixed line telephone subscribers and over 23 million mobile telephones in the country in 2013. As of 2015, Ethio telecom has launched a new call center hosting business model and tariff for its new enterprise customers, and the Fourth Generation (4G) Long-Term Evolution (LTE) service.

There were 656 thousand personal computers in private households in the 10 largest cities of Ethiopia in 2011, and 263 thousand PCs were legally imported into Ethiopia in the same year. No recent statistics are available but the upward trend is evident because market penetration of EEE is rapidly increasing. To this have to be added the computers used in Government, business companies, NGOs and communal facilities.

According to another source, there were ca. 4,300 tons of non-functioning computers, televisions, mobile phones and refrigerators in Ethiopia, mostly in the ten largest cities, in 2013.

Given the growth in the ICT sector in Ethiopia, the Ethiopian government and their partners felt that the e-waste management strategy for Ethiopia would be important to develop now, before e-waste management becomes a crisis situation, due to increased volume, insufficient capacity for managing e-waste, and lack of knowledge of appropriate treatment technologies.

The focus of attention of the UNIDO project presently under terminal evaluation has been (i) the strategy for Ethiopia in the area of waste electronic and electrical equipment (WEEE) and (ii) the upgrading of the Akaki DMF (demanufacturing facility) assisted by the project benefactors. The country is confronted with the challenge of having to cope with ever-increasing volumes of used and discarded consumer and industrial products turned to waste; her problem is greater and more pressing because of the large size of the country. Out of the many types of waste generated, WEEE management has already become urgent, and its importance is bound to be mounting as this equipment will become more widespread.

WEEE coming from a range of goods starting with television sets, mobile phones and other telecommunications equipment is globally one of the fastest growing waste streams. Its main environmental impact arises due to inappropriate processing of the toxic contents that are partly released to the environment during unsound processing and/or disposal. By leaving the WEEE unsorted and untreated, valuable materials that could find use in a number of high-tech industries are getting lost.

Thus the task of the ambitious UNIDO Project now being subjected to terminal evaluation.

To dampen unwarranted optimistic expectations however, it is worth pointing out that not only in the developing world but also in the most advanced countries such as the U.S. the future of electronic waste recycling remains an open issue. US EPA estimates that less than 15% of e-waste is properly recycled. And globally, even though e-waste generation and recycling statistics vary significantly between sources, it appears that more than 50 million tons of e-waste were discarded in 2009 and 72 million tons were disposed in 2014.

By the end of the project in 2017, the main evaluation objective was to determine how successful the project has been.

The overall objective of the project was to promote and up-scale the management of e-waste activities in Ethiopia.

The immediate objectives achieved to this end included: (i) Policy and regulatory support—Establishing national e-waste strategies including necessary legislative and policy measures on the sound management of e-waste; (ii) Enlargement of current operations—Reviewing the existing e-waste treatment infrastructure and upscaling the Akaki DMF to sustainably operate higher volumes in compliance with

environmental and health standards; and (iii) Evaluation and monitoring—Coming up with an evaluated and monitored e-waste management strategy.

These objectives were achieved to a high degree of success at the level of draft policies and recommendations for Ethiopia as a country, and to a moderate degree of success as to the upgrading and streamlining of operations at the Akaki DMF.

Summary of main findings:

(i) The project presently submitted to terminal evaluation demonstrates the farsightedness of all the stakeholders, primarily of the Ethiopia Government, GEF, and UNIDO. The project design was excellent and the multiple expert reports commissioned delivered a wealth of valuable information yet to be fully utilized. Project implementation at Akaki DMF has been relatively successful even though it has missed the opportunity to become a model operation.

(ii) The number of project stakeholders listed was very high and only some of them made substantial contributions to the project.

(ii) The recently approved e-waste legislation initiated by the Ministry of Environment, Forestry and Climate Change (MEF) is a decided step forward. Its resolute implementation as well as a continued legislative progress are preconditions to successful capacity building in the future.

(iii) The training programs/courses run were no doubt useful but their impact and potential overlaps need to be examined. Course curricula should be discussed with trainees, presented and posted.

(iv) Main project focus, in both design and implementation, was on upgrading the dismantling facility at Akaki which was used for the collection and disposal of used PCs, with less focus if any on recovery and processing of the wastes.

(v) The machinery provided under the project is not being used in an optimal manner, and the workflow at the facility is not sustainable; only a minor share of the products of dismantling has found its outlets so far.

The evaluation team recommends that:

(i) Relevant Ethiopian Government Ministries endeavor to update the country's EEE and WEEE statistics; to implement a nation-wide WEEE collection system with participation by both the public and the private sector; and to plan an expansion of the WEEE treatment and recovery facilities in the long term as the e-waste issues will no doubt become more urgent with time;

(ii) The Akaki DMF facility should be expanded only after its workflow will have been streamlined, its technology fully used, and outlets found for all of its products.

(iii) UNIDO should be invited to put its wealth of experience to use in any future expansion, such as in dealing with other categories of WEEE; a possible shift of focus in the nature of the WEEE presently processed should be anticipated,

probably away from PCs, toward mobile phones and, increasingly, towards optical devices.

(iv) UNIDO should maintain good contacts with the African WEEE scene, in order to foster a true international cooperation; and

(v) The experience acquired by both UNIDO staff and the experts involved during the design and implementation of the Akaki DMF project be further exploited by taking an active part in an experts' conference to be held in cooperation with Ethiopia Government in 2018 and mainly in any subsequent expansion of the WEEE collection, dismantling, and recovery schemes in Ethiopia and elsewhere in Africa.

1 EVALUATION OBJECTIVES, METHODOLOGY AND PROCESS

1.1 Evaluation objectives

The purpose of the final evaluation was to determine the degree of success of the project in developing a comprehensive strategy for e-waste management in Ethiopia.

The key duties of the International consultant included reviewing project documentation and relevant country background information; determining substantial data in a field mission; p reparing the evaluation report, with inputs from the National Consultant.

The scope covered the three components of the Ethiopia WEEE project:

1. policy and regulatory support at the level of Ethiopia as a country;
2. enlargement of current operations at Akaki; and
3. evaluation and monitoring of the e-waste management strategy adopted.

The core stage of the terminal evaluation—the field mission—took place during the week from 14 to 20 October 2017, preceded and followed by the experts' home-based work. An international expert (21 days, of which 5 days on a field mission to Addis Ababa and Akaki) and a national expert (21 days on project site in Addis Ababa and Akaki) cooperated on the evaluation. They proceeded according to their respective Terms of Reference to meet the evaluation objectives as spelled out in the TOR (*cf*. Annex 1).

1.2 Methodology and process

The whole project was assessed from its starting date in July 2012 to its termination by the end of 2016, with minor overlaps into 2017.

Interviews were conducted as necessary according to the evaluation work program (Annex 2) and, to some degree, in informal discussions. Meetings were arranged with the local UNIDO staff, two Government Ministries, and the PAN-Ethiopia Association (an important stakeholder of the project). These meetings proved useful.

The Rating tables as per the TOR (Annex 6) were answered in great detail. The outcomes, outputs and activities envisaged by the project were examined and compared with the actual results observed during the terminal evaluation, always bearing in mind the previous project experts' reports and the benchmarks which offered themselves from the extensive experience reflected in part in the chapter devoted to international

comparisons—*i.e.*, how things are being done on the international scene and in a range of foreign countries. However randomly these countries had been chosen, their selection was wide enough to allow for a representative view of the general WEEE situation and of its reflection on Ethiopia.

The Evaluation work program is shown in Annex 2, the List of abbreviations and acronyms is in Annex 3 and the List of persons met can be found in Annex 4.

The list of documents reviewed is shown in Annex 5, while Annex 9 is a technical essay where the evaluator presents the international scene in terms of WEEE, along with different national cases.

2 COUNTRY AND PROJECT BACKGROUND

2.1 Country background

According to The Global Multidimensional Poverty Index (MPI) [1], published by Oxford University, Ethiopia ranks the second poorest country in the world just ahead of Niger. An Oxford University study [2] claims that in rural Ethiopia 96.3% are poor while in the urban area the percentage of poverty is 46.4%; Addis Ababa has the smallest percentage of poverty at 20%. Clearly, poverty remains a widespread problem across the whole country.

Manufacturing in Ethiopia, as in most of Africa, is still struggling with the basics—held back by long-standing issues related to infrastructure, skills and institutions. There is significant potential, but still not globally competitive. Also, electricity access remains inadequate.

However, in marked contrast to the above not too positive statements, Addis Ababa—paralleled no doubt by other Ethiopian cities and towns as well—offers a rather cheerful picture to the eye of an inquisitive stranger: vibrant construction activity is omnipresent, and in a sweeping action which is city-wide, entire squalid neighborhoods are being replaced by modern housing developments.

According to Economic Intelligence Unit [3], real GDP growth is expected to average 6.3% over 2017-21 given existing constraints. This is basically in line with the average annual growth in Sub-Saharan Africa, set to exceed 5% over the next five years.

Also the more detailed forecast summary for Ethiopia is fairly positive:

Table 1. Forecast on Ethiopian outlook

	2016	2017	2018	2019	2020	2021
Real GDP growth	7.6	6.1	5.7	6.2	6.5	7.0
Consumer price inflation (av)	7.3	7.9	7.3	8.4	6.7	

Ethiopia aims to achieve middle-income status by 2025 [4].

Equally hopeful is the situation in the area of information and communications technology (ICT). The Ethiopian Government has made the development of ICT one of its strategic priorities [5]. The policy stems from the recognition by the Government of ICT as the key driver and facilitator for transforming Ethiopia's still predominantly subsistence-agriculture economy to an information and knowledge-based economy and society, effectively integrated into the global economy.

The 2013 statistics available on the Ethio Telecom website (the national telecommunication operator) indicates there were 790,188 fixed line telephone subscribers; 5359 public telephones; 136,744 CDMA (Code Division Multiple Access) telephones; 76,504 dial-up internet hook-up

points; 23,637,007 mobile telephones; and other telecommunication facilities. As of 2015, Ethio telecom has launched a new call center hosting business model and tariff for its new enterprise customers, and the Fourth Generation (4G) Long-Term Evolution (LTE) service in line with its commitment to provide modern and state of the art technologies.

According to a 2013 study by an expert from Öko-Institut e.V. in Freiburg, Germany and his Ethiopian colleagues of PAN Ethiopia [7], the in-use stock of personal computers in private households in the 10 largest cities of Ethiopia was 656 thousand pieces, the total number of PCs legally imported into Ethiopia was 263 thousand pieces, and the stock of non-functional PCs in the 10 largest cities of Ethiopia in 2011 by weight was 3,200 tons as far back as in 2011.

As at 2011/2013, the use of many types of EEE in Ethiopia was mostly restricted to urban centers (except for battery-powered devices in rural areas). E-waste was not yet a major source of environmental pollution or health and safety impacts (compared to *e.g*., Ghana or Nigeria). Nevertheless, the situation also required action as market penetration of EEE was rapidly increasing.

A questionnaire survey [8] indicated that the total number of obsolete e-goods in Bole and Akaki Kaliti (two of the ten sub-cities of Addis Ababa) was 5654 pcs in 2013/2014. All these statistics fall short of meeting any demands on completeness and up-to-datedness, and yet are indicative of a problem that is becoming ever more urgent.

Given the growth in the ICT sector in Ethiopia, the Ethiopian government and their partners felt that the e-waste management strategy for Ethiopia would be important to develop now, before e-waste management becomes a crisis situation, due to increased volume, insufficient capacity for managing e-waste, and lack of knowledge of appropriate treatment technologies.

The focus of UNIDO project presently under terminal evaluation has been (i) the strategy for Ethiopia in the area of WEEE and (ii) the upgrading of the Akaki DMF (demanufacturing facility) assisted by the project benefactors. The country is confronted with the challenge of having to cope with ever-increasing volumes of used and discarded consumer and industrial products turned to waste; her problem is greater and more pressing because of the large size of the country. Out of the many types of waste generated, the management of waste electronic and electrical equipment (WEEE) has already become urgent, and its importance is bound to be mounting as this equipment will become more widespread. Indeed the problem is becoming more urgent as time goes on.

E-waste, also termed WEEE, is globally one of the fastest growing waste streams [4]. Its main environmental impact arises due to inappropriate processing of the toxic contents that are partly released to the environment during unsound processing and/or disposal.

WEEE come from a range of goods starting with television sets, mobile phones and other telecommunications equipment. By leaving the WEEE unsorted and untreated, valuable materials that could find use in a number of high-tech industries are getting lost.

Much more detailed information also reflecting on Country background can be found in the various reports prepared by the experts who collaborated on the project; these are outlined in Chapters 2.3, 3.1 and 3.2. A rough recapitulation of the respective focal areas of activity covered by each of the major expert reports is rendered in Table 1.

2.2 Project background

The project "*Investment promotion on environmentally sound management of electrical and electronic waste: upscale and promotion of activities and initiatives on environmentally sound management of electrical and electronic waste*" started on 30 July 2012 and ended at the end of 2017.

The project was designed to avoid most of the negative impacts experienced in other developing countries, due to high volumes of e-waste in absence of an e-waste management strategy. In addition, the project had the potential to be replicated within other East African countries.

Funded by the GEF, co-financed by local and international institutions and benefitting also from minor contributions by the private sector, the project addresses the issue of e-waste management in Ethiopia by promoting environmental sound methods and state-of-the art technologies.

2.2.1 Project Factsheet

Project Title	Investment promotion on environmentally sound management of electrical and electronic waste: up-scale and promotion of activities and initiatives on environmentally sound management of electrical and electronic waste
UNIDO project No. and/or SAP ID	SAP ID: 120227
Region	Africa
Country(ies)	Ethiopia
GEF project ID	5040
GEF focal area(s) and operational programme	GEF 5: POPs
Project GEF CEO endorsement / Approval date	30 July 2012
Implementing agency(ies)	UNIDO
Executing partner(s)	Ethiopia Environmental Protection Authority; Ministry of Communication, Information and technology
Project size (FSP, MSP, EA)	MSP

Project implementation start date (First PAD issuance date)	30/07/2012
Original implementation end date	30/07/2014
Donor(s):	GEF
Actual implementation end date	31/12/2017
Project Budget	2,955,555
UNIDO co-financing	Cash: 30,000 In-kind: 30,000
Total co-financing at design (cash and in-kind)	Cash: 492,143 In-kind: 1,463,412
Materialized co-financing at project completion (cash and in -kind)	1,955,555

2.2.2 Immediate objectives of the project

Expected Focal Area outcomes [4]:
Contribute to the overall objective of achieving the sound management of chemicals throughout the life-cycle of electrical and electronic equipment in ways that lead to the minimization of significant adverse effects on human health and the environment.

Expected Focal Area outputs:
Countries receiving GEF support to implement SAICM (Strategic Approach to International Chemical Management) relevant activities, including addressing substances and other chemicals of global concern on a pilot basis.

Project objective: Promote and up-scale the management of e-waste activities in Ethiopia by implementing the project components as per Table 2.

Table 2. Components of the Ethiopia WEEE project

Project component	Expected outcomes	Expected outputs
Policy and regulatory support	Establishing national e-waste strategies including necessary legislative and policy measures on the sound management of e-waste.	Project integration in the national stakeholder process, Legal and policy frameworks. Verification of studies and a data base of future e-waste flows. Dissemination of e-waste management strategy to other African countries.
Enlargement of current operations	Reviewing the existing e-waste treatment infrastructure. Upscaling to sustainably operate higher volumes in compliance with	Design and implementation of an effective e-waste collection scheme. A business model for the DMF facility. Improvement and adjustment of operations at Akaki DMF so that the

	environmental and health standards	facility can serve as a regional training center and model in East Africa. Raising general awareness of e-waste; promotion of the collection scheme. Cooperation with international smelters.
Evaluation and monitoring	An evaluated and monitored e-waste management strategy.	Regular monitoring of project. External evaluation of project.
Total amount of grant		**USD 1,000,000**
Total project co-financing		**USD 1,955,555**

2.2.3 Main justification of project

The main objective of the project was to promote and up-scale the management of e-waste activities in Ethiopia.

The ultimate beneficiaries of the project are: (i) the national government of Ethiopia and neighboring countries that have committed to address e-waste in an environmentally sound manner; (ii) the private sector involved in local e-waste treatment in Ethiopia and the region, which was to benefit from aligning with an overall e-waste strategy for Ethiopia, and (iii) communities that would otherwise suffer from the effects of poor e-waste management.

Project justification is mainly based on the following factors:

- The GEF/5 Sound Chemicals Strategy – to promote chemical safety in the area of e-waste and to strengthen the political framework for chemical management within Ethiopia.
- Technology needs assessment – to identify, evaluate and prioritize technological means toward sustainable development.
- Climate resilient green economy strategy – through, for example, dismantling e-waste locally and only transporting the fractions that do not have a nearby downstream market to international partners for further processing.

2.2.4 Organizational arrangements

Project implementation started in June 2012 and the initial project end date was in June 2014, with actual implementation target end date being June 2017. The project was to strengthen and upgrade the existing Computer Refurbishing and Demanufacturing facility in Akaki, on the outskirts of Addis Ababa, and aimed to develop it into a regional training center.

The project document foresaw an independent terminal evaluation (TE) scheduled from March – May 2017. Owing to various delays however, the terminal evaluation took place in the fall of 2017.

Besides the main 3 project components, the following issues were considered within this evaluation:

- Coordination;
- Establishment of systems and facilities;
- Provision of policy, legislative, and business instruments;
- Exchange of experience
- Organization of collection systems and trade in WEEE;
- Monitoring and assessment of the outcome of individual actions taken.

3 PROJECT FINDINGS AND ASSESSMENT

The Evaluation TOR required the evaluation team to approach this waste management project from several fundamental angles, including:

- assessing project design and execution;
- determining the relevance of the project;
- evaluating its effectiveness and efficiency; and
- taking a position regarding project sustainability.

Each of these would then be broken down into a number of subject areas and items to be identified, determined, documented and judged – see the following chapters and also the Rating tables in Annex 6. Furthermore, see also Annex 8 for a detailed description of the e-waste generation and building management in Ethiopia.

3.1 Design

The design of the project was excellent even though eventually, its overall quality was judged only as Satisfactory by the reviewers, in view of the insufficient attention paid to the flow cycle of stocks being processed at the Akaki DMF. The Logframe matrix is very well structured and the overall design is considered to be adequate even though some feedback was missing: little action was sometimes taken in response to the external experts‘ inputs.

3. 2 Relevance

Refer to Table 2 of Annex 6 – Rating tables for details.

Relevance and ownership relate to the national development priorities and Government strategies, as well as to target groups, the UNIDO mandate and counterpart involvement. The convergence between Ethiopian national policies and UNIDO’s mandate and specific expertise is very strong and proved by many interviews conducted by the evaluation team. In particular, UNIDO senior management in the field highlighted the urgency of increasing awareness of the national e-waste policy. The strategy is linking such projects with Sustainable Development Goals (SDGs) and the current UNIDO partnership for Country Program (PCP) engagements. In particular, this specific project has a particular relevance in view of its contribution and impact on UNIDOs Inclusive and Sustainable Industrial Development strategy.

MCIT acknowledged the support of UNIDO by providing technical inputs and recycling equipment for the Akaki facility. Currently there is a plan to upscale the Akaki capacity by building an additional facility and developing a feasible business model. MCIT reaffirmed the commitment of the Ethiopian government and as a way forward and called upon UNIDO to continue its support in this undertaking.
Relevance was judged Highly satisfactory by the terminal evaluators. Refer to Table 3, Item #7 of Annex 6 – Rating tables for details.

3.3 Effectiveness

3.3.1 Capacity building

The capacity building component focused on the Government facility in Akaki, some 25 km out of Addis Ababa.

StEP annual report. As per the StEP annual report 2012/2013 [18], to install an e-waste management system in Ethiopia, StEP has been instrumental in co-organizing a scheme whereby the Global Environment Facility (GEF) contributed USD 1 million, with further financial support and in-kind contributions coming from the Ethiopian Government and StEP members US-EPA, Nokia and Dell, as well as from non-StEP member, Cascade Asset Management, and with UNIDO functioning as the implementing agency while StEP and UNU would take on the international coordination of the project.

Under Task Force 3—Reuse, the main components of the sustainable e-waste management system were to be as per Fig. 1 below.

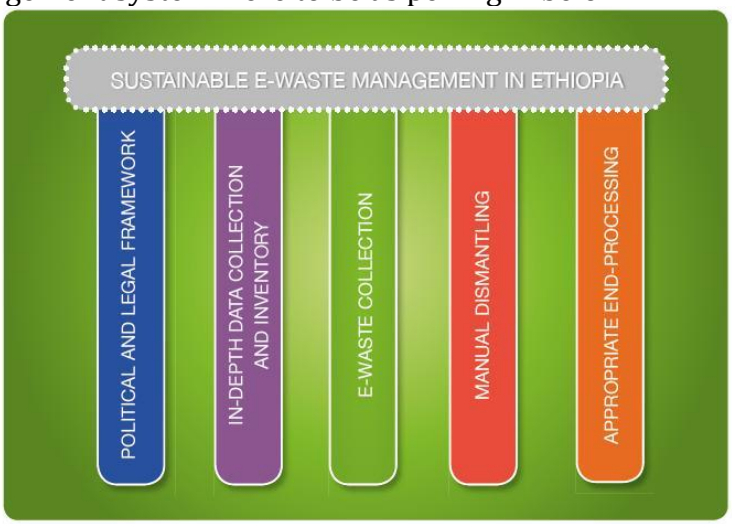

Fig.1. Main components of the e-waste management system in Ethiopia [18]

UNIDO's involvement in e-waste management at Akaki. The key elements of UNIDO's e-waste management approach [19] (outlined further in this report) were applied to Ethiopia's Akaki facility, too.

Technical specifications. Technical specifications applicable to bids for the purchase of recycling equipment to be used in the Akaki DMF were drawn up [48]. Both the technical services and the equipment required (two shredders, a cable stripper, a CRT cutter, and auxiliary equipment (hydraulic baler, scale, degausser, forklift) were specified, with stress laid on safety.

Findings on-site. With the official closing of the project the transfer of assets is still pending because there was an inventory discrepancy which is now cleared. However the assets still need to be transferred from UNIDO to Akaki DMF which is owned by the Ministry of Information & Communication Technology (MCIT).

The national steering committee plus an international committee, constituted of about 25 stakeholders, mainly focused on e-waste policy development, rather than on the Akaki facility.

The equipment supplied to upgrade the facility, worth USD 220,000, arrived rather late during the course of the project owing to UNIDO procurement delay, and its installation was delayed as well because the new facility building was not ready on time.

Numerous issues were dealt with during the course of the project, and a number of risks usually associated with any new type of project had to be resolved. The issues raised by facility staff with UNIDO, mostly concerned with the training and the actual operation of the facility, were mostly handled and resolved through mediation of the national project coordinator.

Civil construction scheduled for setting up the new building became delayed (for reasons not clarified to UNIDO by MCIT). At the time of the project intended termination in July 2016, the building was (almost) completed but the power installation was not in place.

At the time of the reviewers' visit, the main components of the Akaki Demanufacturing Facility (Akaki DMF), also alluded to as the Computer Refurbishment and Training Center (CRTC) under the MCIT, were two buildings adapted for minor manufacturing operations, the 'old' one and the 'new' one. The former building also houses the management offices and two meeting/training rooms seating up to ca. 25 + 25 = 50 trainees. There is also a separate, small Director's office building combined with a staff dining area.

The old building is used mainly for manual refurbishing of used computers and for storage of the disassembled components of which it has lately been filled up to overflowing.

The new building, rather a plant shed, was built as an Ethiopia Government project. The building is unfinished, still lacking electric power installations, due apparently to a contractor‘s default; or rather, the power outlets are in place but remain unconnected. The situation is to be remedied shortly – but has not been for some considerable time. In the meantime, UNIDO has asked for a clarification. This building also accommodates the equipment supplied under the UNIDO program that, consequently, cannot be used properly and is only switched on occasionally by cable connection to an external emergency electric power source. Thus the building also serves mostly for manual dismantling of old computer equipment, rather than for semi-automatic dismantling (*cf*. item 8 of Table 3 of the Rating tables annex, Annex 6). This new building also even more than the old one, is filled up to the ceiling with heaps of computer components, mostly left uncrushed and uncompacted.

This is documented by photographs taken during the terminal field mission (Fig. 2). Additional photographic documentation can be found in Annex 7. Photographic documentation is also available on the internet [49] from the Computer Refurbishment and Training Center at Akaki. Somewhat surprisingly, it has been posted on the internet by the U.S. Department of State. It is noted on

that website [49] that the demanufacturing center provides computers to schools.

Fig.2. Workshop area of Akaki DMF ('new building').

In the meantime, the machinery installed under the project, *i.e.*, the crusher line and the glass cutter, can apparently be operated by cable connection to an outside generator. It was not operated during the two days of the evaluators' visit to the site. And the glass cutter has never been used at all yet because the CRT glass would need decontamination first (removal of coatings on the glass that would interfere with glass remelting in subsequent processing).

Dismantling operations cannot continue like this indefinitely or even for any longer time because the facility is chock-full with semi-demanufactured components for which no market has been found. In fact, the least valuable and least environment damaging components, i.e., steel and aluminum sheet and various copper components, are being sold to state and/or private owned Addis Ababa companies, but all plastics, glass from monitors, semi-decomposed printers, and even the computer hard drives and PCBs, just keep piling up, with no sustainable solution in sight.

Outside the facility, on land owned by the CRTC and intended for future expansion, there also are heaps of dumped, probably partly sorted computer components.

The facility has a total number of 45 staff having expanded the number of its technicians, actually employed in the – mostly manual – dismantling work, from 6 to 10. There are 5 executives (depending on which positions are regarded as 'exec'), 8 guards, 8 cleaners, and the remainder are office staff. Thus the organization appears a little top-heavy, but not unreasonably so considering the local circumstances. The facility director and the director of the CRTC have received training abroad (in Belgium and in Kenya, respectively), and six technicians received the training locally. There were some minor labor disputes concerning the payment of DSA during the local training sessions. In fact there had been two trainings, one delivered by the company which supplied the mechanical equipment (Devotra B.V. in the Netherlands), and the next one by WorldLoop which the trainees had hoped would make them even more knowledgable about the machinery but was instead focused on manual dismantling.

It would make little sense for the facility to expand or even just hire more technicians unless and until the issues of downstream processing, i.e., of the market for the different components, are satisfactorily resolved. Simply speaking, as much material as is coming in must also be leaving the facility. This is also imperative for reasons of tidiness and orderliness of the workplaces, important in this kind of work where small-sized components are handled. In fact the primary idea of the valorization process recommended and initiated by WorldLoop was to provide for smooth facility workflow. And of course, the issues of making the machinery fully operational are urgent, too.

Of course, if no satisfactory outlet is found for some minor components resulting from the dismantling operations a temporary solution could be to build additional storage facilities (which may prove unavoidable anyway one day if there really is an expansion), but such a solution can only be temporary and is not sustainable.

There appear to have been some preliminary talks with some Chinese trader who might be willing to purchase some of the production. There has been unwillingness to dispose of the plastic components, which nobody wants, by incineration, but this seems to be inevitable, and in fact there seems to be a suitable incineration facility nearby. And of course, some of the dismantled components will eventually have to be dumped in any case, but no suitable dumps have been identified yet.

So far the facility has only been accepting old computers from government offices (and some NGOs), and intends to continue doing so. They do realize however that with computerization progressing there will soon be a predominance of WEEE from private business sources and even from private citizens. No strategy has been envisaged for these.

Yet another facet of the Akaki facility operations (again, outside the UNIDO project) is refurbishing computers and selling them to schools and hospitals. The assertion of thousands of refurbished computers thus disposed of seems unrealistic, especially in view of the fact that for most of the time of

the project, Akaki was employing only six technicians – but it is true that other technicians coming from CRTC were also being employed in the refurbishment. Actually, bids are made at irregular intervals for foreign computers and these are being purchased at prices of ~$95.00 apiece or less; rather divergent figures were given for the numbers of pieces taken in ranging from 2000 to 8000 per year. The refurbished computers are sold, at $130.00, to Ethiopian schools, hospitals, and community-based social undertakings.

A promotional leaflet, apparently dating back to early days of the facility, has been provided.

While the entire undertaking of addressing the WEEE issue in Ethiopia by demanufacturing old computers in a model facility is highly commendable and necessary, the Akaki facility in its present condition would rather defeat the purpose if it were to be used as a showcase and model for others to imitate.

3.3.2 Training

The training component of the Akaki operations appears to be promising:here trainees, in lots of up to 50, are receiving training for 12 days or 10-day training sessions focused on basic and advanced computer maintenance. The trainees are recruited from among vocational school students/graduates and/or government employees. The training is conducted by facility staff members. It is not clear how many such trainings have already taken place but, in any case, these trainings (of trainees from outside) must not be confused with the training received by the staff, and are in fact not covered by the present UNIDO project.

3.3.3 Optimization

Facility optimization. The 2015 WorldLoop mission report on the facility and on process optimization [50] dealt with potential optimization of the DMF. This should prepare the facility to scale up and upgrade its current operations. Based on a field mission, the current dismantling & sorting process was reviewed; a new DMF workshop lay-out was designed where an updated process flow should be adopted; a list of recommended upgrade equipment was drafted; and an updated process flow was proposed that would valorize the output fractions.

A number of critical observations were made:

- Workers in the DMF workshop did not perform any targeted depollution (*i.e.*, removing hazardous components) on PCBs.
- Aluminum and ferrous parts often found on mother boards, sound cards, video cards, etc. were not being removed although this would significantly raise the net value of the PCBs.
- The PCBs were not separated by grade reflecting the precious metal content.
- Data connectors were not being cut off but were stored together with the rest of the cable.

- No specific measures were in place to prevent loss or theft of the most valuable items.
- Identical output fractions were stored in different types of containers.
- The workshop floor was full of material while the pallet racks were empty.
- The Gaylord boxes used are expensive and a poor choice.
- Some important fractions of input and output materials were not listed, and there were overlaps between categories.
- Incoming material were not weighed upon arrival preventing effective control.

Chief recommendations were :

- Conduct an extensive hands-on training for DMF workers on depollution techniques, value maximization techniques as well as handling and storage guidelines for equipment containing hazardous material.
- Prepare to organize a first international shipment of sorted fractions.

However, it was recognized that initiation of the international sales and export procedures would be contingent upon meeting a number of prerequisites—first of all, upon identifying the buyer(s) and, thus, the importing country/countries.

3.3.4 Publicity and awareness raising

Waste information platform, According to a review of the e-waste management project [51], the Akaki DMF enjoyed considerable publicity; in 2015 an abstract of the project was also presented under the E-waste information platform of the Basle Convention Regional Centre for Asia and the Pacific [51], noting that UNIDO "commissioned this study to analyze national and international downstream markets for the above fractions, to link the DMF to these downstream markets, and to align the quality of the fractions and the business conditions to the market requirements" while the Ethiopian "Government has been developing new rules stipulating that public entities have to sell their metal scraps via the Public Procurement and Property Disposal Service". The project was commented on far and wide, including places such as Finland [9] and El Salvador [10].

Effectiveness was judged only moderately satisfactory, hampered as they were by multiple factors of which the failure to effectively use the machinery supplied to the Akaki DMF, to resolve the workflow problems, and to keep the place tidy and free from cumbersome overfilling were the most substantial. Refer to Table 3, Items #8 and 9 of Annex 6 – Rating tables for details.

3.4 Efficiency

3.4.1 Financing

Basic project financing information is summarized below in Table 3. More financial data is provided in Chapter 3.6.2 – Project funding and spending.

Table 3. Project financial information (GEF) [4]

GEF Agency(ies)	UNIDO	Grant $	Cofinancing $
Other executing partner(s)	Ethiopia EPA; MCIT		
Parent program	Agency fee	100,000	
Focal area objective CHEM-3	3.2 Overall SAIMV objective—sound mgmt of chemicals in EEE	955,000	1,843,555
	Project mgmt cost (GEF TF)	45,000	112,000
Total project costs		**1,000,000**	**1,955,555**
Components breakdown			
Component: Policy & regulatory support	National e-waste strategies	150,000	820,000
Component: Enlargement of operations	Review & up-scale	745,000	973,555
Component: Evaluation & monitoring		60,000	50,000
Cofinancing sources breakdown			
	US EPA	175,000	grant
	StEP	817,080	in kind
	Ethiopia MCIT	467,143	grant/in-kind
	Ethiopia EPA	416,332	grant/in-kind
	Cascade Asset Mgmt	5,000	grant
	Nokia	15,000	grant
	UNIDO	60,000	grant/in-kind
Consultants & other budget lines breakdown			
Tech. assistance component	Local consultants	198,000	12,000
	International consultants	390,000	200,000
Project management	Local consultants	8,750	30,000
	International consultants	36,250	30,000
	Office & travel	30,000	30,000

3.4.2 Project funding and spending

The UNIDO Annual Project Implementation Reports (PIRs). The PIRs [54-57] for the fiscal years 2013 through 2016 indicate milestones, funding, disbursement, and substantial progress as shown in Tables 5-13: Of these, Tables 5 and 6 are essential for assessing the financial aspects, whereas Tables 7-13 render the interim ratings of various aspects of project performance.

Table 5. Project milestones and funding

		FY2014	FY2015	FY2016
Milestones	*Implementation start*	***12/3/2012***	***3.12.2012***	***3.12.2012***
	Proposed implementation end	***4/30/2014***	***30.4.2014***	***30.4.2014***
	Revised implementation end	***4/30/2015***	***31.12.2015***	***31.7.2016***
	Actual implementation end	***NA***	***NA***	***NA***
Funding	Grant amount	**$1,000,000**	**$1 000 000**	**$1 000 000**
	GEF disbursement as of June 30	**$583,299**	**$967 484**	**$997 927**
	Confirmed Co-finance at CEO Endorsement	**$3,000,000**	**$3 000 000**	**$3 000 000**
	Terminal Evaluation Date	**4/30/2015**	**1.4.2016**	**31.7.2016**

Table 6. Project evaluation: GEF grant disbursement summary

Buli	**FY2014**	**FY2016**
1100 - International Experts	82,181.87	
1500 - Project Travel	44,083.90	64 337,78
1700 - National Experts	87,373.79	142 729,47
2100 - Subcontracts	286,746.43	319 426,27
3000 - Trainings/Fellowships/Study Tours	30,647	31 500,19
3500 - International Meetings	NA	40 937,82
4500 - Equipment	47,002	126 902,02
5100 - Sundries	5,263	17 645,48
TOTAL	**583,299.12**	**997 927,01**

Efficiency was judged moderately satisfactory.

3.5 Sustainability

In terms of sustainability, main stakeholders met by the evaluation team stressed in particular the importance of the three main factors involved in the sustainability of WEEE actions, namely ecology, potential profitability, and legislation.

Several stakeholders stated that the pilot project served as a medium to enhance awareness of the e-waste issues in Ethiopia, provide a significant input for the development of e-waste legislation, improve the management and the technology at the Akaki DMF thanks especially to the new equipment's and to training, and potentially, serve as a GEF model of a success story for Africa. As the next step, PAN-Ethiopia recommended developing a new concept based on an approach wider and more program-oriented than merely a project level; this could address related issues and concerns in the area of e-waste management.

3.5.1 Legislation

Naturally, the situation of Ethiopia in the legislative field has a direct bearing on the Akaki DMF. Especially, making collection of WEEE mandatory would free Akaki from the task of chasing down their incoming materials and, on the other hand, would make expansion more urgent as the incoming waste streams would multiply.

3.5.2 Potential profitability and downstream markets

National and international downstream markets. The 2015 study [45], with an extensive annex of valuable data and statistics, listed the major e-waste components arriving at Akaki DMF. These include steel scrap, aluminum and copper, printed wiring boards and plastics (Table 4). Each of these was analyzed in detail as to quantity and "visual quality" (Table 5), composition, sortability as well as to marketability *i.e.*, available national and foreign downstream markets, prices, and business and legislative conditions.

Steel, aluminum and copper can be sold in Ethiopia. Neither local nor regional markets were identified for PCBs and plastics. Access to international markets is difficult for a number of reasons; economy of scale also is a factor. A new landfill for Addis Ababa is mentioned as being under construction in Sendafa; it is doubtful whether this could ever accept hazardous waste.

Table 4. Main used electrical and electronic equipment coming to the Akaki Center in 2014 [45]

IT & accessories	Communication, consumer & other WEEE
CRT Monitors	CRT- and flat panel TVs
LCD Monitors	Telephony apparatus
Printers	Loudspeakers
Keyboards	Photocopiers
Mouse	Typewriters
Plotters	Refrigerators
Scanners	Electrical stoves
	Air conditioners

Table 5: Quantities of main fractions stored at the DMF in 2014 [45]

	Steel scrap	Aluminum	Copper	PCBs	Plastics
Qty stored at DMF (tons)	ca. 0.26	ca. 0.45	ca. 0.32	ca. 1.8	ca. 8.3
Apparent quality	Pure steel scrap	Pure aluminum scrap	Mix of naked copper parts and other waste, *e.g.* cables with insulation	Mix of low, medium & high grade waste; no removal of larger steel and aluminum parts	Mix of larger-sized parts of different plastics (unsorted but uncontaminated)

This 2015 study also mentions the unsatisfactory situation in 2014 regarding the specific e-waste legislation,

The study [45] presented multiple considerations—rather than recommendations—for each of the e-waste groups individually, plus a number of overall conclusions regarding the markets; the sorting and dismantling procedures; the buyer-specific optimization; the legal status of the Akaki DMF (mentioning the absence of common understanding about the DMF's institutional relationship to the CRTC, the ownership and supervision by MCIT, its status as a budgetary institution, and the resulting competences for the DMF and its management in terms of administrative procedures to be followed and entrepreneurial freedom); the sales procedures (mentioning *e.g.*, the necessity of applying for a VAT number and an export license), and financial incentives.

Other interviews were held with representatives from Akaki CRTC, discussing mainly the obsolescence of the electronic equipment they have received from Digital partners (out of the 20000 originally promised obsolete and used computers, 8000 have been received so far). Refurbished computers are sold to schools, community based organizations and hospitals. In refurbishing the printers, the working components are cannibalized from other printers. Also, cartridge toners are sold. However, the main source of e-waste inputs is from Government offices and local NGOs.

Discussions with a cement factory to use the plastics as fuel in the kilns were not successful because the factory would only accept larger volumes of plastics than the facility can provide. The shredder of plastics is not being used as it is "time consuming and unprofitable". Equally, the local glass companies are not interested in the glass from Akaki, so for the time being both the plastics and the glass are just kept in store; plans exist to build a new warehouse to provide more space for these.

PC hard disks and even the more valuable PWBs are also piling up because the dismantling of the former "is tedious and offers a low profit margin", while for the latter the facility has been unable so far to find any suitable market.

Sustainability hinges on attaining a smooth, streamlined workflow at the facility. The reviewers' over-all view of project sustainability was not very positive, owing to the risks preventing the facility from attaining a sustainable mode of operation. Refer *e.g.*, to Table 3, Item #11 of Annex 6 – Rating tables, or to the 'Findings on site' section of Chapter 3.2.1 Capacity building.

3.6 Project coordination and management

This section of the evaluation report addresses the issues of project management, project funding and spending, and various evaluation specifics and interim ratings.

3.6.1 Project management

Coordination and management issues are reflected in the interim reports outlined below. On the whole, project management was adequate. Also refer *e.g.*, to Table 3, Items #12 and 13 of Annex 6 – Rating tables.

UNIDO project EWAMP report (E-waste management project in Ethiopia). The 2016 final report [53] by the Institute for the advanced study of Sustainability of the UNU (UNU-IAS, renamed to UNU/ViE SCYCLE), acting in the capacity of International Project Coordinator, is concerned with (i) the national e-waste strategy and (ii) the Akaki DMF upgrade. It reviews the activities engaged in during the period from February 2015 until July 2016.

The rather complicated project management structure is depicted in Fig. 15.

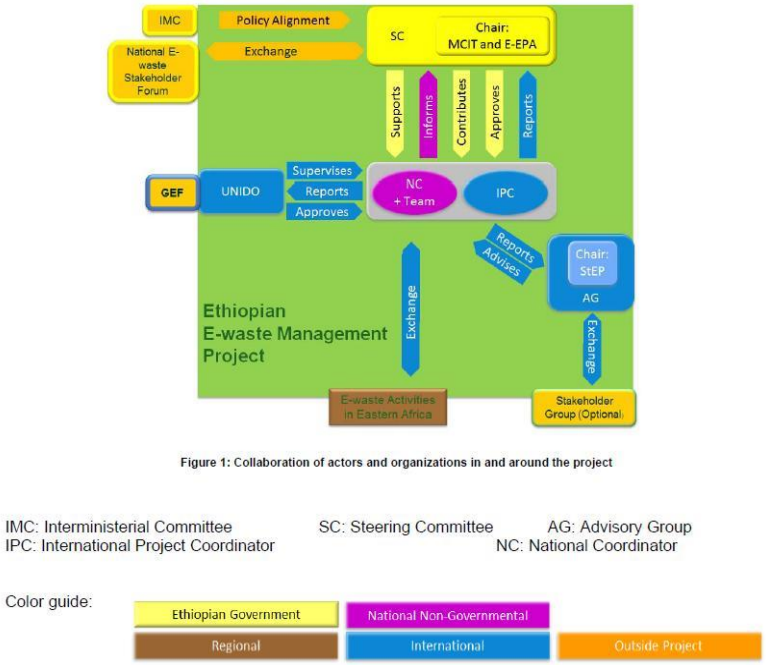

Figure 1: Collaboration of actors and organizations in and around the project

Fig. 3.Collaboration of actors and organizations in and around the Akaki DMF project [53]

According to the report [53], the National E-waste Strategy includes the elements of

- legislation (of which an improved version had been presented by the Government in 2014, whereupon no further assistance by UNU-IAS was requested);

- collection of e-waste from industries, businesses, and lower-level Government offices (to broaden DMF's sources of e-waste, yet to be implemented by the DMF);
- financing of the e-waste management system (where a final report [14] was made available to the Steering Committee and the DMF).

As regards the Akaki DMF upgrade, the report on downstream markets [45], [54] was finalized during the period under scrutiny but the Akaki DMF has not taken any steps toward facilitating exports in line with the national and international requirements.

There were two more items of negative news: (i) the initially planned pilot e-waste collection could not be realized owing to lack of funds and the new DMF building not expected to be finished in the foreseeable future; and (ii) the requisite legislation was not in place so that, consequently, no sustainable financing mechanism was available.

Progress Report by Project Coordinator. According to the progress report [41] covering the period from April 2013 to July 31, 2016, the main outcomes of the Akaki DMF project are:

1. An established national e-waste management strategy for Ethiopia [52,53], including pertinent legislative and policy measures [7,45] conducive to a sound management of e-waste.
2. A thorough review of the existing e-waste treatment infrastructure [11] and scale-up recipes to operate this infrastructure more efficiently, to manage e-waste in an environmentally sound manner and to ensure financial sustainability of the operations [11,14,18,45]**.**
3. Enhancement of regional cooperation among East African countries and international information sharing (with examples to be provided).
4. Evaluation and monitoring of the current e-waste management strategy (proofs to be provided)

The report presents detailed tabular reviews of

- technical activities (planned, implemented, and remaining, listed for the 9 outputs envisaged in the project concept)
- major problems encountered and measures taken (by outputs)
- post-2016 work plans

plus appendices including

1. Budget breakdown (to be provided by the PM)
2. EWAMP progress report published in the spring of 2015 **[45]**
3. Technical reports:
    a. Downstream Market Assessment
    b. Collection Strategy
    c. Facility Optimization and Process Valorization
    d. Financing Taskforce.

3.6.2 Evaluation ratings

The factors of importance covered in this chapter reflect the interim ratings of

- performance (Development objectives, Implementation progress, Risks, Table 7);
- project implementation performance (Table 8);
- progress made towards achieving Global environment objectives, Development objectives and Implementation (Table 9);
- risk management (Table 10);
- implementation issues, execution issues and feedback (Table 11);
- environmental and social concerns (Table 12); and
- knowledge management and lessons learned (Table 13)

as taken from the PIRs [54-57] for the fiscal years 2013 through 2016.

Table 7. Project evaluation: Performance ratings "Development objectives", "Implementation progress", "Risk rating"

	FY2013	**FY2014**	**FY2016**
Reference	**[55]**	**[56]**	**[54]**
Overall Development Objective Rating	**S**	**S**	**MS**
Overall Implementation Progress Rating	**S**	**S**	**MS**
Overall Risk Rating	**L**	**L**	**S**
Remarks on risks		*The recycling facility is 90% completed*	**--**

Table 8. Project evaluation: Rating of Project implementation performance

		FY2014	FY2016
Component 1	**Indicator(s)**	• Legislations and regulations signed • E-waste management strategy developed • Co-operations with neighboring countries are explored	• Legislations and regulations signed • E-waste management strategy developed • Co-operations with neighboring countries are explored • Legislations and regulations signed • E-$_{waste}$ management strategy developed • Co-operations with neighboring countries are explored
	Target Level		
	Progress To Date	• Legislations is drafted and reviewed by international expert group • Inventory is finalized • Steering Committee as nat. E-waste working Group was established • Open stakeholder forum was organized to reach wider public • Regular SC meetings organized	• Technical inputs were provided to the draft E-waste legislation prepared by the Ministry of Environment and Forest (MEF) by the member of the International Advisory Group and the project team. The Legislation is still processed by national authorities • Participation in the national stakeholders' forum to finalize the draft policy. •Frequent communication with the MEF regarding the status of the submission of the legislation. •The following taskforces could be finalized and provided information to the government in order to further develop the e-waste management strategy: - Downstream Markets - Collection Strategy - Financing strategy •Experts from National Cleaner Production Centre across Africa were given both theoretical and practical trainings on E-waste standards and Auditing process •The project team had conducted meetings with UNEP Liaison office to AUC, UNECA and Ethiopia ITU Liaison office to AUC and UNECA Multilateral Environmental Agreements (MEAs) program at the African Union.
	Rating	**S**	**MS**
Component 2	**Indicator(s)**	• Amount of e-waste collected per generated • e-waste treated per e-waste collected • # Jobs created • E-waste treated per employee • agreements with international smelters	• Amount of e-waste collected per generated • e-waste treated per e-waste collected • # Jobs created • E-waste treated per employee • agreements with international smelters
	Target Level		

	Progress To Date	• Studies on Downstream markets (national and international) are finalized and disseminated • Taskforce established to develop an effective collection strategy – expected to be finalized in Q4 2014 • Taskforce established to review and improve operations at Akaki facility – first mission taking place first week of August • Manager of Akaki attended trainings for e-waste managements • Trainings held at Akaki facility regarding international standards on e-waste management • Communications with integrated smelters ongoing to organize shipping of hazardous fractions • Open stakeholder forum held to raise public awareness	• As facility was not operational at project ending and the recommendations of the four reports is still to be implemented by national stakeholders, no additional data with regards to e-waste collected/ treated was gathered. Some output fractions (mainly steel) have been sold on the national market. The majority of other fractions, which need to be exported for proper treatment, could not be sold so far. The taskforce "Downstream markets" provided guidelines how and to whom the fractions could be sold, implementation of this recommendations is still due. •The activities at the Akaki DMF have been reviewed by WorldLoop and an improved set-up of the work flow and dismantling techniques has been proposed. Based on the study and consultation with MCIT a list of equipment for up scaling the DMF were developed. The procurement of the required equipment is finalized. 5 new jobs have been created Machinery was delivered and trainings for the staff at Akaki Demanufacturing facility were conducted in 2016 by WorldLoop. The training and the provided equipment aimed at helping 10 workers to dismantle the equipment more efficiently. •A business plan training for the Akaki facility was conducted to help the facility to plan the future operations of the facility in a sustainable manner.
	Rating	**MS**	**MS**
Component 3	**Indicator(s)**	• evaluation strategy implemented • finalized report by external evaluator	
	Target Level		
	Progress To Date		• Reports were developed on a regular basis (see also Tab 6: Assessment of Outcomes) • Final report by UNU produced
	Rating	**N/A**	**S**

Table 9. Project evaluation: Performance ratings justification and assessment of progress made towards achieving "Global environment objectives/Development objectives" and "Implementation progress"

	FY2014	**FY2016**
Assessment of **Global Environment Objectives/Development Objectives (DO)**:	The project and its objectives are promoted on an international level. The project was presented at several international meetings and conferences to raise awareness on an international level about the current situation in Ethiopia and UNIDO's interventions to improve it. The outreach on an international level helps to raise awareness and connect to neighboring countries to explore options for cooperation. On a national level regular SC meetings are held to keep the involved partners updated about the project progress Further activities were conducted on national level as outlined in detail in the above table.	Several reports and studies produced in the course of the project were used by other partners to further develop sustainable solutions for e-waste management on a global level. Inputs were provided for the draft of a national e-waste legislation, machinery and multiple trainings for an e-waste dismantling facility in Akaki have been provided as well as several strategies/reports have been developed to help to improve the e-waste treatment and management in Ethiopia. These recommendations are to be implemented as next step. The project and its objectives were promoted on an international level. The project was presented at several international meetings and conferences to raise awareness on an international level about the current situation in Ethiopia and UNIDO's interventions to improve it. The outreach on an international level helped to raise awareness and connect to neighboring countries to explore options for cooperation. On a national level regular SC meetings were held to keep the involved partners updated about the project progress.
Assessment of **Implementation Progress (IP)**:	It was agreed with the implementing partners that the new facility at the Akaki De-manufacturing facility will be finished by Q2 2013. The co-financing contribution of MCIT was earmarked to fund the construction work. Due to some unexpected reasons, which were not communicated to UNIDO, the facility is still not ready. For that it is difficult to achieve the expected project outcomes in time as many activities are linked with the finalization of the facility. During the last mission in June 2014, MCIT announced that the facility would we finalized by September 2014.Other activities which are not directly linked with the improvements of Akaki DMF, are progressing. Studies regarding available downstream markets on national and international level have been conducted. On policy level UNIDO works with the Ethiopian EPA to push the e-waste legislation forward. Legislation and Directives laying out details to be implemented within the legislation are drafted and ready for submission to the parliament.	The implementation progress can be rated as mildly satisfactory. It was agreed with the implementing partners that the new facility at the Akaki De-manufacturing facility will be finished by Q2 2013. The co-financing contribution of MCIT was earmarked to fund the construction work. Due to some unexpected reasons, which were not communicated to UNIDO, the facility could only be (partly) finalized in 2016. For that it was difficult to achieve the expected project outcomes in time as many activities are linked with the finalization of the facility. Other activities which are not directly linked with the improvements of Akaki DMF, have been implemented as planned. On policy level UNIDO worked with the Ethiopian EPA to push the e-waste legislation forward. Legislation and Directives laying out details to be implemented within the legislation are drafted and have been submitted to the parliament. Although the process was already initiated in Q1 of 2014, the legislation is still not approved and only existing in draft form (standing October 2016). UNIDO and the international Advisory Group were in frequent communication with the Ministry of Environment and Forestry in order to provide expertise where ever needed. In this regard a study on a suitable financing scheme for e-waste treatment in Ethiopia was conducted and discussed with national stakeholders.
In case of suboptional risk rating:	NA	

Table 10. Project evaluation: Risk management

	FY2014	**FY2016**
Progress made in **managing risks identified at project start**	The project team has weekly calls to update each other on going issues and to identify potential risks in an early stage. Further frequent communication with all involved stakeholders on a national and international level is conducted. SC meetings are held to address the progress made and stimulate discussions between the stakeholders. A face-to-face meeting for the Advisory Group (AG) was conducted in June 2014 to discuss the current progress of the project and to exchange experiences from prior project implemented in Ethiopia. Policy and legal framework won't be approved by the Parliament: The project team is in close contact with the Ministry of Environment and Forestry who is responsible for the policy legislation to provide inputs to the legislation. Development of the prices of precious metals on the international market: A potential fluctuation of the world metal prices is taken into account when designing the Business model for Akaki DMF. Through the transport of the e-waste to different locations CO2 emissions will raise: A collection and transport system is designed in the most efficient way in terms of logistics. Insufficient input into the facility to keep the operations running: An efficient collection system for e-waste to be provided to Akaki is designed to ensure sufficient input of materials. Development of collection and recycling activities within the informal sector: Incentives to dispose of e-waste through the formal system will minimize the activities of the informal sector.	*Risk:* Policy and legal framework won't be approved by the Parliament. *Mitigation:* Stakeholder meetings and awareness raising initiatives on policy level to point out the need to approve the policy. *Progress:* Frequent meetings with involved government institutions. *Risk:* Development of the prices of precious metals on the international market. *Mitigation:* The business case will be designed taking into account a fluctuation of the prices. *Progress:* Study on "Financing Scheme" finalized and Business Plan training conducted *Risk:* Through the transport of the e-waste to different locations CO2 emissions will raise. *Mitigation:* Design the collection and transport system in a way to minimize CO2 emissions. *Progress:* Effective collection system developed, further implementation by national stakeholders still due. *Risk:* Insufficient input into the facility to keep the operations running. *Mitigation:* Agreements with Governments and other institutions with high usage of EEE will be established to ensure ongoing input. *Progress:* Effective collection system developed; agreements with government institutions exist, Implementation of strategy still due. *Risk:* Development of collection and recycling activities within the informal sector. *Mitigation:* Relatively high incentives for the informal sector will be calculated. *Progress:* Still low activities of informal sector. Collection system takes into account the important role of repair shops.
Additional/new risks internal or external	• Lack of governmental involvement: To minimize this risk, the local coordinator is in frequent contact with government counterpart and regular SC meetings are conducted. - M • High turnover of staff in governmental institutions: Through regular communication with Government counterparts, the project team tries to be updated on new persons involved on the government side. • The Project team tried to maintain the flow of communication by having face to face meetings, e-mail and phone correspondence as well as requests for official visits.a	--
In case of suboptional risk rating:	NA	

Table 11. Project evaluation: Implementation issues, Execution issues, Feedback

	FY2014	FY2016
Implementation issues	The lack of isufficient and timely nvolvement is a challenge as this is linked to the delay of the construction work at Akaki DMF. The project team cannot implement all planned activities as long as the facility is not finalized. Further the frequent turn-over of staff at governmental entities is a challenge as new staff needs takes time to understand the objective and status quo of the project.	Issues with large scale procurement conducted in-house by UNIDO. The procurement process for the recycling equipment required was delayed due to frequent changes regarding the required specifications of the machinery and, thus, lead to further in-house delays. Furthermore, the change of key members of project steering committee further delayed the process even though the Government and the project steering committee members provided their inputs on time.
Execution issues	A Project management structure was agreed during the first joint SC and AG meeting, however the implementation of it is challenging. The review and steering process that is expected from the SC did not take place as originally planned as the chair did not call upon frequent meetings. To overcome this issue the NC started organizing SC meetings to keep the national stakeholder up to date. As mentioned above in June 2014 a second joint SC and AG meeting was held to report on the progress made. The challenges that were faced during the implementation so far were addressed and it is expected that the involved governmental institutions will resume more ownership of the project.	The general lack of government involvement and ownership of the project delayed the execution of the project and caused a minor amendment of the implementation/finalization dates . At National steering committee meetings, advisory group meetings and Ethiopian E-Waste management working group meetings in 2016 the progress made and address outstanding issues were discussed. The challenges that were faced during the implementation were addressed and it was expected that the involved governmental institutions will resume more ownership of the project. Nevertheless, the lack of governmental involvement remained a challenge till project completion as this is linked to the delay of the construction work at Akaki DMF (which is still not finalized for certain aspects of the building).
Feedback from National Operational Focal Points (OFPs)	The national OFP did not submit any feedback regarding the implementation of the project so far.	PIRs will be shared with OFPs and stakeholders
Feedback from co-financiers and other partners/ stakeholders	No feedback was submitted so far.	NA
Additional supporting information and/or documents	NA	--

Table 12. Project evaluation: Environmental and social concerns

	FY2016
Environmental and social risk considerations	NA
Gender considerations	General gender considerations were taken into account at project design phase and especially at the selection of National coordinator for the project

Table 13. Project evaluation: Knowledge management and Lessons learned

	FY2016
Knowledge management	Relevant technical reports have been shared with a range of national and international stakeholder. The outcomes of the project are presented at various international events and reported on a regular basis to the members of the Solving the E-waste Problem (Step) Initiative.
Lessons learned	An event was planned for September 2016 to officially launch the facility once all equipment has arrived and the trainings have been conducted. This is no longer relevant as the equipment has arrived already, and the training was conducted. A short overview of lessons learned has been compiled by the National Coordinator.

3.7 Reviewers' rating of the project

The overall rating of the project as seen by the reviewers is shown in Table 14 (which is basically a recapitulation of Table 4 of Annex 6 – Rating tables).

The objectives were met, and most of the results were achieved. Further success depends on overcoming the problems encountered. Sustainability of project outcomes hinges on attaining a smooth, streamlined workflow at the facility which in turn depends on finding suitable outlets for all the components produced and implementing the legislation. Monitoring and evaluation were on the whole, adequate. Project formulation was very good, project design as well as project management were adequate.

The reviewers' overall project rating is "**satisfactory”**.

Table 14. Overall rating of UNIDO project

Criterion	Evaluator's summary comments	Reviewers' rating*
Attainment of project objectives and results		
Design	Really good logframe matrix. Fully adequate design even though some feedback was missing: little action was sometimes taken in response to the external experts' inputs.	S
Relevance	Highly important to all stakeholders.	HS
Effectiveness	No more than moderately effective; plagued by problems.	MS
Efficiency	Methodologies were good but outputs were not always forthcoming.	MS
Sustainability of project outcomes		
Economic dimension	Going in the right direction but at its present size, expected soon to be unable to cope with mounting demand.	MS
Social dimension	Adequate reflection of the current needs in the area of WEEE.	S
Environmental dimension	The best intentions but not sustainable in view of the problems encountered in seeking suitable outlets for all Akaki DMF products.	MS
Project management		
National management	Quality at entry / Preparation and readiness: Excellent, with numerous endorsements from Ministries etc. in place. Supervision & support: not always tight enough.:	S
UNIDO management	Supervision and backstopping: adequate	S
Monitoring and self-evaluation	On the whole, adequate.	S
Synergies	The regional office of UNIDO was helpful in facilitating with Govt counterparts. The National Steering Ctee members were keen on having the project succeed. The facility management tended to be hampered by a number of unforeseen even if rather commonplace hitches and hindrances which they had to overcome:	MS
UNIDO specific ratings		
Quality at entry and termination	Very good.	
Implementation approach	Adequate.	
Overall rating		**S**

***NOTE:**

- Highly Satisfactory (HS): The project had no shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency;
- Satisfactory (S): The project had minor shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency;
- Moderately Satisfactory (MS): The project had moderate shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency;
- Moderately Unsatisfactory (MU): The project had significant shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency;
- Unsatisfactory (U) The project had major shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency;
- Highly Unsatisfactory (HU): The project had severe shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

4 CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

4.1 Conclusions

The overall objective of the project, i.e. to promote and up-scale the management of e-waste activities in Ethiopia, has been met.

The immediate objectives included (i) policy and regulatory support; (ii) upscaling the Akaki DMF; and (iii) an evaluated and monitored e-waste management strategy.

These objectives were achieved to a high degree of success at the level of draft policies and recommendations for Ethiopia as a country, and to a moderate degree of success as to the upgrading and streamlining of operations at the Akaki DMF.

The project was entirely in line with the environment-conscious policy followed by UNIDO in the realm of waste management, and has made adequate use of UNIDO's expertise and experience in this area of environmental protection. It should be noted that the project was also in line with the Nairobi Declaration on the Environmentally Sound Management of WEEE [58] and can be regarded as expanding and complementing the e-waste Africa programme of UNEP under the Basel Convention.

Specific conclusions:

(i) The project at its post-termination stage demonstrates the farsightedness of all the stakeholders, primarily of the Ethiopia Government, GEF, and UNIDO. The project design was excellent and the multiple expert reports commissioned delivered a wealth of valuable information yet to be fully utilized. Project implementation at Akaki DMF has been relatively successful even though it has missed the opportunity to become a model operation.

(ii) The number of project stakeholders listed was very high and only some of them made substantial contributions to the project.

(iii) The recently approved e-waste legislation initiated by the Ministry of Environment, Forestry and Climate Change (MEF) is a decided step forward and can be regarded.as the greatest achievement relating to the present project. Its resolute implementation as well as a continued legislative progress are preconditions to successful capacity building in the future.

(iv) The training programs/courses run were no doubt useful but their impact and potential overlaps need to be examined. Course curricula should be discussed with, and tailored according to the needs of, the trainees.

(v) Main project focus, in both design and implementation, was on upgrading the dismantling facility at Akaki which was used for the collection and disposal of used PCs, with less focus if any on recovery and processing of the wastes.

(vi) The machinery provided under the project is not being used in an optimal manner and the operations floor of the facility requires tidying up and emptying of excess material. The workflow at the facility is not sustainable; only a minor share of the products of dismantling has found its market outlets so far, and no dumpsite has been selected for those by-products for which all search for markets has proved fruitless. Now when the project ownership is to pass over completely to the Government, tight oversight and some assistance with finding outlets for the products of dismantling is required.

(vii) All stakeholders welcome the idea of widening the publicity and furthering the WEEE-related knowledge and experience through holding an Experts' conference in Addis Ababa, best in 2018. The CRTC and the DMF are interested in continued UNIDO support, focused on establishing a pilot collection center so as to implement the collection scheme proposal made under the project (see Annex 10 on the new Parliamentary Regulation on WEEE management for additional details).

4.2 Recommendations

The reviewers recommend that:

(i) relevant Ethiopia Government Ministries endeavor to update the country's EEE and WEEE statistics; to implement a nation-wide WEEE collection system with participation by both the public and the private sector; to plan an expansion of the WEEE treatment and recovery facilities in the long term as the e-waste issues will no doubt become more urgent with time; and to exercise tight oversight over the Akaki DMF facility and provide it with support in its search of markets and, if unavoidable, dumpsites for all its dismantling products;

(ii) any expansion of the Akaki DMF facility, however necessary and even unavoidable in the long term, be conditioned upon optimizing its present operations and upon finding suitable outlets—markets or if need be, dumpsites—for all of the products of dismantling; as much material has to go out as is coming in, and any piling-up of stocks must be regarded as only temporary. In other words, the Akaki DMF facility should be expanded only after

its workflow will have been streamlined, its technology fully used, and outlets found for all (or most) of its products;

(iii) UNIDO be invited to participate in, and/or to act as the implementing agency for, any future expansion, owing to its wealth of experience in the field;

(iv) there is a whole range of other types of WEEE which the Government will also have to pay attention to, such as the so-called 'white goods' and other categories (as clearly listed in the recently adopted Regulation, *cf*. Chapter 3.1.2 and Annex 8); also a probable shift of focus in the nature of the WEEE category already handled at Akaki should be anticipated, at least in terms of the quantity of wastes generated: away from PCs, toward mobile phones and, increasingly, towards optical devices. This will entail changes in the collection strategies as well as in processing and recovery technologies;

(v) UNIDO through its regional office in Addis Ababa should maintain lively contacts with the African WEEE scene, in order to foster a true international cooperation conducive to an expansion of the collection and recovery operations; and

(vi) the experience acquired by both UNIDO staff and the experts involved during the design and implementation of the Akaki DMF project be further exploited through (a) distributing the "*Guide for conducting an e-waste inventory in Africa*" [12,13] to a relevant international audience; (b) producing a volume of proceedings compiled of the bulky and valuable, generally high-quality, specialized expert reports prepared for the present project, such as [7,10,13,14,18,45,50]; (c) an experts' conference to be held in 2018 (also supported by the relevant Ethiopia Government Ministries and by PAN-Ethiopia), and mainly through (d) future e-waste policy formulation by the Ethiopian Government, and (e) any subsequent expansion of the WEEE collection, dismantling, and recovery schemes in Ethiopia and elsewhere in Africa and the developing world.

4.3 Lessons learned

It has been stated before, in relation to an analogous project concerned with environment-threatening wastes [21], that ”No one will do anything until and unless there is pertinent legislation in place“. This should be remembered because it also applies to Ethiopia.

Complete success in the area of e-waste management cannot realistically be expected; the problem is daunting and its solution—paralyzed as it often is by the ever-increasing volumes of waste generated—will take decades, or even generations. Also, it has to be understood that e-waste is only one of the many Government priorities which are all of them urgent.

The valuable experience acquired by UNIDO staff and project experts during the course of the project is worth exploiting further, in (i) an experts' conference where papers principally by those experts who produced the valuable specialized reports for the present project delivered to an international audience recruited from Ethiopia as well as other African countries, and in (ii) any follow-ups to the project which, whether or not supported by UNIDO and/or any other organization, ought to be regarded as inevitable by the Government and be included in Government planning—because the problem of WEEE will not go away but is bound to expand and become more urgent as time progresses.

Annex 1 – TOR for Final evaluation

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION TERMS OF REFERENCE FOR PERSONNEL UNDER INDIVIDUAL SERVICE AGREEMENT (ISA)

Title:	International evaluation consultant, team leader
Main Duty Station and Location:	Home-based
Missions:	Missions to Vienna, Austria and Ethiopia
Start of Contract (EOD):	June 5, 2017
End of Contract (COB):	June 30, 2017
Number of Working Days:	21 working days

1. ORGANIZATIONAL CONTEXT

The UNIDO Independent Evaluation Division (ODG/EVQ/IEV) is responsible for the independent evaluation function of UNIDO. It supports learning, continuous improvement and accountability, and provides factual information about result and practices that feed into the programmatic and strategic decision-making processes. Evaluation is an assessment, as systematic and impartial as possible, of a program, a project or a theme. Independent evaluations provide evidence-based information that is credible, reliable and useful, enabling the timely incorporation of findings, recommendations and lessons learned into the decision- making processes at organization-wide, program and project level. ODG/EVQ/IEV is guided by the UNIDO Evaluation Policy, which is aligned to the norms and standards for evaluation in the UN system.

2. PROJECT CONTEXT

Part of the global GEF e-waste strategy, the project focuses on building upon previous and ongoing efforts to develop a strategy for sound management of e-waste within Ethiopia. Funded by the GEF, co-financed by local and international institutions and benefitting also from minor contributions from private sector, the project addresses the issue of e-waste management in Ethiopia by promoting environmental sound methods and state-of-the art technologies. Furthermore, the project also seeks to emphasize a regional approach in East Africa over the long-term.

The overall objective of the project is to develop a comprehensive strategy for e-waste management in Ethiopia, together with national authorities and other international partners. Project implementation started in June 2012 and the initial project end date was in June 2014, with actual implementation end date being April 2015.
The project strengthened and upgraded the existing Computer Refurbishing and De-manufacturing facility in Akaki, on the outskirts of Addis Ababa, and aimed to develop it into a regional training center.

The ultimate beneficiaries of the project are: a) the national government of Ethiopia and neighboring countries that have committed to address e-waste in an environmentally sound manner; b) the private sector involved in local e-waste treatment in Ethiopia and the region, will benefit from aligning with an overall e-waste strategy for Ethiopia and c) communities that would otherwise suffer from the effects of poor e-waste management.

Detailed background information of the project can be found the terms of reference (TOR) for the terminal evaluation.

3. DUTIES AND RESPONSIBILITIES

MAIN DUTIES	Concrete/ Measurable Outputs to be achieved	Working Days	Location
1. Review project documentation and relevant country background information (national policies and strategies, UN strategies and general economic data); determine key data to collect in the field and adjust the key data collection instrument of 3A accordingly (if needed); Assess the adequacy of legislative and regulatory framework relevant to the project's activities and analyze other background info.	Adjust table of evaluation questions, depending on country specific context; Draft list of stakeholders to interview during the field missions; Brief assessment of the adequacy of the country's legislative and regulatory framework.	5 days	Home-based
2. Briefing with the UNIDO Independent Evaluation Division, project managers and other key stakeholders at UNIDO HQ. Preparation of the Inception Report	Detailed evaluation schedule with tentative mission agenda (incl. list of stakeholders to interview and site visits); mission planning; Division of evaluation tasks with the National Consultant. Inception Report	2 days	Vienna, Austria
3. Conduct field mission to Ethiopia in **September 2016**[1].	Conduct meetings with relevant project stakeholders, beneficiaries, the GEF Operational Focal Point (OFP), etc. for the collection of data and clarifications; Agreement with the National Consultant on the structure and content of the evaluation report and the distribution of writing tasks; Evaluation presentation of the evaluation's initial findings prepared, draft conclusions and recommendations to stakeholders in the country, including the GEF OFP, at the end of the mission.	5 days	Ethiopia
4. Present overall findings and recommendations to the stakeholders at UNIDO HQ	After field mission(s): Presentation slides, feedback from stakeholders obtained and discussed	2 days	Vienna, Austria
5. Prepare the evaluation report, with inputs from the National Consultant, according to the TOR;	Draft evaluation report.	5days	Home-based

[1] The exact mission dates will be decided in agreement with the Consultant, UNIDO HQ, and the country counterparts.

MAIN DUTIES	Concrete/ Measurable Outputs to be achieved	Working Days	Location
Coordinate the inputs from the National Consultant and combine with her/his own inputs into the draft evaluation report. Share the evaluation report with UNIDO HQ and national stakeholders for feedback and comments.			
6. Revise the draft project evaluation report based on comments from UNIDO Independent Evaluation Division and stakeholders and edit the language and form of the final version according to UNIDO standards.	Final evaluation report.	4 days	Home-based
	TOTAL	**21 days**	

MINIMUM ORGANIZATIONAL REQUIREMENTS
Education:
Advanced degree in environment, energy, engineering, development studies or related areas

Technical and functional experience:

Minimum of 10 years' experience in project management and/or evaluation (of development projects)
Strong experience on environmental/energy and knowledge about GEF operational programs and strategies and about relevant GEF policies such as those on project life cycle, M&E, incremental costs, and fiduciary standards
Experience in the evaluation and knowledge of UNIDO activities an asset
Knowledge about multilateral technical cooperation and the UN, international development priorities and frameworks
Working experience in developing countries

Languages:

Fluency in written and spoken English is required.

Reporting and deliverables

1) At the beginning of the assignment the Consultant will submit a concise Inception Report that will outline the general methodology and presents a concept Table of Contents;

2) The country assignment will have the following deliverables:
Presentation of initial findings of the mission to key national stakeholders;
Draft report;
Final report, comprising of executive summary, findings regarding design, implementation and results, conclusions and recommendations.

3) Debriefing at UNIDO HQ:
Presentation and discussion of findings;
Concise summary and comparative analysis of the main results of the evaluation report.

All reports and related documents must be in English and presented in electronic format.

Absence of conflict of interest:

According to UNIDO rules, the consultant must not have been involved in the design and/or implementation, supervision and coordination of and/or have benefited from the program/project (or theme) under evaluation. The consultant will be requested to sign a declaration that none of the above situations exists and that the consultants will not seek assignments with the manager/s in charge of the project before the completion of her/his contract with the UNIDO Independent Evaluation Division.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

TERMS OF REFERENCE FOR PERSONNEL UNDER INDIVIDUAL SERVICE AGREEMENT (ISA)

Title:	National consultant
Main Duty Station and Location:	Home-based
Mission/s to:	Travel to potential sites within Ethiopia
Start of Contract:	24 July 2017
End of Contract:	30 Sep 2017
Number of Working Days:	21 working days

PROJECT CONTEXT

The national evaluation consultant will evaluate the projects according to the terms of reference (TOR) under the leadership of the team leader (international evaluation consultant). S/he will perform the following tasks:

MAIN DUTIES	**Concrete/measurable outputs to be achieved**	**Expected duration**	**Location**
Review and analyze project documentation and relevant country background information (national policies and strategies, UN strategies and general economic data); in cooperation with the Team Leader: determine key data to collect in the field and prepare key instruments in both English and local language (questionnaires, logic models) to collect these data through interviews and/or surveys during and prior to the field missions; Coordinate and lead interviews/ surveys in local language and assist the team leader with translation where necessary; Analyze and assess the adequacy of legislative and regulatory framework, specifically in the context of the project's objectives and targets; provide analysis and advice to the team leader on existing and appropriate policies for input to the team leader.	List of detailed evaluation questions to be clarified; questionnaires/interview guide; logic models; list of key data to collect, draft list of stakeholders to interview during the field missions Drafting and presentation of brief assessment of the adequacy of the country's legislative and regulatory framework in the context of the project.	ongoing	Home-based

MAIN DUTIES	Concrete/measurable outputs to be achieved	Expected duration	Location
Review all project outputs/ publications/feedback; Briefing with the evaluation team leader, UNIDO project managers and other key stakeholders. Coordinate the evaluation mission agenda, ensuring and setting up the required meetings with project partners and government counterparts, and organize and lead site visits, in close cooperation with the Project Management Unit. Assist and provide detailed analysis and inputs to the team leader in the preparation of the inception report.	Interview notes, detailed evaluation schedule and list of stakeholders to interview during the field missions. Division of evaluation tasks with the Team Leader. Inception Report.	ongoing	Home-based (telephone interviews)
TOTAL		**21 wd**	

REQUIRED COMPETENCIES

Core values:
1. Integrity
2. Professionalism
3. Respect for diversity

Core competencies:
1. Results orientation and accountability
2. Planning and organizing
3. Communication and trust
4. Team orientation
5. Client orientation
6. Organizational development and innovation

Managerial competencies (as applicable):
1. Strategy and direction
2. Managing people and performance
3. Judgement and decision making
4. Conflict resolution

MINIMUM ORGANIZATIONAL REQUIREMENTS

Education: Advanced university degree in science, engineering or other relevant discipline like developmental studies.

Technical and functional experience:

Exposure to the needs, conditions and problems in developing countries. Familiarity with the institutional context of the project is desirable.
Experience in the field of environment and energy, including evaluation of development cooperation in developing countries is an asset

Languages: Fluency in written and spoken English and Amharic is required.

Annex 2 – Program of the Evaluation mission

June to early October	Administrative arrangements; preparations for the field mission, independently by International Consultant and National Consultant
Field mission	
14.10.2017	International Consultant arriving in Addis Ababa; inception meeting of International Consultant and National Consultant
15.10.2017	meetings cont'd.
16.10.2017	Meeting with Mr. Gustavo Aishemberg the Resident Representative and Director of Addis Ababa UNIDO office, and with Mr. Asegid Membratu the National Programme Officer; work on terminal report
17.10.2017	Visit to and initial assessment at Akaki DMF facility in Akaki Town; meeting with Mr. Kassahun Eshetu the Finance & Admin Manager of the CRTC; visit to the Ministry of Environment, Forestry and Climate Chge in Addis Ababa; meeting with Dr. Ayele Ababu Director of the Policy, Law and Standards Directorate General, and his senior legal advisor Mr. Wondwossen Tadesswe Debelle; work on terminal report
18.10.2017	Visit to and in-depth talks at Akaki DMF facility in Akaki Town; meeting with Mr. Dereje Masresha the Director of the CRTC (which includes the DMF) and with Mr. Kassahun Eshetu the Finance & Admin Manager; meeting with Mr. Tadesse Amera the Director of Pesticide Action Nexus Assn (PAN-Ethiopia); passing visit to the Reppie Waste to Energy facility (incinerator); work on terminal report
19.10.2017	Meeting with Mr. Teshgome Worku at the Ministry of Communications, Information and Technology (MCIT); courtesy call at the Czech Republic Embassy (meeting with Mr. Martin Lubojacký, Counsellor Economy & Trade); work on terminal report
20.10.2017	Wrap-up meeting with UNIDO Addis Ababa Resident Representative and office Director & staff; departure of International Consultant from Addis Ababa
from 1.11.2017 onwards	Work on terminal report, in cooperation by International and National Consultant
tbd	Final touches to Terminal report, presentation at UNIDO HQ by International Consultant

Annex 3 – Acronyms and abbreviations

ADSL	Aszmmetric Digital Subscriber Line
BAT	Best Available Techniques
BEP	Best Environmental Practices
BFRs	Brominated Flame Retardants
Buli	Budget Line
CAGR	Compound Annual Growth Rate
ccTLD	country code Top-Level Domain
CDMA	Code Division Multiple Access
CRT	Cathode Ray Tube
CRTC	Computer Refurbishing and Training Center
CZ	Czech Republic
DMF	Dismantling/Demanufacturing Facility
DNS	Domain Name System
DO	Development Objective
DSA	Daily Subsistence Allowance
EC	European Communities
EEE	Electronic and Electrical Equipment
EoL	End-of-Life
EPA	Environmental protection Authority /Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPR	Extended Producer Responsibility
EU	European Union
EVA	Evaluation Unit, UNIDO HQ Vienna
EVDO	Evolution Data Optimized protocol
EWAMP	E-Waste Management Project
FY	Financial Year
GDP	Gross Domestic Product
GEF	Global Environmental Facility
IBLF	International Business Leadership Forum
ICT	Information and Communications Technology
IP	Implementation Progress
IPEN	International PoPs Elimination Network
LCD	Liquid Crystal Display
LTE	Long-Term Evolution service
MCIT	Ministry of Communication and Information Technology of Ethiopia
MEF	Ministry of Environment, Forestry and Climate Change of Ethiopia
MOFED	Ministry of Finance and Economic Cooperation
MPI	Global Multidimensional Poverty Index
NGO	Non-Governmental Organization
NIP	National Implementation Plan

NPC	National Project Coordinator
NPD	National Project Director
NSC	National Steering Committee
OFP	Operational Focal Point
PAN	Pesticide Action Network
PBB	Poly Brominated Biphenyls
PBDE	Polybrominated Diphenyl Ether
PCBs	Printed Circuit Boards
PCP	Partnership for Country Program
PIF	Project Identification Form
PIR	Project Implementation Report
PMU	Project Monitoring Unit
POPs	Persistent Organic Pollutants
PVC	Polyvinyl Chloride
PWBs	Printed Wiring Boards
RoHS	Restriction of Hazardous Substances
SAICM	Strategic Approach to International Chemical Management
SC	Steering Committee
SDGs	Sustainable Development Goals
StEP	Solving the E-waste Problem
TOR	Terms of Reference
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNU	United Nations University
US EPA	United States Environmental Protection Agency
VAS	Value Added Services
VSAT	Very Small Aperture Terminal
WASH	Water, Sanitation and Hygiene
WEEE	Waste Electronic and Electrical Equipment
WB	World Bank

Annex 4 – List of persons met

1. **Mr. Gustavo Aishemberg**, Representative and Director of Regional office, UNIDO in Addis Ababa
2. **Mr. Asegid Adane Membratu**, National Programme Officer, UNIDO in Addis Ababa
3. **Mr. Dereje Masresha** the Director of the CRTC (which includes the DMF) at Akaki Town
4. **Mr. Kassahun Eshetu** the Finance & Admin Manager of the CRTC at Akaki Town
5. **Dr. Ayele Ababu** the Director of the Policy, Law and Standards Directorate General, the Ministry of Environment, Forestry and Climate Change
6. **Mr. Wondwossen Tadesswe Debelle,** Senior Legal Advisor, the Ministry of Environment, Forestry and Climate Change in Addis Ababa
7. **Mr. Teshome Worku** at the Ministry of Communications, Information and Technology (MCIT) in Addis Ababa
8. **Mr. Tadesse Amera**, Director of Pesticide Action Nexus Assn (PAN-Ethiopia) in Addis Ababa
9. **Mr. Martin Lubojacký**, Counsellor Economy & Trade, Embassy of the Czech Republic in Addis Ababa – courtesy call

Annex 5 – List of documents reviewed

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[2] Oxford University study 2017, http://www.madote.com/2014/06/ethiopia-ranks-second-poorest-country.html, also https://ethiopiantimes.wordpress.com/2014/06/18/ethiopia-ranks-second-poorest-country-in-the-world-oxford-university-study/, also http://nazret.com/blog/index.php/2014/06/16/ethiopia-ranks-second-poorest-country

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[11] An efficient & effective e-waste collection system for Ethiopia, Öko-Institut e.V. (Institut für angewandte Ökologie, Freiburg & Addis Ababa, Final report by Tobias Schleicher, Andreas Manhart (Öko-Institut), Tadesse Amera, Atalc Belay and Zamanu Genet (PAN-Ethiopia), *01-ETH-Ewaste-Collection Schemes_Final_2015-02-24.PDF*, February 2015, 69 pp.

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Annex 6 – Rating tables as per TOR

(as per Draft TOR UNIDO SAP ID 120227, GEF ID 5040)

Ratings are presented in the form of tables **with each of the criteria / aspects rated separately and with** brief justifications for the rating **based on the findings and the main analyses (see Table 1 to Table 3) below. Table 4 presents a summarization of the overall ratings.**

Table 1. **Rating criteria for Quality of project identification and formulation process (LFA Process**)

Evaluation issue	Evaluators' comments	Ratings
1. Extent to which the situation, problem, need / gap is clearly identified, analyzed and documented (evidence, references).	Clearly identified, adequately analyzed, sufficiently documented.	**S**
2. Adequacy and clarity of the stakeholder analysis (clear identification of end-users, beneficiaries, sponsors, partners, and clearly defined roles and responsibilities in the project(s)).	Multiple expert reports covering various aspects; clear enough in most aspects except the roles and responsibilities in the project which were not fully identified from the outset.	**S**
3. Adequacy of project monitoring and evaluation (M&E) design.	Fully adequate even though some feedback was missing; many experts came and went, delivered their recommendations, but little action was taken.	**S**
4. Overall LFA design process.	Addressed in the various reports.	**MS**

Table 2. **Quality of project design (LFM)**

Evaluation issue	Evaluators' comments	Ratings
1. Clarity and adequacy of outcome (clear, realistic, relevant, addressing the problem identified). Does it provide a clear description of the benefit or improvement that will be achieved after project completion?	Addressed, clearly described, but insufficient attention was paid to the flow cycle of stocks being processed and, consequently, the improvement expected could not be realized in full.	**MS**
2. Clarity and adequacy of outputs (realistic, measurable, adequate for leading to the achievement of the outcome).	Adequate.	**S**
3. Clarity, consistency and logic of the objective tree, and its reflexion in the LFM results hierarchy from activities to outputs, to outcome and to overall objective.	Clear and consistent, logical. Market analysis was conducted with the outcome that there were at least some markets for most of the outputs of the facility so that the overall objective could, from the angle of observation of the early stages of the project, well be achieved.	**HS**
4. Indicators are SMART for Outcome and Output levels.	Yes.	**HS**
5. Adequacy of Means of Verification and Assumptions (including important external factors and risks).	External factors and risks while fully understood were not fully reflected in action: examples include (i) the new facility building not completed by the end of project; (ii) markets originally promising for certain specific products eventually proving not to be feasible; the problem was compounded by delayed legislation.	**MS**
6. Overall LFM design quality.	Satisfactory.	**S**

Table 3. **Quality of project implementation performance**

Evaluation criteria	Evaluators' comments	Ratings
7. Ownership and relevance: to national development priorities and Government strategies; to target groups; to UNIDO's mandate and thematic priorities; to Donor's priorities; counterpart(s) were appropriately involved in the identification of critical problem areas and in the development of implementation strategies; supported actively project implementation including through in-kind and cash contributions; and the project(s) / program are relevant to the ISID agenda).	Highly important to national development priorities and Govt strategies; also important to target groups; fully consistent with UNIDO's mandate and thematic priorities, also relevant to Donors' priorities (as reflected in their endorsement letters). The counterparts' involvement was appropriate even if necessarily differentiated, each of them focusing on areas closest to their remit; there has been active support by the counterparts, including a rather exceptional Govt contribution in cash of US$ 5 million; the programs were relevant to the ISID agenda.	**HS**
8. Effectiveness: objectives and final results at the end of the project (outputs were produced; outcome(s) were achieved or are likely to be achieved through the operation of outputs; and the project/program contributed to inclusive and sustainable industrial development).	No more than moderately effective: again, hampered by (i) incomplete civil construction; (ii) no electric power connection towards the end of the project period when the automation machinery was delivered; (iii); conspicuous shortage of electric hand-held tools and absence of special dismantling jigs and fixtures in the manual demanufacturing section; weak ownership by facility management (predominance of manual dismantling practices even after delivery of automation equipment due to various impeding factors; not having negotiated the incineration of plastics with the giant incinerator nearby that expressed itself willing to accept them — unlike the cement factories with whom negotiations were conducted but which asked for deliveries of very high quantities that the facility could not supply) as well as by Govt counterparts (example: the exports of PCBs, the most valuable part of old computers which however could not, as at today's standards of technology, be processed within the country, were not cleared by sufficiently active follow-up of the facility with the responsible Ministries).	**MS**
9. Efficiency (UNIDO, Donors, implementing agencies and counterpart inputs have been provided as planned and were adequate to meet requirements; the quality of UNIDO, Donors, implementing agencies and counterpart inputs and services (expertise, training, methodologies, etc.) was as planned and led to the production of outputs; UNIDO procurement services were provided as planned and were adequate in terms of timing, value, process issues, responsibilities; the project used the most cost-efficient option and was cost-effective etc.).	Many operations and/or steps toward accomplishing the project objectives were delayed (such as, the international tender for equipment; the construction of the new facility building; the terminal evaluation and the formal closure of the project). Yet the counterpart inputs were provided, although there were some complaints e.g., regarding the quality of the training provided. Methodologies were good but they have not always led to the production of outputs (examples: the financing scheme, the downstream markets assessment, the collection scheme).	**MS**
10. Impact (which long term developmental changes, e.g. economic, environmental, social and inclusiveness, have occurred or	Fairly good in terms of implementation but not very successful in terms of impact. No long-term developmental changes were perceived to have occurred yet; impact will be augmented if and when the facility is fully complete and	**ML**

are likely to occur as a result of the intervention).	operational, making full use of its automation, and will have resolved its work flow problems in that it would have adequate markets, or at least adequate means of destruction or dumping sites, for all of its different products arising from its computer demanufacturing operations. What all counterparts would desire is that the Akaki facility could be admired by all who come and see it, for its smooth and streamlined workflow. Presently at Akaki they have outlets for some of the less valuable components (steel, aluminum, copper; some printer cartridges) but have none for the most valuable PCBs (PWBs) as well as for the not invaluable but difficult-to-disassemble hard disk drives, the difficult-to-reprocess glass from computer monitors, and the seemingly quite useless plastics.	
11. Likelihood of/risks to sustainability (results achieved so far are sustainable; the project was replicated/had a multiplying effect; a sustainability strategy was formulated; and what are the prospects/risks for technical, organizational, financial, sociopolitical, institutional framework and governance, and environmental sustainability).	Sustainability hinges on attaining a smooth, streamlined workflow at the facility. Refer to above, item 10; risks will be reduced and chances at attaining sustainability will improve if and when the problems mentioned there are resolved. Also, the situation has improved somewhat with the adoption of the country's latest waste legislation (National Policy and Legal Framework). The concerned Ministries (Environment, Forest & Climate Chge; the MCIT) as well as the UNIDO regional office and another stakeholder – PAN have expressed interest in having an experts' conference organized, or at least a workshop devoted to the WEEE issues, say in 2018 in Addis Ababa, with a Volume of Proceedings based on the multiple expert reports associated with this project, and with these experts invited in; a more resounding success of the Akaki facility having resolved its problems would however be a prerequisite to demonstrating it as a model to follow.	**L**
12. Project management (the national management and overall field coordination mechanisms of the project have been efficient and effective; the UNIDO management, coordination, quality control and technical inputs have been efficient and effective; changes in planning documents during implementation have been approved and documented; and synergy benefits can be found in relation to other UNIDO activities in the country or elsewhere).	The regional office of UNIDO was helpful in facilitating with Govt counterparts. The National Steering Ctee members were keen on having the project succeed. The facility management tended to be hampered by a number of unforeseen even if rather commonplace hitches and hindrances which they had to overcome: for instance, the electric power installations are being held back by the fact that the court case of the defaulted building contractor is still pending. The management must in fact be aware that they cannot continue operations indefinitely unless outlets are found for not just some but for all of their production. They realize that but so far have not been able to convert this into successful action. In relation to the Partnership Country Program (PCP), the project also can offer some synergies perhaps within the Industrial Parks agenda.	**L**
13. M&E (monitoring and self-evaluation was carried out based on indicators for outputs, outcomes and objectives; M&E activities were documented; and M&E information was used for project steering and adaptive management).	Monitoring and self-evaluation were all right but adaptive management would be a bit too much to ask considering the elementary problems the Akaki facility had to contend with.	**ML**

Table 4. **Overall ratings**

Criterion	Evaluators' summary comments	Ratings
Attainment of project objectives and results (overall rating), sub criteria (below)	The objectives were met, most of the results were achieved. Further success depends on overcoming the problems encountered.	**S**
Project implementation	Much as expected.	**S**
Effectiveness	No more than moderately effective; plagued by problems.	**MS**
Relevance	Highly important to all stakeholders.	**HS**
Efficiency	Methodologies were good but outputs were not always forthcoming.	**MS**
Sustainability of project outcomes (overall rating), sub criteria (below)	Sustainability hinges on attaining a smooth, streamlined workflow at the facility which in turn depends on finding suitable outlets for all the components produced and implementing the legislation.	**L**
Financial risks	The risks were sustained, the facility even made a profit by being able to sell some of the dismantled goods.	**U**
Sociopolitical risks	None.	**U**
Institutional framework and governance risks	Depend on the survival of the facility and its enhanced productivity and efficiency.	**MU**
Environmental risks	Some were addressed, other (e.g., plastics and glass) are waiting for a harmless solution.	**L**
Monitoring and evaluation (overall rating), sub criteria (below)	On the whole, adequate.	
M&E Design	Major design problems.	**HS**
M&E Plan implementation (use for adaptive management)	Involved delays. There were several expert reviews during the course of the project, focused however on the facility rather than on the project.	**MS**
Budgeting and funding for M&E activities	Adequate.	**HS**
Project Formulation	Very good.	**HS**
LFA (Situation, stakeholder, problem and objective analyses / Preparation and readiness)	Clearly identified, adequately analyzed, sufficiently documented.	**HS**
Project Design	Adequate.	**S**
Project design (LFM, main elements of the project, i.e. overall objective, outcomes, outputs, their causal relationship, indicators, means of verification and assumptions)	Really good logframe matrix. Fully adequate design even though some feedback was missing: little action was sometimes taken in response to the external experts' inputs.	**S**
Project management - UNIDO specific ratings	Adequate.	**S**
Quality at entry / Preparation and readiness	Excellent, with numerous endorsements from Ministries etc. in place.	**HS**
Implementation approach	The approach was good; the project had full support of all counterparts.	**HS**
UNIDO Supervision and backstopping	Adequate.	**S**
Gender mainstreaming	Adequate.	**S**
Overall Project rating	**Successful**	**S**

RATING OF PROJECT OBJECTIVES AND RESULTS
Highly satisfactory (HS): The project had no shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.
Satisfactory (S): The project had minor shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.
Moderately satisfactory (MS): The project had moderate shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.
Moderately unsatisfactory (MU): The project had significant shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.
Unsatisfactory (U) The project had major shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.
Highly unsatisfactory (HU): The project had severe shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.
Please note: Relevance and effectiveness will be considered as critical criteria. The overall rating of the project for achievement of objectives and results may not be higher than the lowest rating on either of these two criteria. Thus, to have an overall satisfactory rating for outcomes a project must have at least satisfactory ratings on both relevance and effectiveness.

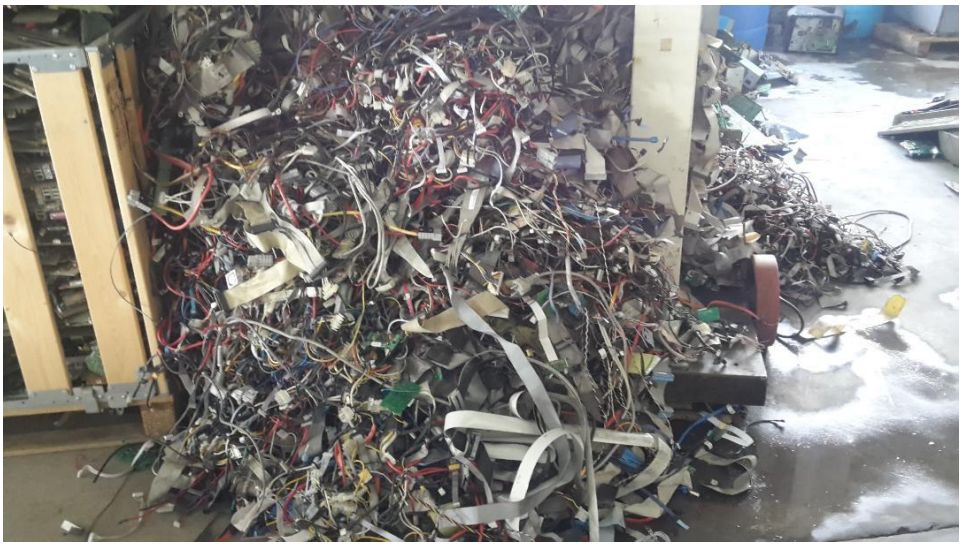
RATINGS ON SUSTAINABILITY
Sustainability will be understood as the probability of continued long-term outcomes and impacts after the project funding ends. The evaluation will identify and assess the key conditions or factors that are likely to contribute or undermine the persistence of benefits beyond project completion. Some of these factors might be outcomes of the project, i.e. stronger institutional capacities, legal frameworks, socio-economic incentives /or public awareness. Other factors will include contextual circumstances or developments that are not outcomes of the project but that are relevant to the sustainability of outcomes.
Rating system for sustainability sub-criteria
On each of the dimensions of sustainability of the project outcomes will be rated as follows.
Likely (L): There are no risks affecting this dimension of sustainability.
Moderately likely (ML). There are moderate risks that affect this dimension of sustainability.
Moderately unlikely (MU): There are significant risks that affect this dimension of sustainability.
Unlikely (U): There are severe risks that affect this dimension of sustainability.
All the risk dimensions of sustainability are critical. Therefore, overall rating for sustainability will not be higher than the rating of the dimension with lowest ratings. For example, if a project has an Unlikely rating in either of the dimensions then its overall rating cannot be higher than Unlikely, regardless of whether higher ratings in other dimensions of sustainability produce a higher average.

RATINGS OF PROJECT M&E
Monitoring is a continuing function that uses systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing project with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds. Evaluation is the systematic and objective assessment of an on-going or completed project, its design, implementation and results. Project evaluation may involve the definition of appropriate standards, the examination of performance against those standards, and an assessment of actual and expected results.

The Project M&E system will be rated on M&E design, M&E plan implementation and budgeting and funding for M&E activities as follows:
Highly satisfactory (HS): There were no shortcomings in the project M&E system.
Satisfactory(S): There were minor shortcomings in the project M&E system.
Moderately satisfactory (MS): There were moderate shortcomings in the project M&E system.
Moderately unsatisfactory (MU): There were significant shortcomings in the project M&E system.
Unsatisfactory (U): There were major shortcomings in the project M&E system.
Highly unsatisfactory (HU): The Project had no M&E system.
M&E plan implementation will be considered a critical parameter for the overall assessment of the M&E system. The overall rating for the M&E systems will not be higher than the rating on M&E plan implementation.

All other ratings will be on the following six-point scale:
HS = Highly satisfactory Excellent
S = Satisfactory Well above average
MS = Moderately satisfactory Average
MU = Moderately unsatisfactory Below average
U = Unsatisfactory Poor
HU = Highly unsatisfactory Very poor (appalling)

Annex 7 – Photographic documentation from Akaki DMF



Annex 8: e-waste generation in Ethiopia

8.1 E-waste generation and management building

Solving the E-Waste Problem (StEP) Initiative Green Paper. Under the auspices of United Nations University and StEP Initiative 2013, A. Manhart of Öko-Institut e.V. in Freiburg, Germany and his two Ethiopian colleagues of PAN Ethiopia (Pesticide Action Nexus Association of Ethiopia, a non-governmental organization) in Addis Ababa conducted a thorough country study focused on e-waste **[7]**. Having reviewed the basic facts of Ethiopia; the EEE and WEEE range of products; as well as the WEEE management practices, downstream markets, and related legal Framework; and having paid attention also to the import and refurbishing of used computers with special focus on the Computer Refurbishment and Training Centre (CRTC) in Akaki, they produced detailed statistics on the chief EEE and WEEE products (*cf.* Table 6) and came up with a number of relevant conclusions and recommendations.

Table 1. Selected statistics: Estimates of the stocks of functional, non-functional, and imported EEE in Ethiopia's 10 largest cities in 2011 (based on [7])

Type of equipment	**Stock of non-functional equipment in the 10 largest cities of Ethiopia in 2011, by weight (tons)**	**In-use stock in private households in the 10 largest cities of Ethiopia in 2011 (pcs)**	**Total number of electrical and electronic devices legally imported into Ethiopia in 2011 (pcs)**
Personal Computers	3,200	656,000	263,116
TVs	510	946,000	177,047
Mobile Phones	3	2,129,000	346,084
Refrigerators	590	758,000	53,368
Total	**4,300**		

Conclusions of the 2013 study:

- As at 2011/2013, the use of many types of EEE in Ethiopia was mostly restricted to urban centers (except for battery-powered devices in rural areas).
- E-waste was not yet a major source of environmental pollution or health and safety impacts in Ethiopia (compared to *e.g.*, Ghana or Nigeria).
- Nevertheless, the situation also required action as market penetration of EEE was rapidly increasing so it was imperative to install adequate collection and recycling systems and defining aspects related to policy and legislation, finance mechanisms, monitoring and control, and awareness-raising. In this light, the Akaki DMF being developer and searching for downstream markets and solutions for the various output fractions (steel, aluminum, cables, printed wiring boards, plastics etc.) was regarded as most relevant.

The study [7] recommended the following steps to be taken:

- Strengthen the Akaki DMF initiative by expanding e-waste collection, optimizing pre-processing and storage, widening the scope of collection and management efforts to other types of EEE, and developing solutions for non-valuable fractions.
- Develop and adopt a national e-waste strategy of environmentally-sound e-waste management, based on existing regulative frameworks and taking into account aspects related to (1) policy and legislation, (2) business and finance mechanisms, (3) recycling technology, skills and downstream markets, (4) monitoring and control, and (5) marketing and awareness raising.
- On a national basis, follow international legislative efforts to reduce adverse environmental impacts in the life cycle of EEE, in alignment with *e.g.*, the European RoHS Directive banning the use of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ether (PBDE) in EEE.
- Owing to the fact that the costs of e-waste collection, recycling and disposal are usually not fully covered by the revenues from material recovery,

consider the need for a financing mechanism based on the principle of extended producer responsibility.

WASH on Context and Environment. According to a United Nations University report [9], there are about 4300 tons of non-functioning computers, televisions, mobile phones and refrigerators in Ethiopia, mostly in the ten largest cities (Manhart et al., 2013 [7]).

Figure 7 taken from a recent (2016) Finnish source (although its origins are more complex, see below) shows open, uncontrolled solid waste disposal sites in Addis Ababa and Bahir Dar close to residential areas. One interesting point is that actually, the two photographs can be traced back to the 2013 Manhart's study [7] which has copied them. However, in that study [7] they are correctly attributed to a 2011 PAN source. This is an example of how different authors repeatedly make free use of pictorial material produced by others, never having to visit the respective sites themselves. It is true nevertheless that all types of waste, including hazardous waste like heavy metals, are discarded here without any treatment, so toxins can seep into the soil and groundwater.

Fig. 1. Uncontrolled waste disposal in Bahir Dar (left) and Addis Ababa (right).

Again, the Finnish source [9] mentions that there is one e-waste demanufacturing facility (DMF) in Addis Ababa managed by the government. This is the facility where the project that has been ongoing during 2012-2017 is subject to the present terminal evaluation. The DMF collects e-waste from governmental offices, dismantles them manually and sorts the different components to recover valuable metals. This is presented as an example of good practice in e-waste disposal. It is not clear whether the photograph in Fig. 7 on the right originates from the huge and imposing, mountainous Reppi dumpsite, located 13 km southwest of the city center of Addis Ababa and covering 25 ha. Apparently, that dumpsite has the status of a sanitary landfill. The site was established in 1968 and is still used and growing after 50 years, surrounded by settlements. Spontaneous fires cause local air pollution. A recently built giant incinerator has started digging into the mountain of waste but this is going to be a long-term, tedious process.

US EPA e-waste efforts in Ethiopia. The E-waste efforts by two of the partners in the Akaki DMF project, US EPA and StEP, in Ethiopia were also reviewed in a presentation held in 2013 at an E-waste workshop in El Salvador [10]. An "Ethiopia

E-waste Management Working Group" (Fig. 8) was established, with key players from the ranks of Ethiopian organizations (Government – Environmental Protection Authority, Ministry of Communication and Information Technology, Standards Authority; civil society – PAN Ethiopia, Forum for the Environment, Institute for Sustainable Development, ENDA Ethiopia; academia – Addis Ababa University; and industry - Ethiopia Plastic, Ethiopia Iron and Steel) as well as international organizations (StEP, UNIDO, UNU, Cascade Asset Management LLC, University of Limerick, Öko Institute, IBLF, US EPA**).** It is difficult however based on documentary sources and a brief field mission to recognize what precisely the Group has accomplished. The presentation identified some disturbing aspects of the project: as at 2013 there was „no output to downstream markets yet, the dismantled WEEE were mostly stored (18 tons of steel scrap and 6.8 tons of mixed plastic at facility)“, and there was „no hazardous waste disposal site or waste incinerator in Ethiopia“.

Fig. 2. Setup of Ethiopia e-waste management working group

Proposal of an efficient & effective e-waste collection system. The principles and considerations outlined in [7,9,18] were implemented in the 2015 final report [11] by Öko-Institut of Freiburg, Germany and PAN Ethiopia which (i) analyzed the solid waste management situation in four selected Ethiopian cities (Fig. 9) and (ii) confronted the findings with e-waste collection systems in Germany and Ghana, to come up with (iii) considerations for an e-waste collection system in Ethiopia and (iv) suggestions for a pilot collection system in Addis Ababa.

Fig. 3. Map of Ethiopia with four cities highlighted

The considerations related to the organizational setup of the collection system (Fig. 10), the collection infrastructure, incentives, and collection financing schemes (Fig. 11). The suggestions relating to the pilot collection system for the nation's capital focused on the already existing collection point in Bole and a potential collection point in the Merkato area (both within Addis Ababa). Monetary incentives based on a regularly updated price list (to be compiled) for the various waste products/components were suggested.

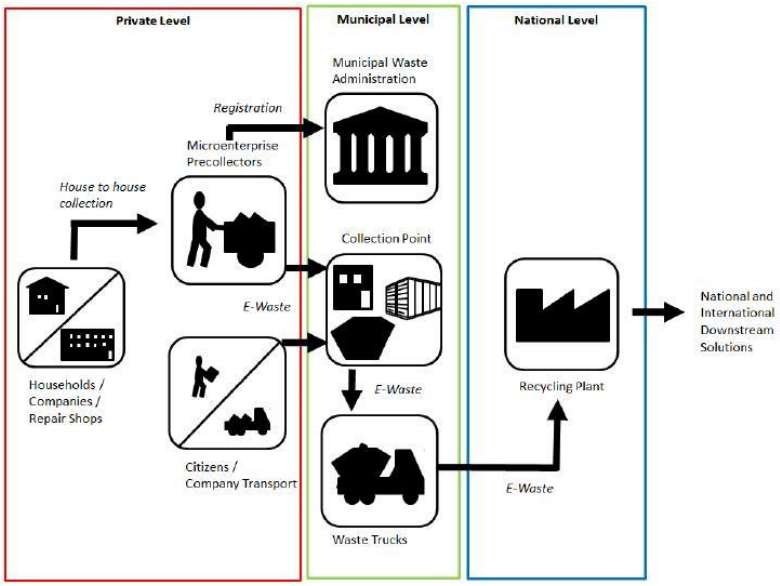


Fig. 4. Flowchart of proposed e-waste collection system [11]

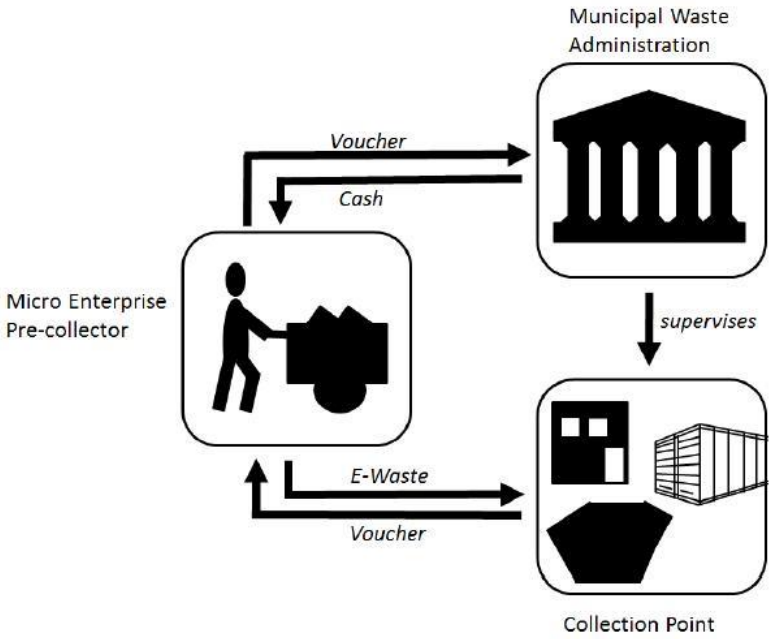


Fig. 5. Suggested E-waste collection mechanism incl. monetary incentives [11]

The following key recommendations were made for the near-to-medium horizon:

- Consider managing e-waste collection on a municipal level—in parallel to the established municipal solid waste collection systems. Employ financial incentives.
- Alongside the state-operated system of collection points, leave room for private stakeholders active in the collection and transport of e-waste to the collection points.
- Activate an additional mechanism based on the principle of Extended Producer Responsibility (EPR). A timely political decision is needed to introduce such a mechanism.

E-Waste country study Ethiopia, slide presentation. Data in the presentation by T. Amera [44], Table 7, are an extract of basically the same data presented elsewhere by E. Herbeck [19] and contained in the report on downstream markets by Otmar Deubzer *et al.* [45]; they originate from the 2013 country study [7].

Table 2. Total number of e-devices legally imported into Ethiopia in 2011 (incl. accessories)

Computers	TV sets	Mobile phones	Refrigerators
263116	177047	346084	53368

It is noted that, as at 2013 at least, most mobile phones on the Ethiopian market were illegally smuggled into the country, in part to avoid paying the high import taxes.

Electronic waste generation and its management in Bole and Akaki Kaliti. A questionnaire survey [8], originating from Ambo University in Ambo City, was performed in 2013/2014 indicating a total number of obsolete e-goods of 5654 pcs in both Sub-cities. A considerable volume of obsolete items ought to have existed at the time in the remaining eight Sub-cities of Addis Ababa. CRTs occupied a prime position among the residues in repair shops.

Guidebook for conducting an e-waste inventory (PAN). Essentially the same information as in the study "WASH: Context and Environment" [9] is also given in the "Guidebook for conducting an e-waste inventory (PAN)" [12]. The survey conducted in four major Ethiopian cities (Addis Ababa, Bahir Dar, Dire Dawa and Hawassa) focused on four selected types of EEE (also *cf.* [11]:

- personal computers and accessories
- television sets and accessories
- mobile phones
- refrigerators.

As part of the effort to establish the DMF, MoFED has written a circular letter to all federal ministries to hand over stored end-of-life EEE to the MCIT. The Guidebook [12] also mentioned that there was no hazardous waste disposal facility in Ethiopia.

Guide for conducting an e-waste inventory in Africa. The Guide [13], published by PAN Ethiopia (Pesticide Action Nexus Association) with inputs from IPEN, the global organization working to establish and implement safe chemicals policies and practices aims at the whole of Africa, basically relies on the Ethiopian experience. It offers a recipe for conducting an e-waste inventory in Africa.

The purpose of the Guide [13] is, therefore, to share the Ethiopian experience not only in carrying out and compiling the results of the inventory of e-waste but also emerging issues in the up-stream and mid-stream aspects of the lifecycle management of electronics, which are needed because of the high investment

opportunity being exploited by companies being set up for electronics and electrical equipment production in developing countries like Ethiopia.

8.1.2 Legislation

Until recently, Ethiopia had no specific e-waste legislation in place [45] apart from a draft regulation on Management and Disposal of Electrical and Electronic Wastes prepared by the Ministry of Environment and Forestry (MEF). However, new legislation intended *i.a*., to foster the collection and recycling of WEEE was approved in August, 2017 by the Ethiopian Parliament.

The new Council of Ministers Regulation (*cf*. Annex 8) is a modern, well-balanced document that

- defines the waste management hierarchy;
- introduces the Extended Producer Responsibility concept and also defines the responsibility of EEE consumers;
- makes it mandatory for waste collection center operators as well as for WEEE dismantling center operators and for persons engaged in the transportation thereof to register and secure a certificate of competence;
- imposes defined obligations on WEEE refurbishers and recyclers;
- makes it mandatory for WEEE in temporary storage to be sorted , recorded, and examined.

8.1.3 Financing

Financing models for sound e-waste management. An extensive 2015 report [14]—commissioned by UNIDO and produced under the auspices of GEF and two Ethiopian Government Ministries (Ministry of Communications & Information Technology and Ministry of Environment & Forestry)—presents a series of reviews covering the following topics:

- The context, societal need, and financing of e-waste management, plus the Extended Producer Responsibility principle;
- Examples of financing models from the EU, California, Japan, Ghana, South Africa, and Kenya;
- Policy options and recommendations for financing e-waste management in Ethiopia.

The various examples of financing models were examined as to their correspondence with the EU WEEE Directive (2002/96/EC on Waste Electrical and Electronic Equipment, amended to Directive 2012/19/EU [20]). Unfortunately, the text of the report does not comment on the highly interesting flowsheet depicting the financial and physical flows as per the WEEE Directive (Fig. 12).

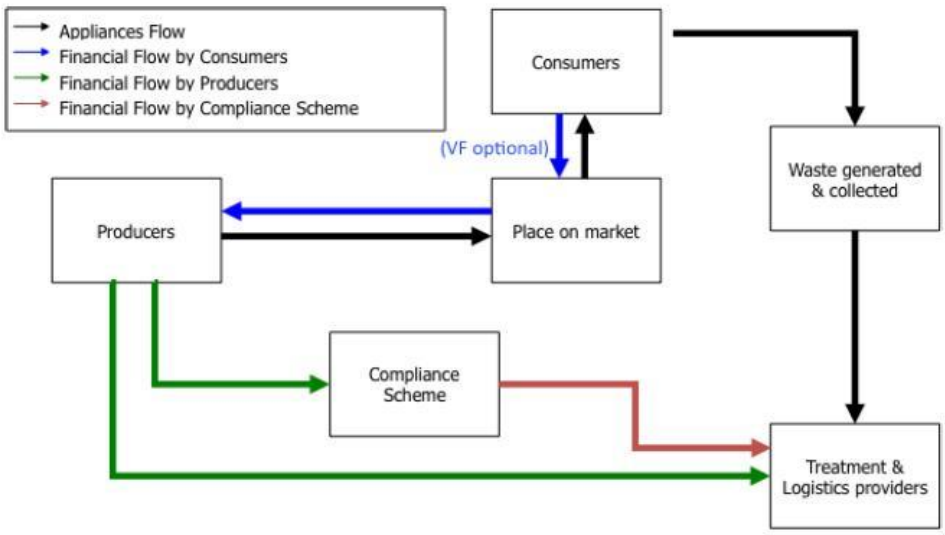


Fig. 6. Financial and physical flows in the WEEE Directive.

The report stipulates that

- Modern electronic products have revolutionized the world: are used in areas such as education, communication, medicine, transportation, health, food-supply, security, environmental protection and culture.
- After use those products are discarded as e-waste which (i) creates a waste problem detrimental to the environment and to human health, while (ii) representing potential resource if the various valuable materials contained therein are recovered.
- In many cases the costs of proper collection and recycling e-waste might exceed the revenues generated from the recovered materials: this is why a proper financing mechanism, tailored so as to suit the societal context of the country, needs to be defined and enforced.

Recapitulation of chief recommendations of the report:

- Payments of entities to individuals delivering e-waste to formal e-waste collection points should be exempted from taxes.
- EPR-based systems organized and implemented by the private sector tend to offer a higher long-term cost-effectiveness, one of the key drivers for long-term cost-effectiveness being fair competition between logistics providers and recyclers.
- Transparency of the real recycling costs is conducive to elucidating the financial requirements of a proper e-waste management.
- The e-waste collection system should not aim at competing with the local reuse and refurbishment sector.
- The ”producer” should be defined as if to include not only the manufacturers or the brand of the individual product, but all the entities locally producing, assembling or importing new or used electrical and electronic equipment that is sold on the national market.
- Efforts to tackle and resist smuggling, should be strengthened.

- Out of the models presented in the report, the shared responsibility approach (a model splitting the responsibility for financing e-waste management between the consumers of EEE and the producers) matches best the local conditions in Ethiopia.

Annex 9 – Technical Annex: International scenario of WEEE and specific national cases

The sub-chapter *International* refers to connotations of a global character or relating to more than one country. This is followed by sub-chapters pointing to the variegated experience of a selection of countries: *Czech Republic* the international terminal evaluator's home country; *Ghana, Kenya, Nigeria* and Uganda on the African continent; *Russia*; *Sri Lanka*; *United Kingdom*, and the *USA*. It is believed that this seemingly haphazard selection has managed to offer a representative view of the general WEEE situation and of its reflection on Ethiopia.

The information contained therein has the potential of providing benchmarks for the various facets of the WEEE issue facing Ethiopia. Moreover, the various case histories described can become a source of inspiration for both the Government and the business community on what can be done to foster the collection, processing, and recovery of WEEE and to refine the relevant policies and strategies.

International

Regarding the electronic waste recovery business, it was claimed by a market research report [15] published in 2005 that the worldwide market for electronic waste will rise at an AAGR (average annual growth rate) of 8.3% from $11.5 billion in 2004 to $17.1 billion in 2009.

Electronic waste (e-waste) is a term globally used to categorize electronic equipment that has reached end-of-life (EOL) for its current user. Such devices or equipment generally are considered toxic when disassembled or incinerated and typically are targeted for hazardous disposal or slated for recovery and reuse. Recent technological advancements provide manufacturers with less toxic material choices and more cost-effective ways to recover electronic circuitry and associated equipment. As a result, an e-waste industry has emerged, with corresponding significant markets.

Forecasts of future global markets for recovery, reuse and disposal technologies in the e-waste industry suggest that the material composition of electric and electronic equipment and components will change dramatically over the next years as global regulatory trends compel manufacturers to migrate to nontoxic materials and manage the lifecycle of those materials from ‘cradle-to-grave.’

The resultant technological shifts have to be analyzed and exploited, including the use of higher value and less toxic materials, such as engineered plastics and lead substitutes, and more efficient recycling technology. Key objectives are to identify

growth in current and new materials and recycling technologies, assess market values and provide a comprehensive analysis of related technology development.

On the issue of global markets for electronic waste recovery, another market research report [16] published in 2010 by the same company (BCC Research, Wellesley, MA, USA) arrives at similar conclusions as that [15] published previously:

- The global market for revenues from electronic waste materials recycling is projected to grow from $8.5 billion in 2009 to nearly $13 billion in 2014, a compound annual growth rate (CAGR) of 8.9%.
- The fastest-growing segment of the E-waste market is recycled plastics, valued at $976 million in 2009 and projected to reach $1.6 billion by 2014, a compound annual growth rate (CAGR) of 10%.
- The recycled metals sector is expected to continue to grow at a compound annual growth rate (CAGR) of 8.8%, increasing in value from $7.5 billion in 2009 to $11.4 billion in 2014.

As regards the recycling of computers [17], more than 90 % of e-waste is being dumped or incinerated without any processing. This waste however amounts to one of the largest resources of heavy metals and, simultaneously, is the source of large amounts of organic environmental contaminants present in municipal waste.

The StEP annual report 2012/2013 [18] states that issuing from groundbreaking ideas of the ideas laid down in the Brundtland Report—which coined the first widely accepted definition of 'sustainable development' following the World Commission on Environment and Development in 1987, the Solving the E-waste Problem (StEP) Initiative made efforts to tackle the e-waste problem from a scientific, multi-stakeholder perspective. Hosted by the United Nations University Institute for Sustainability and Peace, StEP Initiative is a multi-stakeholder network of actors under the UN umbrella. The members of StEP include large and small business companies, research institutes as well as associations or NGOs, in particular from newly industrializing and developing countries.

Five Task Forces were formed by StEP in 2012/2013: on Policy, Redesign, Reuse, Recycling, and Capacity building in the area of WEEE. Task Force 3—Reuse was specifically concerned with Ethiopia. Also, with an indirect bearing also on Ethiopia, a White Paper was compiled on the effect of waste legislation on transboundary movements of EEE destined for re-use.

The concrete objectives of the multi-stakeholder approach adopted are as follows:

1. E-waste research & piloting:

- Scientific research
- Stewardship and promotion of positive change
- Research into the design of systems, processes and management practice
- Support to the piloting of problem-solving ideas through to implementation

- Monitoring and analysis of product to recycler supply chain

2. Strategy & goal setting:

- Durable strategies and recommendations to fit local conditions
- Benchmarking e-waste practices
- Leverage of member expertise

3. Training and development:

- Training activities for multisector e-waste players
- Standards for and design of training syllabuses
- Capacity building and employee training modules
- Developing an interdisciplinary StEP e-waste Academy

4. Communication & branding:

- Publications to broaden/deepen audience understanding
- Awareness raising about issues and opportunities in e-waste prevention, processing and disposal
- Engagement with National Governments and the international community on legislation development.

StEP has been instrumental in co-organizing a scheme to install an e-waste management system in Ethiopia (see elsewhere in this report).

As regards UNIDO's involvement in e-waste management, the key elements of UNIDO's e-waste management approach include [19]:

1. Policy and legislation development or enhancement, including collection strategies and financing mechanism;
2. Detailed inventory of existing volumes and ongoing initiatives;
3. Design of collection and processing schemes;
4. Set-up / up-scale of national e-waste treatment options, including the establishment of sustainable business models;
5. Connection to downstream markets on national, regional and international level in accordance with international conventions, *e.g*. Basel Convention;
6. Capacity building, training and awareness-raising.

In addition to Ethiopia, the ongoing elements of UNIDO's e-waste management portfolio (as at 2012/2013) included projects in Uganda, Tanzania, and Cambodia.

Deliverables range(d) from economic feasibility studies to multi-annual business plans (to set up facilities), from assessments of existing e-waste management businesses to business models, process optimization schemes, collection strategies, and financing schemes; and there are numerous pipeline projects. Also, UNIDO is involved in various partnerships and networks.

According to a WASH study on Context and Environment [9], e-waste poses a huge challenge to the environment because they contain toxic substances such as cadmium and lead from batteries, which leach out and pollute rivers and groundwater. E-waste is becoming a major problem in many African countries,

including Ethiopia, where the use of electrical equipment has increased sharply with the rising number of people on higher incomes.

The basic legislative document governing (attempting to govern) Europe's e-waste collection and treatment efforts is the Directive 2012/19/EU [20].

Many of the observations made in other countries, as well as many lessons learned and conclusions drawn, would apply in a considerable measure to Ethiopia, too: The countries specifically mentioned in this terminal evaluation report are Russia [21], the USA [16,22,23,34], Czech Republic [24-31], Germany [11], Nigeria [32], Ghana [11,33], Sri Lanka [35], and the U.K. [36].

Observations:

European Union countries. The legal basis for e-waste collection in Germany, CZ, etc. ...is the European Directive 2002/96/EC of the European Parliament and the Council on Waste Electrical and Electronic Equipment (so called WEEE Directive, see above) that came into force in 2003. Consequently, the WEEE-Directive had been implemented into the countries' national law.

A basic principle of the WEEE Directive is the approach of Extended Producer Responsibility (EPR). The basic idea of an EPR approach is to incentivize producers to minimize end-of-life (EoL) costs of their products by adopting product design to the needs of recycling.

Within the EPR system implemented in Germany, distributors (*e.g*., retailers) take back e-waste voluntarily. In contrast to some other EU member states and to Switzerland, distributor take-back is not mandatory in Germany.

The purpose of the Guide [13] for conducting an e-waste inventory in Africa, compiled by PAN Ethiopia (Pesticide Action Nexus Association) with inputs from IPEN, the global organization working to establish and implement safe chemicals policies and practices, is to share the Ethiopian experience on a pan-African scale.

A recent Czech paper [23] claims that the computer industry encourages planned obsolescence in order to sell more product. This business model exacerbates the problem of computer disposal because it artificially shortens computer lifespans. This increases production and, ultimately, the numbers requiring disposal. One result is that *e-waste*—electronics waste—is now one of our most pressing environmental challenges.

There are about one billion PCs in use worldwide (estimate 2010). There are an additional several hundred million sitting in basements and attics awaiting disposal. Given average lifespans of only two to five years, a tidal wave of computers requiring disposal sweeps towards us.

The 'toxic brew' contained in consumer PCs is shown in Table 1.

Table 1. Toxins contained in consumer PCs

Toxin:	Use and Effects:
Lead	CRT display monitors contain anywhere from two to eight pounds of lead, which can cause brain damage in children and other neurological effects if ingested. CRT's are being disposed of in massive numbers, due to the switch to flat-panel technology. (We're seeing the same phenomenon in TV disposal as the public switches from analog to digital TV). Circuit board soldering also contains lead.
Mercury and **Arsenic**	Flat panel and laptop displays contain mercury and arsenic, poisonous even in small amounts. Mercury is also present in circuit boards.
Cadmium	Every desktop contains a battery, and laptops contain two or three. Cadmium is among the toxicants in batteries. It's also found in SMD chip resistors, semiconductors, infrared detectors, and some plastics. Cadmium is a known carcinogen that concentrates within the human body.
Phosphorus	The insides of CRT display monitors are coated with phosphorus dust. You don't want to inhale it.
BFRs	Brominated flame retardants or BFRs coat computer plastics. BFRs have hormonal effects and leading manufacturers like Apple have stopped using them.
Beryllium	Beryllium is another known carcinogen, used in circuit boards and connectors.
Polyvinyl Chloride and Plastics	PVC and plastics compose roughly 20% of computers. Burning them releases dioxins and furans.
Barium	Barium is present in CRT's to protect users from radiation. It's not as beneficial in landfills or your drinking water.

Burning computer components releases dioxins, furans, PCBs, and other toxins into the atmosphere, and also into the lungs of anyone nearby. Why would anyone incinerate a PC? It's the cheapest, low-tech way to separate the worthless plastics from the salable metals. If you reside in a poor country without environmental and safety standards, this is how you separate and "recycle" materials. For example, yank the wires from desktops, then burn them to separate the worthless rubberized plastic coating from the salable copper within.

With over 1,000 different materials going into computer manufacture, it's not surprising many harmful elements are involved.

Manufacturers can be encouraged to limit the toxins they put into computer equipment, through the use of the web tool called EPEAT (Electronic Product Environmental Assessment Tool, https://www.epeat.net/about-epeat/) to buy the most environmentally-friendly items. EPEAT has a data base of several thousand computers and displays and rates them all on a variety of environmental criteria.

Where Do The Toxins End Up?

Where all the toxins in computers end up depends on many factors, one of which is the country disposing of them. In the United States, the Environmental Protection Agency estimates that less than 15% of e-waste is properly recycled. Of the remaining 85% that is improperly disposed of, some goes straight into landfills. Most goes overseas.

The overseas trade works like this. The U.S. imports billions of dollars of goods from China every year. All these items arrive in standard shipping containers. Since the U.S. exports very little back to China (as measured by volume), the majority of these shipping containers go back to China empty. So shipping to China is very inexpensive, and shipping even very low-value items there makes economic sense.

While Americans are eager to dispose of their toxic e-waste, China lacks the safety and environmental standards common to developed nations. And the Chinese labor rate is very low.

This combination of cheap shipping, inexpensive labor, and a lack of safety and environmental law breeds a thriving export trade. Computers and other e-waste go to China and sometimes Africa where they are "recycled" with a complete lack of environmental and safety rules. The firms engaged in this toxic trade try to hide what they are doing, so one can only estimate. Some responsible estimates assert that from 50% to 80% of American e-waste goes into this business. The phenomenon has become so prevalent that it has been exposed repeatedly in the media.

This trade has become a thriving business. Companies called "fake recyclers" approach well-meaning organizations—charities, churches, and community organizations—and offer to hold a Recycling Day. The charity provides publicity, legitimacy, and a parking lot for the event. On the designated day, well-meaning residents drop off their old electronics for recycling. The fake recycler picks it up in their trucks, hauls it away for shipping, and makes money by exporting it to Chinese or African "recycling" centers. Nobody's the wiser.

Organizations with outstanding reputations are conned into participating in this business while believing they are engaging in beneficial activity. It's not their fault. Since fake recycling is unregulated by U.S. law, anyone is free to call themselves a recycler and sell materials into the overseas trade. Misrepresentation about it is not illegal. Fake recycling is a thriving business.

Quotation [23]: *It costs several dollars per item to properly dispose of much e-waste, and our society has decided not to pay that price. Instead those costs are imposed on the environment and those who work overseas in unsafe and unhealthy conditions.*

Suggested remedies:

- Vendor "take back" programs

- An older computer making an excellent secondary machine for a large family
- Donating an old computer to a *refurbisher* rather than to a *recycler*. A refurbisher reuses the equipment, while a recycler destroys it and reuses the component materials. Vendor take-back programs do not refurbish because they cannot afford the labor to do this. They only recycle. But there are many non-profit refurbishers.
- Looking for 'red flags'. One red flag is that companies accept CRT display monitors, TVs, and computer printers for free. These items can almost never be reused, and it costs money to environmentally recycle them. Organizations that environmentally recycle these items take a monetary loss on them if they don't ask for a small recycling fee.

Recycling one ton of mobile phones is of an unparalleled value [37]**.** Gold possesses a permanent value tested by all the millennia during which people have been mining it. It is estimated that the total amount extracted has surpassed 160 thousand tons, of which approximately one third during the last score of years. Current annual production worldwide is approximately 2,500 tons. Prices are high and this is why the mining and processing companies even invest in looking for new deposits and 'deposits'. With some overstatement, it can be said that the latter even include mobile phones.

Refining is the key processing step. This is done by means of pyrometallurgy (which involves heating the metal to the melting point) or hydrometallurgy (which consists mainly in leaching the ores in a suitable liquid).

To separate gold from mobile phones, a flux-forming element may be added such as borax to prevent oxidation (of other elements) and assist the melting process. When gold is solidified the flux having absorbed the impurities is precipitated and removed. Chemicals used in hydrometallurgy include *e.g*. nitric acid where gold remains unaffected and the other elements can be vaporized or otherwise removed.

Czech Republic

E-waste processing companies. A number of Czech e-waste processors are listed [24], of various types of e-waste. Next to recycling, the processes to consider are *upcycling* (processing of materials already used, by-products that could become potential waste) and *remanufacturing* (~ repair, rebuilding, re-functionalizing of product or its components—largely forgotten or disdained today). Also refers to EKOLAMP, ELEKTROWIN, ASEKOL & EKOBAT.

The Ecobat 2016 annual report [25], concerned with the e-waste situation of Czech Republic, with a population of 10 million, can serve as a convenient benchmarking yardstick for the situation of Ethiopia (with a population ten times as high, *i.e.* 100 million).

In 2016, a total of 889 battery producing companies were part of the spent batteries collection system. Of the 3641 tons of batteries marketed, the shares of zinc, alkaline, and other batteries (incl. storage batteries) were 796, 1651, and 868 tons, respectively. Over recent years, the more efficient primary cells (*i.e.*, non-rechargeable) alkaline batteries have come to prevail over the cheaper zinc batteries.

By 2017, the Ecobat Association has been in existence for 16 years. This non-profit organization takes care of take-back (Table 4) and recycling of portable batteries and storage batteries in the Czech Republic, in an effort to meet the 2016 target of minimum 45% effectiveness of recycling based on the stipulations of EU Directive 2006/66/EU. Ecobat is member of Eucobat[l], the European association representing 18 major collective battery take-back systems from 15 European countries.

Table 4.Ecobat battery take-back statistics

Year	Take-back, tons	Take-back, percent	No. of producers involved	No. of take-back sites
2015	1243	35	820	19934
2016	1638	45	889	20546

Steel, zinc, manganese, copper, cadmium, nickel, lead, cobalt, silver, and lithium are separated from the spent batteries after sorting. As much as 65 kg of metal-bearing materials are obtained from 100 kg of batteries after recycling. One ton of pencil batteries received for recycling yield 167 kg of steel, 210 kg of zinc, 205 kg of manganese, and ca. 15 kg of nickel and copper.

There are two battery sorting facilities in the country. Lead, zinc, and alkaline coin button batteries (56% of total) are recycled in the Czech Republic, the rest are exported (Poland, Zn + alkaline 36%; Germany, NiMH - nickel metal hydride storage, 5%; Sweden, Li-ion, Li-storage 2%; Spain, Li-ion storage 1%). No more than 1% of total (difficult to identify or non-recyclable) goes to incineration. The take-back rate is 155 grams of batteries per head of population (corresponding to ca. 6 type AA pencil batteries).

Profits raised by Ecobat are used to further expand the take-back sites network. The major take-back channels (red containers) include towns and villages, schools, sales outlets, and business companies. Take-back competitions are organized in some cities to boost efficiency; pupils and students from 891 kindergartens, elementary schools and secondary schools took part in a playful autumn collection campaign; and the European Battery Recycling Day was held on 9 September to promote the recycling idea.

[l] the European association of national collection schemes for batteries, Zaventem, Belgium.

Ekolamp, a member of EucoLight, is a lighting equipment collection system [26] active in the Czech Republic. It associates the manufacturers (and importers) of luminaires and lighting fixtures who have the mandatory obligation to take back such equipment pursuant to the waste legislation in force. Founded by four major lighting companies it currently operates a network of 3643 take-back sites, see map, Fig. 1. These include

- collection yards
- collection points with a small-sized collection bin
- waste consolidation sites
- waste recyclers
- wholesale organizations (with access to the public)
- sales outlets (where old equipment is only taken back against the purchase of new).

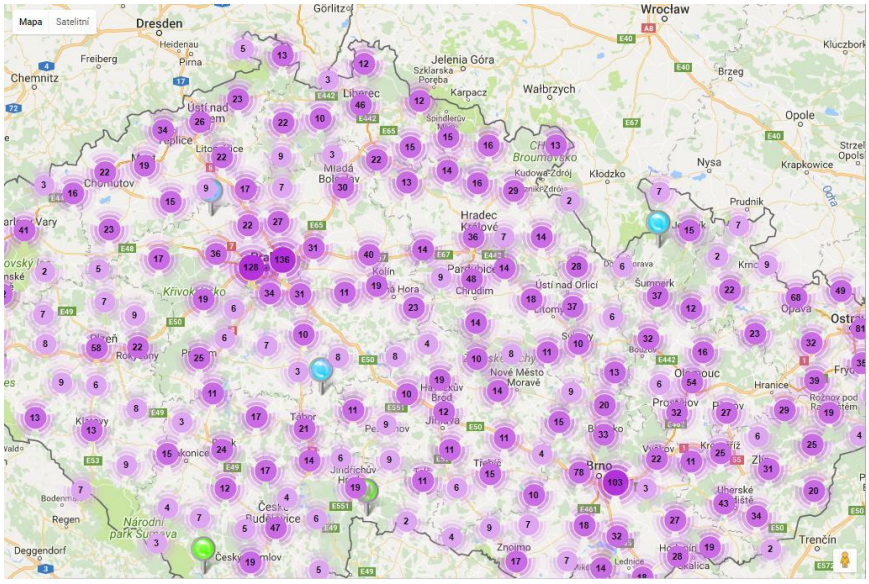


Fig. 1. National network of Ekolamp collection points, CZ

Elektrowin a.s. [27] is a not-for-profit stock-holding company founded by major producers of large and small household apparatus and electrical tools for the purpose of sorted collection, processing, and disposal of this type of waste. During the decade of 2005-2015 it collected 245,000 tons of electrical equipment. The take-back rate per citizen has been 5,5 kg of electrical waste in 2014. Much of this has been cooling/freezing equipment. Elektrowin operates 4,300 take-back sites for the public, plus additional >8,000 sites at schools, firefighting squads, business companies, and towns providing mobile waste collection systems.

Asekol, founded in 2005 by seven companies active in the production and sales of consumer electronics and office, telecommunications, and computer equipment, is a non-profit organization for country-wide take-back of outdated/faulty e-equipment [28,29]. It is a member of WEEE Forum (Brussels). It operates 14,032 take-back points of various types. In various regions of the country it collects 1.05 to 1.87 kg of e-waste per head of population.

The official website of a Czech regional town, Vsetín, makes it clear [30] that through the major collection systems (*i.e.*, ASEKOL, EKOLAMP, and ELEKTROWIN), every Czech has surrendered 4.1 kg of old e-equipment in 2016. In recent years the take-back rates have levelled off. Larger-sized white goods (refrigerators & freezers, laundry equipment, and electric cooking stoves) constitute a dominant share of the e-waste collected. This does not include the take-back of batteries through EKOBAT which has been growing in recent years.

Prohibited take back and sales of e-waste [31]**.** In the Czech Republic, illegal selling of outdated e-equipment (avoiding mandatory take-back) carries a penalty of up to CZK 50 million. This applies even when such equipment is sold to certified waste processors or collectors.

E-waste information on Wikipedia [38] teaches us that the nature of e-waste is defined pursuant to local legislation. Only listed products are subject to mandatory take-back: *e.g.*, in the Czech Republic, batteries yes, classical light bulbs not... A recycling charge is introduced by law, deriving from the recycling costs, and applied as a surcharge on the purchase invoice of new equipment. There also is a take-back scheme called the REMA System, again specializing in WEEE, with branches dedicated to solar panels, batteries, and packaging.

The business company AIIService Prague [39] has been involved in repairs and servicing of mobile phones since 1997, and gradually re-focused to disposal & recycling of computers and other electronic equipment, including domestic appliances. The service is free of charge to individual customers bringing their outdated equipment. It operates the following divisions:

- Disposal: apple Praha
- Disposal: photo Praha
- Disposal: coffeemakers
- Disposal: laptops Praha
- Disposal: mobile phones
- Disposal: notebooks
- Disposal: computers
- Disposal: radio receivers Praha
- Disposal: telephones
- Recycling: apple Praha
- Recycling: coffeemakers
- Recycling: laptops Praha
- Recycling: mobile phones
- Recycling: computers
- Recycling: telephones
- Recycling: electronics
- Recycling: notebooks
- Recycling: radio receivers Praha
- Recycling: tablets.

A wide range of services to the capital city of CZ is provided by Pražské služby, a.s. (Prague Service Company) to both business companies and citizens [40]. Noteworthy waste related services include:

Comprehensive waste management services, *i.e.*:

- collection yards
- collection of bio wastes
- paper sorting lines
- large-sized containers
- recycling center
- comprehensive waste management, including
  - periodic & special removals via containers & receptacles (see Fig. 2)
  - removals & haulage via large-volume containers, cages & compressed waste containers
  - removal of confidential documents
  - removal of other documents
  - removal & haulage of general waste
  - comprehensive water treatment services (environment-free disposal of the contents of fat separators, maintenance, sampling & analysis)
  - cleaning of sewers & sewerage systems and drains
  - outdoor housekeeping (wintertime, summertime)
  - paving works, roadway carpeting, greenery upkeep
  - wastes report keeping and contacts/negotiations with state authorities.

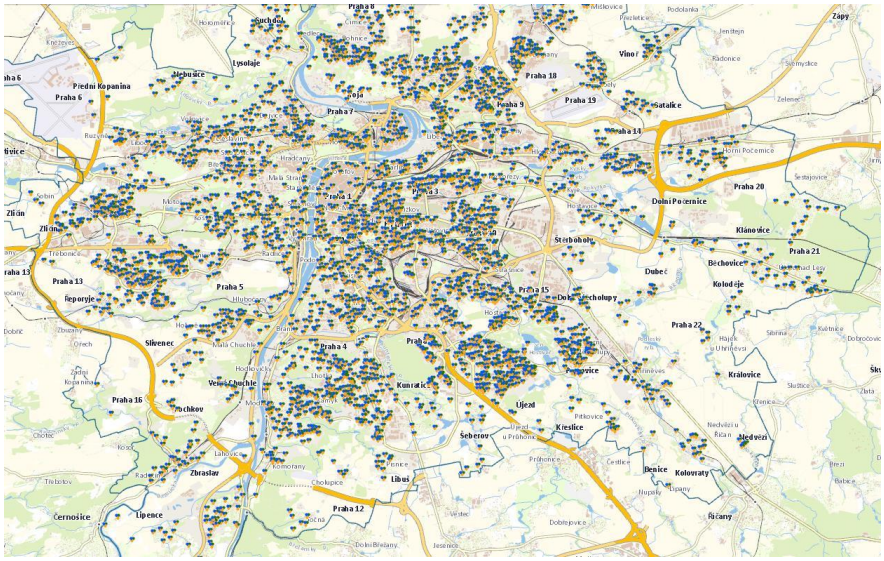


Fig. 2. Map showing the locations of sorted waste containers for the public in the capital city of Prague, CZ

Processing line for treatment of old TV screens and PC monitors. The CRTs of color TV sets are composed of two sections—the phosphorescent screen or 'front glass' (made of barium glass) and the cone section or 'rear glass' (made of lead glass)**.** On the periphery the glass of the screen is coated with a film of vaporized aluminum while the glass of the cone section is coated with

graphite containing an acrylate binder. These coats are stripped off the glass at a work station equipped with blasting chambers where these undesirable substances are blasted away from the CRTs by steel grit of a specific granularity. Then the clean glass is ready for further processing of the glass substance. The annual capacity of the processing line in one-shift operation is 40,000 pieces, whereby 440 tons of glass is returned for recycling, separated into three types—the screen glass, the glass of the cone section, and the glass from black-and-white TV screens.

At the beginning of the line, operators feed the TV screens and monitors onto a roller conveyor band. The rear cover is removed and air is let to enter the CRT so as to remove the vacuum. The TV set is transferred to the blasting action chamber where the interior of the dismantled set is cleaned.

After this stage of dismantling the isolated CRTs are fed onto an accumulation roller band and transported to a workstation where the protective frame is removed. This frame, usually made of metal, is mounted (glued or encased) so as to cover the junction between the cone section and the screen; this may be a soldered seam or a glass-melt junction in the case of color or black-and-white TV sets, respectively. Simultaneously, the non-metallic parts of the cone section and the electron neck are removed manually.

In the next step, the cone is separated from the screen at an automated workstation equipped with an industrial computer that controls all the steps of screen separation. The cutter elevation is adjusted and the screen glass is scratched and grooved so as to induce cracking of the CRT along the notch line. This notch also minimizes the required heating time.

After notching the CRT is clamped again and remains clamped until the end of the entire break-down operation. Two heating bands are applied in parallel around the CRT, along the notch line. The computer determines the heating intensity and time depending on screen size.

On termination of heating when the glass has split the operator will remove the cone section, the flat shadow mask (from color screens only), and by rubbing and suction using a special industrial exhaustor will remove the layer of luminescent substance from the front glass.

Recyclers' directory. On the subject of electrical waste recycling [42], there is a directory of business companies active in waste recycling in the Czech Republic. Any company can apply to be entered in the directory. Relevant categories include:

- Recycling of electrical waste (53 companies)
- Take-back of car batteries (21 companies).

Patented mobile phone recycling process. The Czechs have a unique patent [37] indicative of the worth of recycling one ton of mobile phones.

One ton of gold-bearing rock yields 1 to 3 grams of gold. It is much more profitable to recycle gold from mobile phones where the yield rate is 300 grams from one ton of apparatus.

At Safina Co., the prime Czech gold refining company, this recycling is done using a patented process which is unique and the only one in Europe. There is yet another process in existence, operated in the U.S. There the principle is plasma melting used in combination with microturbines.

It is as environment friendly as possible, producing no direct or indirect waste, and allowing for the reclamation and re-use of important raw materials while at the same time, using the released energy to generate electricity and heat.

Manufacturers enter as much as 27 tons of gold in their mobile phones each year. In addition to gold, the mobile phones and similar electronics also incorporate other valuable materials such as silver. According to data released by Asekol Co. and Elektrowin Co., a total of 8.5 million pieces of discarded mobile phones are currently stowed away in various drawers in the Czech Republic, and these contain ca. 300 kg of gold and more than 2.5 tons of silver worth one billion Czech Crowns.

Ghana

Ghana has been in the center of the debate around unsound management of e-waste in the African context. The accumulated e-waste (collected by informal collectors typically using push-carts to move around urban areas) is exclusively steered into informal recycling systems, which are associated with severe impacts on human health and the environment. However, the first formal e-waste collection point opened in 2013, and other similar initiatives followed. Collected e-waste is picked up by a truck and transported to the e-waste recycling facility operated by City Waste Recycling Ltd. in Accra.

The Ghana e-waste Country assessment [33] confirms that the increased demand of electronic and electrical equipment has led to increased second-hand imports, conducive to the generation of high amounts of waste (WEEE). In general the level of awareness on environmental impacts of wrong disposal of WEEE among the consumers, especially within Accra is better but due to the lack of environmentally sound disposal options, most obsolete equipment is either handed over to informal collectors or stored in refurbishing or repair stores.

The country has ratified both Basel and Bamako conventions on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The provisions of these conventions are not fully integrated in the existing environmental legislation framework, hence implementing them on the ground to address the imports and disposal of WEEE is a challenge. Currently there is no separate e-waste policy. However, a national e-waste management strategy to provide policy and management of WEEE directions nation-wide is under

development to address the institutional framework, financing scheme, collection handling, and disposal of WEEE as hazardous waste.

Kenya

The Kenyan approach is outlined in two publications [32a,b]: As a follow-up to the removal of tax levies on computers; promotion of e-learning in institutions of higher learning; and the launch of the e-government strategy in 2004, the demand for electronic equipment has increased tremendously. This is attributed to Kenya's rapid development of the ICT industry. According to Otieno and Omwenga, this comes with the need for addressing the challenge of proper management of the end-of-life obsolete electronic equipment. In 2010, UNEP estimated the WEEE generated annually in Kenya at 11,400 tons from refrigerators, 2,800 tons from TVs, 2,500 tons from personal computers, 500 tons from printers, and 150 tons from mobile phones. The study highlighted that low citizen awareness, lack of proper policy and legislative framework including public procurement and disposal laws, inadequate infrastructure for WEEE management; high cost of brand-new EEE, absence of frameworks for end-of-life product take-back and implementation of Extended Producer Responsibility (EPR) are challenges that need to be tackled to ensure efficient management of electronic waste.

The 'Guidelines for E-waste management in Kenya', published by the National Environment Management Authority of Kenya in 2011, serve as a guiding document to overcome the inadequate regulatory and policy structures to safeguard health, environment and social consequences of e-waste. However, this should also be coupled with enhancing the limited capacity of government agencies and facilities for dealing with e-waste.

Nigeria

According to the e-waste Country assessment of Nigeria [32], the efficient implementation of the already in place National Environmental (Electrical and Electronic Sector) Regulations, via the National Environmental Standards and Regulations Enforcement Agency (NESREA) of Nigeria, is slowed down by various issues. Lack of clear demarcation and quality criteria while importing used electronic equipment and near-end-of-life equipment without hampering their socio-economic value through sales, refurbishing, and recycling represent a major challenge. Other challenges include lack of initiatives for establishing 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; weak links between the informal collectors with the formal recyclers in Nigeria and with international recycling companies; lack of an adequate financing scheme like Extended Producer Responsibility; nonexistent market incentives for take-back and for developing downstream market outlets for the e-waste fractions.

Russia

According to a 2016 UNIDO report [21] on a BAT/BEP Center for Environmentally Safe Disposal of waste in Russia, the country has a wide network of waste collection and treatment points. The locations of these collection points, processors, and facilities in the Moscow region of Russia [21], with a population >7 million (not counting Moscow City), area 44,300 square kilometers, for WEEE and worn automobile tires are shown in a map on Fig. 3.

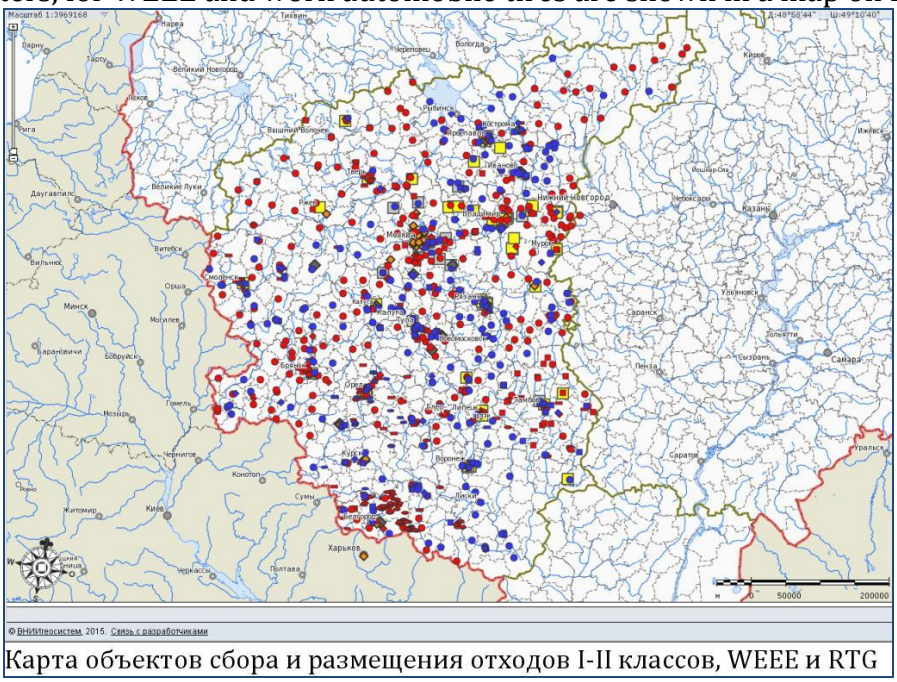


Fig. 3. Map showing the locations of waste treatment collection points, processors, and facilities in the Moscow region

Sri Lanka

Mobile phone waste management is urgently needed in developing countries. This has been demonstrated by the case of Sri Lanka [35]. New trends of mobile phones impact on consumer attitude and shorten the usable life span of a mobile phone. Lack of legislation, illegal markets, second hand markets and lack of processing technologies make mobile phone waste management process more critical in developing countries compared to developed countries. Major gaps in mobile phone waste management in developing countries were identified, with a special emphasis on Sri Lanka:

- Lack of public contribution and awareness—people are not inclined to hand over old mobile phones free of charge; rather they keep it as a backup phone at home. Eventually, uncollected phones are dumped or stockpiled at homes, exposing people to hazardous materials in mobile phones.
- Illegal mobile phone waste collections market—low income groups consider mobile phone waste as a way of earning money; thus they collect mobile phone waste and dismantle them to get precious metals, unaware of health effects, while dumping and landfilling other parts thereof
- The legal mobile phone waste market focuses only on collection, while other procedures such as sorting, processing and disposal are ignored.

- Second-hand mobile phone dealers—some sell locally used mobile phones but others import from other countries creating an oversupply above the exact demand, thus raising the amount of waste mobile phones, ultimately increasing the percentage of old mobile phones dumped in trash bins.
- Absence of a national policy and lack of regulations—creating the need for a more intense government activity through stakeholders involved in mobile phone waste management processes such as government bodies, researchers and mobile phone waste collectors/recyclers; proper mobile phone waste management should be implemented in a global context.

Uganda

The Ugandan approach to e-waste management is described in the UNIDO publication "Inventory on e-waste management practices in Uganda" produced by the Uganda Cleaner Production Centre on the basis of the terminal report on UNIDO project UE/UGA1/1/001. This October, 2013 report emphasizes the decisive role of enforcement and implementation of e-waste regulations for management of WEEE in Uganda. However, there as a need (as at 2013) for putting in place a sustainable financing scheme or business model that can facilitate the implementation of the legislative framework. Furthermore, the emerging informal and formal e-waste recyclers in Uganda can upscale their activities with less adverse impacts on both human health and the environment. Although Uganda is signatory to international conventions dealing with transboundary movement of hazardous waste including e-waste, it is a land-locked country which complicates the export of problematic e-waste fractions that cannot be treated locally.

United Kingdom

A U.K. project, Crowdfunder infoline on e-waste recovery [36] , aims at offering removal of e-waste to businesses and households to help stop e-waste being dumped on poorer nations. A small company Electronic Waste Recovery was started by an idealist individual, with the aim to collect more obsolete technology under a 'Crowdfunder' project. What started as a small business idea turned into a moral obligation. The project website [36] noted in 2015 that, thankfully, the U.K. government "have now has legislation in place to help prevent this sort of activity but still millions of tons of e-waste makes it to poorer nations through hundreds of schemes that send old computers and gadgets to developing nations". This however this does not solve the issue as the computers are at the end of their life and after a short amount of use they are simply added to the growing mountain of e-waste.

USA

The future of electronic waste recycling in the United States remains an open issue [22]**.** Even though e-waste generation and recycling statistics vary significantly between sources, it appears that globally, more than 50 million tons of e-waste were discarded in 2009 and 72 million tons were disposed in 2014 [22]. Europeans produce approximately 20 kilograms of e-waste/person/year, while U.S. residents produce about 7 kilograms of e-

waste/person/year. This discrepancy may be attributed to the varying definitions of e-waste; in the U.S. electronic waste generally consists of information technology(IT) and telecommunications equipment, monitors and televisions, whereas in Europe (and possibly also in Africa) it also includes large household appliances, cooling and freezing appliances, and medical devices.

Responsible end-of-life management of e-waste is imperative in order to recover valuable components and properly manage hazardous and toxic components. End-of-life management of e-waste includes reuse of functional electronics, refurbishment and repair of electronics, recovery of electronic components, recycling e-waste, and disposal.

Currently, the main driver for the recycling of e-waste is the pressure of regulatory factors. Key lessons learned include: (a) high collection volumes are seen when laws make the collection convenient, or when they establish collection goals; (b) states with high collection volumes have laws covering collection costs, encouraging a variety of collector types, including government, private and non-profit; and (c) landfill bans boost recycling levels.

Generally, the e-waste generated in the U.S. is pre-processed domestically and then sent overseas for end-processing, including the recovery of precious and special metals. It is estimated that 50 to 80 percent of the e-waste collected in the U.S. is exported to developing countries such as China, India and Pakistan, due to low-cost labor and less stringent environmental regulations. The remaining e-waste collected in the U.S. is processed via pyrometallurgical processing methods at copper smelters in Western Europe and Canada. The U.S. does not have integrated smelting capacity, and therefore does not process any of the e-waste it generates. However, The U.S. does have small scale recycling plants for the recovery of precious metals from spent automotive and industrial catalysts. Currently the smelting and refining industry dominates e-waste recycling; hydrometallurgical processing is just emerging. Biometallurgy (bioleaching and biosorption) still is at the stage of research and development.

On the whole, even in the U.S. the recycling and recovery of e-waste is limited. Recommendations include:

- Devise a national approach to e-waste recycling.
- Increase collection efforts (and rates).
- Research, develop and build domestic end-processing capacity for e-waste.

Recycling of old computers in the USA. It is estimated [34] that nearly 50% of all heavy metals dumped comes from consumer electronics. Unless this is remedied, an environmental catastrophe will ensue (*cf.* Fig. 4, Table 5).

Forecast of production, aging, and recycling of processors in the U.S. (million units/yr)

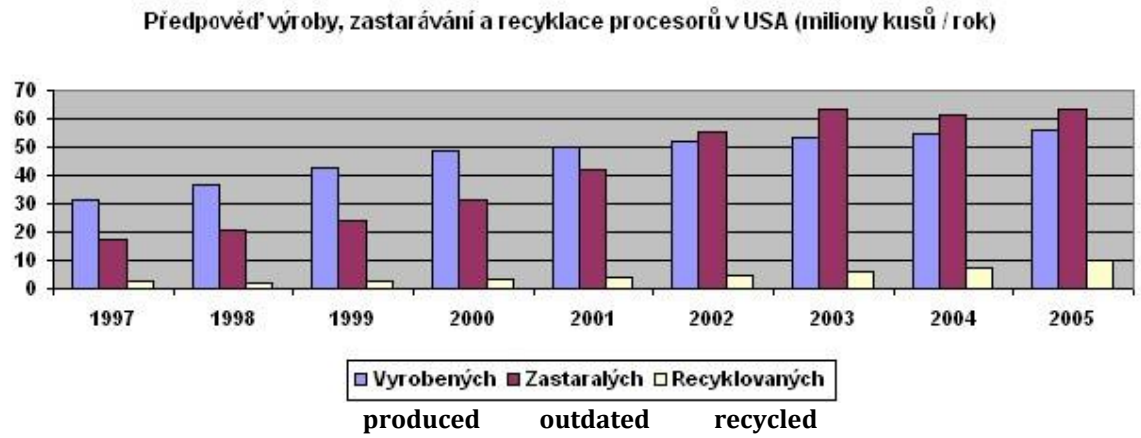


Fig. 4. U.S. processor production, aging, and recycling forecasts

Table 2. EEE units produced, outdated, and recycled

Million units / yr	1997	1998	1999	2000	2001	2002	2003	2004	2005
Produced	31.4	36.7	42.6	48.9	49.9	52.0	53.3	54.6	55.8
Outdated	17.5	20.6	23.8	31.6	41.9	55.4	63.3	61.1	63.4
Recycled	2.4	2.3	2.7	3.2	3.8	4.8	6.0	7.6	9.9

A recent study by the U.S. National Security council[I] predicts that more than 300 million personal computers will have to be recycled during the course of the next four years. This estimate includes ca. 150 million outdated computers now being stowed away to no use. EPA estimates that presently, 80% of outdated computers are dumped.

Three 'layers' of the recycling industry are envisaged:

1. Local take-back, collection & sorting
2. Dismantling to isolate metals, electronic components, CRTs & plastics
3. Refining to reclaim the constituent materials. Here the printed circuits of PCs are the most valuable waste.

45 Billion Cameras by 2022. "Five Year Visual Technology Market Analysis" **[43]** is an American study published by LDV Capital as late as in August 2017, Therefore, it is listed here under USA but essentially ought to have a worldwide impact. The study suggests there will be 45 billion cameras in operation worldwide by 2022—probably many, many more than computers or most other e-technology. Eventually, these will also be generating e-waste. LDV Capital of New York, NY is an investment company active in the field of visual technologies.

Over the next five years there will be a proliferation of cameras integrated into products across industries and markets. Nearly all inanimate objects will begin to see, creating vast amounts of visual data across the visual technology ecosystem. Taking into account the industries that will embed cameras into

[I] Source: US EPA „WasteWise Update“ Electronic Reuse and Recycling

products, those that will add additional cameras to products, and new vision-enabled products that will arise, the number of cameras will grow at least 220% in the next five years. Embedded cameras, like the ones in smartphones, will become an essential component of nearly every device used by businesses and consumers. Using industry data as a baseline, LDV Capital believe Fig. 5 shows a conservative projection of the market size.

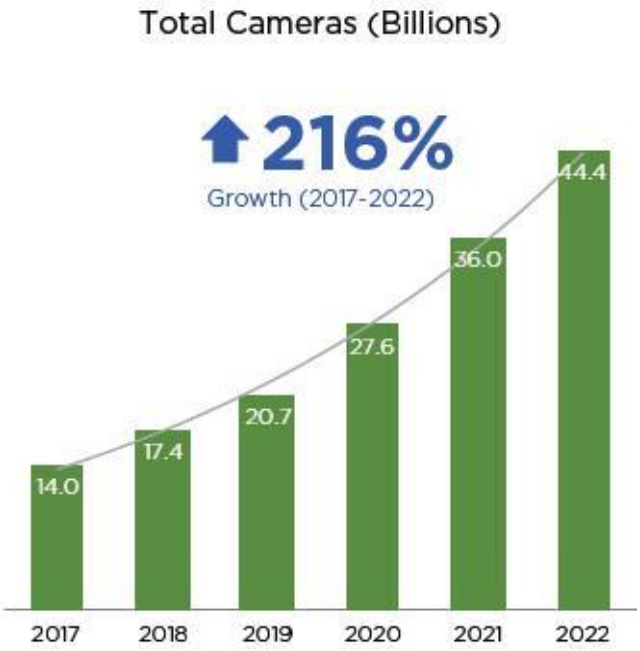


Fig. 5. Expected surge of cameras [43]

Key findings are that:

- Most of the pictures captured will never be seen by a human eye.
- A paradigm shift will take place in the meaning and use of a camera.
- Over the next five years there will be a proliferation of cameras integrated into products across industries and markets.

For example,

- By 2022, the number of cameras will be nearly 12x the 2012 figures.
- Smartphones will have between 4 and 10 cameras by 2022.
- The Internet of Eyes will be larger than the Internet of Things: Nearly every household appliance will have cameras; surveillance is to be more powerful with computer vision.
- In the next five years, robotics will have 20x more integrated cameras, because of robotic autonomy achieved with cameras, *cf*. Fig. 6.
- By 2022, all new vehicles will be equipped with more than 25 cameras and this does not include Lidar or Radar.

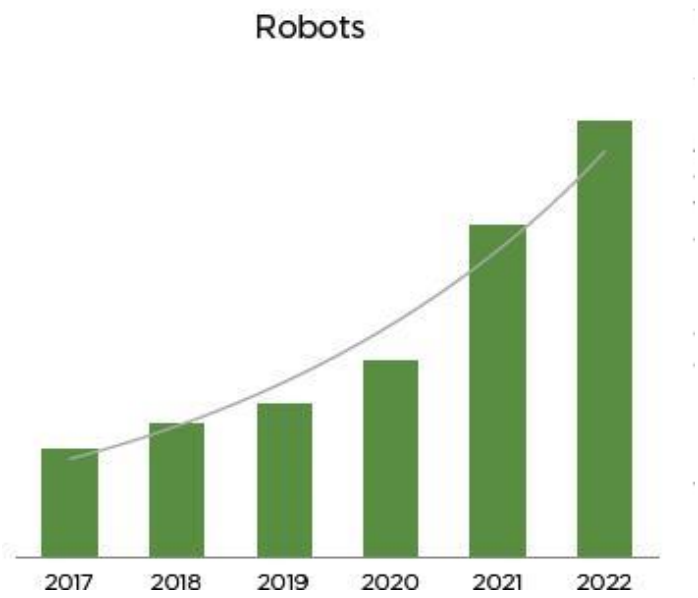


Fig. 6. Soaring incidence of robots—computers in motion that operate autonomously and intelligently [43]

Other industries will no doubt be disrupted by camera integration. Many of these changes cannot be fathomed today. But it can be envisaged with some certainty that all this is bound eventually to exert a profound impact on the future composition of e-waste. Some analogies can be derived from the changes in the e-waste industry that had come with the worldwide spread of the mobile phone.

Annex 10 – The new Parliamentary Regulation on WEEE management

Council of Ministers Regulations No. …../2017

COUNCIL OF MINISTERS REGULATIONS ON THE MANAGEMENT OF ELECTRICAL AND ELECTRONIC WASTE

These Regulations are issued by the Council of Ministers pursuant to Article 5 of the Definition of Powers and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia Proclamation No. 916/2015 and Article 20 of the Environmental Pollution Control Proclamation No.300/ 2002.

1. Short Title

These Regulations may be cited as the "Electrical and Electronic Wastes Management Council of Ministers Regulations No. ---------- /2017".

2. Definition

In these Regulations:

1/ "electrical and electronic equipment" means an equipment which is powered by electric currents or electromagnetic fields including those used for the generation, transmission and measurement of electric currents and electromagnetic fields and designed for use with a voltage rating not exceeding 1000 Volt for alternating current and 1500 Volt for direct current;

2/ "electrical and electronic waste" means all types of electrical and electronic equipment and its parts that have been discarded;

3/ "extended producer responsibility" means responsibility of any producer of electrical and electronic equipment for environmentally sound management of such products;

4/ "producer" means any person who:

a) manufactures electrical and electronic equipment under his own brand/ trade mark; or

b) assembles electrical and electronic equipment for sale;

5/ "importer" means any person who imports electric and electronic equipment into Ethiopia;

6/ "consumer" means any person using electrical and electronic equipment;

7/ “wholesaler” means any person who sells electrical and electronic equipment to a retailer after buying them from a manufacturer or an importer, or when a manufacturer or an importer sells goods to a retailer or to a wholesaler it is considered to have been engaged in wholesale business;

8/ “retailer” means any person who sells electrical and electronic equipment to consumers or users after buying them from a wholesaler or a manufacturer or an importer; or when a wholesaler or a manufacturer or an importer sells goods to consumers or users it is considered to have been engaged in retail business;

9/ “reuse” means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived;

10/ “collection” means the gathering of electrical and electronic waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility;

11/ “collection center” means a center established individually or jointly to collect electrical and electronic waste;

12/ “recycle” means reprocessing of an electrical and electronic waste materials for their original purpose or for other purposes;

13/ “recycler” means any person who is engaged in recycling of electrical and electronic waste;

14/ “refurbish” means functional testing, repairing, upgrading or otherwise preparing used or discarded electrical and electronic equipments or components thereof for resale or reuse;

15/ “refurbisher” means any person who is engaged in refurbishment of used electrical and electronic equipment or component;

16/ “dismantle” means the process of disassembling an electrical and electronic equipment into parts that can be reused as they are or that can be used as a raw material to make new appliances or that become hazardous material for disposal;

17/ “dismantler” means any person engaged in dismantling of electrical and electronic equipment;

18/ “treatment” means reuse or recycling of electrical waste by recovering useful materials from such wastes or disposal of electrical and electronic waste when it is deemed useless;

19/ "recovery" means recycling of materials from electrical and electronic wastes or parts and fractions thereof or incineration with energy recovery;

20/ "transporter" means any person engaged in the transportation of electrical and electrical waste by land, air or sea;

21/ "disposal" means any operation which does not lead to recycling or recovery and includes incineration and deposition of electrical and electronic wastes in secured landfill;

22/ "environmentally sound management of wastes" means taking all practicable steps to ensure that hazardous wastes are managed in a manner which protects human health and the environment against the adverse effects which may result from such wastes and to save resources;

23/ "Region" means any region of the Federal Democratic Republic of Ethiopia referred to in Article 47(1) of the Constitution of the Federal Democratic Republic of Ethiopia and, includes the Addis Ababa and Dire Dawa City administrations;

24/ "person" means any natural person or juridical person;

25/ "Ministry and Minister" means the Ministry and Minister of Environment, Forest and Climate Change, respectively;

26/ any expression in the masculine gender includes the feminine.

3. Scope of Application

These Regulations shall apply to producers, distributors, retailers, importers, transporters, collection centers, re-furbishers, dismantlers, recyclers and consumers of electrical and electronic equipment listed under ANNEX ONE of these Regulations and any other appliance that may be added to the list by the Ministry in a Directive issued under these Regulations.

PART TWO: MANAGEMENT OF ELECTRICAL AND ELECTRONIC WASTE

4. Hierarchy Waste Management

To minimize the environmental impacts of electrical and electronic waste, the following waste management hierarchy shall be applied:

1/ reduction of waste generation;

2/ refurbishing and reuse of waste;

3/ recycling of waste;

4/ disposal of waste.

5. <u>Extended Producer Responsibility</u>

1/ In order to reduce sources of electrical and electronic waste generation and to strengthen the reuse, refurbishing and recycling of electrical and electronic waste any electrical and electronic equipment producer, wholesaler, retailer or importer shall have extended producer responsibility.

2/ The extended producer responsibilities shall entail the following responsibilities:

a) collection of electrical and electronic waste generated during the manufacture of electrical and electronic equipment and channelizing same for recycling or disposal;

b) collection of electrical and electronic waste generated from the end of life of the products or take back system, and to ensure that such electrical and electronic wastes are channelized to registered refurbishing or dismantling or recycling centers;

c) financing either individually or collectively, and organizing a system to meet the costs involved in the environmentally sound management of electrical and electronic waste.

3/ The Ministry shall maintain the register of producers and inventory of electrical and electronic wastes.

4/ Any producer shall keep records of the electrical and electronic wastes and such records shall be accessible for scrutiny by the Ministry.

6. <u>Responsibilities of Consumers</u>

Consumers shall have responsibility to ensure that the electrical and electronic wastes are handed over to collection centers or to persons entitled to collect for collection centers.

7. <u>Collection of Wastes</u>

1/ Any person seeking to open a collection center for electrical and electronic wastes shall submit application to the Ministry, secure certificate of competence and get registered.

2/ The person who secured a certificate of competence from the Ministry to open a collection center for electrical and electronic wastes shall fulfil the following requirements before commencement of the operation:

a) the collection of electrical and electronic waste shall be done separately from other types of wastes;

b) the downstream traceability and movement of the waste;

c) that the electrical and electronic wastes collected are stored in a manner that ensures that nobody reaches them and that they pollute nothing till they are sent to the authorized dismantling, refurbishing or recycling center;

d) that no damage is caused either to human health or to the safety of the environment during collection, storage or transportation of the electrical and electronic wastes.

e) the electrical and electronic collection site is located within a reasonable proximity to consumers, and their services should be well advertised.

3/ Sources of electrical and electronic waste may include:

a) households;

b) governmental and non- governmental organizations;

c) producers;

d) industries;

e) places where the presence of abandoned electrical and electronic wastes have been notified to the Ministry and the Ministry has notified the collection centers.

8. **<u>Dismantling of Wastes</u>**

1/ Any person seeking to set up a dismantling center for electrical and electronic wastes shall submit application to the Ministry, secure a certificate of competence and get registered.

2/ Any person that secured a certificate of competence from the Ministry to engage in dismantling items of electrical and electronic equipment shall fulfil the following requirements from the Ministry before commencement of the operation:

a) the dismantling processes do not have any adverse effect on human health or on the safety of the environment;

b) the place or room to the dismantled electrical and electronic wastes are readily available.

3/ Any dismantling centre shall maintain the following records and shall make accessible for scrutiny by the Ministry:

a) types and weights of electrical and electronic wastes received;

b) types and weights of fraction of electrical and electronic wastes dispatched;

c) evidence of fraction of the destinations of dispatched wastes.

9. Reuse of Wastes

Electrical and electronic wastes destined for reuse shall properly be tested by the re-furbishers for their functionality and the results are recorded.

10. Recycling of Wastes

1/ Any person seeking to engage in recycling electrical and electronic wastes shall submit application to the Ministry, secure a certificate of competence and get registered.

2/ Any person that secured a certificate of competence from the Ministry pursuant to sub-article (1) of this Article shall fulfil the following requirements before commencement of the operation:

a) compliance with the terms and conditions of registration;

b) documentation of quantities of the various output materials from recycling processes;

d) that the hazardous residues generated during the recycling process are disposed of in an environmentally sound waste management.

11. Refurbishing of Wastes

1/ Any person seeking to engage in refurbishing of electrical and electronic wastes shall submit application to the Ministry, secure a certificate of competence and get registered.

2/ Any person that secured a certificate of competence from the Ministry pursuant to sub-article (1) of this Article shall fulfil the following requirements before commencement of the operation:

a) compliance with the terms and conditions of registration;

b) made accessible records to the Ministry;

d) the hazardous residues generated during the refurbishing process are disposed of in an environmentally sound waste management.

12. Labeling of Wastes

All electrical and electronic wastes that are reused, refurbished or recycled shall be clearly and permanently labeled with a written notification both in Amharic and English languages that it is reused, refurbished or recycled product and the identity of the refurbishing or the recycling facility.

13. Treatment and Management of Wastes before Recycling

1/ After conducting treatment if an item of electrical and electronic equipment is deemed un-reusable, it shall be kept in an appropriate waste storage..

2/ During storage, the risks of breakage and potential exposure to substances of concern from improper handling shall be minimized.

3/ The owner or manager of the recycling center shall ensure provision of sufficient training to all the staff members to avoid possible risks and on mechanisms of their prevention.

14. <u>Sorting and Temporary Storage of Wastes</u>

1/ Electrical and electronic wastes shall be sorted for further examination.

2/ A storage center shall be located in places that meet the following criteria:

a) the center shall be readily accessible for firefighting and other emergency situations;

b) the storage center is not subject to flooding;

c) the storage center shall not cause any damage to the quality of surface water and ground water.

3/ There shall be no entry of any unauthorized personnel or individual into the storage center specified under sub-article (2) of this Article.

4/ A storage center shall bear signs indicating that electrical and electronic wastes are stored therein.

5/ The signs that are mentioned under sub- Article (4) of this Article shall be of such design as to be legible from a reasonable distance.

6/ Storage areas shall be assigned and marked for spares of electrical and electronic equipment, output fractions and components to be recycled, fractions and components to be disposed, and devices and components to be refurbished or reused.

7/ The owner or manager of a storage center shall maintain records indicating the date, type, location and quantity of electrical and electronic wastes that was brought into or removed from the center.

15. <u>Transportation of Wastes</u>

1/ Any person seeking to engage in the transportation of electrical and electronic wastes shall submit application to the Ministry, secure a certificate of competence and get registered.

2/ The transportation of any electrical and electronic waste shall be in a manner that does not affect the reusability or subsequent treatment of the waste.

3/ Any trans-regional transportation of electrical and electronic waste within Ethiopia may be permitted by the Ministry only when the environmental protection organ in the destination Regional State has agreed on the transfer of the waste in writing.

16. Disposal of Wastes

1/ The electrical and electronic wastes disposal shall only be conducted when all available options of reuse, refurbishment and recycling have been exhausted.

2/ Electrical and electronic wastes shall be disposed by landfilling or incineration and any other technologies that may be determined by the Ministry in a Directive issued under these Regulation.

PART THREE

MISCELLANEOUS PROVISIONS

17. Occupational Safety, Health and Working Environment

1/ Any facility engaged in electrical and electronic wastes management shall take the necessary measure to safeguard adequately the health and safety of the workers.

2/ The occupational health and safety requirements provided under the Labor Proclamation shall be applicable for persons engaged in electrical and electronic wastes management activities.

18. Criminal and Civil Liability

Any violation of the provisions of these Regulations shall entail criminal and civil liability in accordance with the appropriate provisions of the Pollution Control Proclamation and other laws.

19. Power of delegation

The Ministry may delegate some of its powers and duties, as it may be deemed appropriate, to other agencies.

20. Power to Issue Directives

The Ministry may issue directives necessary for the implementation of these Regulations.

21 . Effective Date

These Regulation shall enter into force on the date of their publication in the Federal Negarit Gazzeta

Done at Addis Ababa, this …. Day of ……..

HAILEMARIAM DESSALEGNE

PRIME MINISTER OF THE FEDERAL DEMOCRATIC

REPUBLIC OF ETHIOPIA

ANNEX ONE

LIST OF ELECTRICAL AND ELECTRONIC EQUIPMENT

LARGE OUSEHOLD ELECTRICAL AND ELECTRONIC EQUIPMENTS	
1	REFRIGERATORS
2	AIR CONDITIONER APPLIANCES
3	CLOTHES DRYER
4	WASHING MACHINES
5	ELECTRIC STOVES
6	DISHWASHING MACHINES
7	ELECTRIC HEATING APPLIANCES
8	MICROWAVE OVENS

SMALL HOUSEHOLD ELECTRICAL AND ELECTRONIC EQUIPMENTS	
1	VACUUM CLEANERS
2	CARPET SWEEPERS
3	APPLIANCES USED FOR SEWING AND WEAVING
4	IRONING MACHINE
5	FRYERS
6	COFFEE MACHINES
7	COFFEE GRINDERS
8	ELECTRIC KNIVES
9	APPLIANCES FOR HAIR- CUTTING, HAIR DRYING, SHAVING MACHINE, MASSAGE AND OTHER BODY CARE APPLIANCES

INFORMATION TECHNOLOGY AND TELECOMMUNICATIONS EQUIPMENT	
1	MINICOMPUTER
2	MAINFRAMES
3	PERSONAL COMPUTER (CENTRAL PROCESSING UNIT, MOUSE, SCREEN AND KEYBOARD INCLUDED)
4	LAPTOP PERSONAL COMPUTER (CENTRAL PROCESSING UNIT, MOUSE, SCREEN AND KEYBOARD INCLUDED)
5	PRINTERS
6	NOTEPAD COMPUTERS
7	COPYING MACHINES
8	ELECTRICAL AND ELECTRONIC TYPEWRITERS
9	POCKET AND DESK CALCULATORS
10	ELECTRICAL AND ELECTRONIC EQUIPMENT FOR THE COLLECTION AND STORAGE OF INFORMATION
11	TELEX
12	TELEPHONES
13	MOBILE TELEPHONES
14	CORDLESS TELEPHONES

CONSUMER ELECTRICAL AND ELECTRONIC EQUIPMENTS	
1	RADIO
2	TELEVISIONS
3	VIDEO CAMERAS
4	VIDEO RECORDERS
5	HI-FI RECORDERS
6	AUDIO AMPLIFIERS
7	MUSICAL INSTRUMENTS

LEISURE AND SPORTS ELECTRICAL AND ELECTRONIC EQUIPMENT	
1	VIDEO GAME AND ACCESSORIES
2	ELECTRICAL AND ELECTRONIC TOYS
3	ELECTRICAL AND ELECTRONIC SPORTING EQUIPMENT

MEDICAL ELECTRICAL AND ELECTRONIC EQUIPMENTS	
1	RADIOTHERAPY EQUIPMENT
2	CARDIOLOGY EQUIPMENT
3	DIALYSIS EQUIPMENT
4	LABORATORY EQUIPMENT
5	OTHER APPLIANCES FOR DETECTING, PREVENTING, MONITORING, TREATING, ALLEVIATING ILLNESS OR DISABILITY

MONITORING AND CONTROL ELECTRICAL AND ELECTRONIC EQUIPMENTS	
1	SMOKE DETECTOR
2	FIRE DETECTION AND ALARM SYSTEM
3	HEATING REGULATORS
4	THERMOSTATS
5	OTHER MONITORING AND CONTROL INSTRUMENTS USED IN INDUSTRIAL INSTALLATIONS

LIGHTING EQUIPMENT	
1	FLORESCENT LAMPS
2	COMPACTED FLORESCENT LAMPS
3	HIGH AND LOW PRESSURE SODIUM LAMPS
4	LED LAMPS

AUTOMATIC DISPENSERS	
1	AUTOMATIC DISPENSERS FOR HOT DRINKS
2	AUTOMATIC DISPENSERS FOR COLD BOTTLES OR CANS
3	AUTOMATIC DISPENSERS FOR MONEY
4	ALL APPLIANCES WHICH DELIVER AUTOMATICALLY ALL KIND OF PRODUCTS