SUSTAINABLE RECYCLING INDUSTRIES

Baseline Assessment on E-waste Management in Ghana

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AMA	Accra Metropolitan Assembly
ELV	End-of-life vehicle
GASDA	Greater Accra Scrap Dealers Association
HBCD	Hexabromocyclododecane
LAB	Lead-acid battery
MESTI	Ministry of Environment, Science, Technology and Innovation
PBDE	Polybrominated diphenyl ethers
PC	Personal computer
PCB	Polychlorinated biphenyl
SRI	Sustainable Recycling Industries
ULAB	Used lead-acid batteries
UPS	Uninterruptible power-supply
WEEE	Waste Electrical and Electronic Equipment

1. Introduction

This report was produced within the framework of the Ghanaian part of the programme on Sustainable Recycling Industries (SRI). SRI is a global programme building capacity for sustainable recycling in developing countries. It is funded by the Swiss State Secretariat of Economic Affairs (SECO) and is implemented by the Swiss Institute for Materials Science & Technology (Empa) and the World Resources Forum (WRF). In Ghana the project is implemented together with the Ghana National Cleaner Production Centre, international experts from Sofies and Oeko-Institut and is supported by the Ghana Ministry of Environment, Science, Technology and Innovation and the Ghana Environmental Protection Agency. The Ghana-part of the Sustainable Recycling Industries project supports small and medium sized enterprises that would like to become part of a sustainable e-waste recycling chain in Ghana. This support encompasses the development of alternative business models, transfer of know-how on recycling practices and technologies, as well as the access to markets for recycling outputs. In addition, the project addresses issues around standards and financing mechanisms to generate favourable conditions for sustainable recycling industries.

The report was compiled as part of the project's activities on baseline assessment. This activity is meant to provide facts and information necessary for the implementation of other project activities, in particular related to conformity assessment, financing mechanisms and technology partnerships. Thus, the report primarily aims at filling knowledge gaps rather than providing a comprehensive update of existing e-waste related surveys on Ghana.

A large portion of the information contained in this report was collected during field investigations in Q4 2015 and Q1 2016. While this data collection method is able to provide first-hand information, it might also result in some limitations, which can be described as follows:

- The information on registered companies and informal recycling (chapters 3 to 5) might not be complete. Gaps might occur in both, the description of individual companies and recycling clusters, as well as in the total coverage. Generally, it sees quite likely that formal and informal e-waste recycling is also carried-out in clusters and companies not covered by this report. Due to constraints in budget and time, it is virtually impossible to exhaustively assess all e-waste recycling activities in Ghana.
- The assessment yielded a wealth of information, which is not suitable for publication as it touches upon various sensitive business issues of companies. Amongst others this includes information on financial flows, contracts with downstream companies and future business strategies. Thus, not all assessment results are integrated into this report.

In order to find a balance between information that can be displayed to the wider public and information that will not be given to any third party, the project team decided to integrate non-sensitive business information into the Annex of this report. This information entails descriptions of the various business activities in a qualitative manner, as well as data on locations, branches and contacts of companies. This Annex will be only given out on written request. Requests shall be directed to Mr. Sampson Atiemo (atiemosam@gmail.com).

2. Review of available studies

Various aspects of e-waste management in Ghana have been studied in various previous projects. Table 2-1 gives an overview on these existing studies:

Table 2-1: Existing studies on e-waste management in Ghana

Year	Title	Scientific reference
2008	Poisoning the poor - electronic waste in Ghana	(Kuper & Hojsik 2008)
2008	Chemical contamination at e-waste recycling and disposal sites in Accra and Korforidua, Ghana	(Brigden K. et al. 2008)
2010	Socio-economic assessment and feasibility on sustainable e-waste management in Ghana	(Prakash & Manhart 2010)
2011	Ghana e-Waste Country Assessment	(Amoyaw-Osei et al. 2011)
2011	Human exposure to PCBs, PBDEs and HBCDs in Ghana: Temporal variation, sources of exposure and estimation of daily intakes by infants	(Asante K. A. et al. 2011)
2011	Where are WEee in Africa? Findings from the Basel Convention E-waste Africa Programme	(Secretariat of the Basel Convention 2011)
2011	Assessing Worker and Environmental Chemical Exposure Risks at an e-Waste Recycling and Disposal Site in Accra, Ghana	(Caravanos J. et al. 2011)
2012	Mapping the Invisible and Real "African" Economy: Urban E-waste Circuitry	(Grant & Oteng-Ababio 2012)
2012	Multi-trace element levels and arsenic speciation in urine of e-waste recycling workers from Agbogbloshie, Accra in Ghana	(Asante et al. 2012)
2013	E-Waste Disposal Effects on the Aquatic Environment: Accra, Ghana	(Huang et al. 2013)
2014	Status analysis, generation of WEEE and ELVs in Ghana, and analysis of collection, sorting and pre-treatment in Ghana	(Manhart, Schleicher et al. 2014)
2014	Legal and institutional requirements for e-waste recycling in Ghana	(Manhart, Meinel et al. 2014)
2015	Recycling of Hard Disk Drives – Analysing the optimal dismantling depth for recyclers in developing countries and emerging economies	(Manhart, Buchert et al. 2015)
2015	Waste Management in Ghana: Options for an Engagement of German Development Cooperation in E-waste	(Manhart, Kükenshöner et al. 2015)

Source: Own compilation

Furthermore, some few studies have been carried-out on the management of used-lead acid batteries in Ghana (see Table 2-2).

Table 2-2: Existing studies on ULAB management in Ghana

Year	Title	Scientific reference
2009	Solar energy projects in Ghana; How to handle lead acid batteries after their useful life?	(Partners in Development 2009)
2010	Workers' exposure to lead in metal recycling industry at Kpone Industrial Area, Tema	(Lomotey 2010)
2015	The recycling chain for used lead-acid batteries in Ghana	(Manhart & Schleicher 2015)

Source: Own compilation

Together, these studies provide a wealth of information on the e-waste and ULAB management situation in Ghana, which serves as important base for the implementation of the SRI project. Nevertheless, the analysis of these reports and the review of SRI tasks revealed that some specific information necessary for project implementation is missing. These missing aspects were listed and grouped into the following baseline assessment workplan:

- Overview on companies with activities in e-waste management
- Update of the situation in Agbogbloshie
- Structure and environmental impacts of the lead-acid battery recycling industry in Ghana
- Overview and status on regulatory initiatives on e-waste in Ghana
- The role of standards and guidelines in Ghana

The SRI Project Implementation Team collected and compiled the required information between November 2015 and March 2016. The results of this baseline assessment are document in the chapters 3 to0.

3. Overview on companies active in e-waste management

As indicated in Table 3-1, there are various registered companies in Ghana that are either already active in e-waste management and recycling, or that have plans to merge into this segment in the near future. It is noteworthy that the compilation provided in Table 3-1 might not be complete and – taking into account the current dynamics in the waste management sector in Ghana – it is very likely that the profiles of many of the listed companies will require updating in the near future as business activities will change in the one or other direction. The current information status is based on various company visits and is documented in more detail in the Annexes to this report. From the current perspective, the listed companies can be grouped in the following clusters:

- Companies with main activities in municipal waste management that plan to diversify (No. 8,11,14)
- Companies with main activities in management of industrial hazardous waste (No. 9, 12, 13)
- Companies primarily focusing on the recycling of lead-acid batteries (No. 6, 7, 10)[1]

In addition, there are some companies that have quite specific profiles each and that see e-waste as part of their core business:

[1] See chapter 5 for more information.

- The Agbogbloshie Recycling Centre was founded as initiative to reduce unsound recycling practices in Agbogbloshie. The approach is not profit orientated and governed by a steering committee composed of various organisations. In terms of recycling operations, the initiative currently focuses on cables, but has plans to also integrate other e-waste fractions.
- Atlantic Recycling International Systems is a company that developed recycling activities out of its repair and re-use activities for ICT equipment.
- City Waste Recycling is pioneering sound e-waste recycling in Ghana. Although it emerged from the recycling of saw dust and plastics, e-waste recycling is a major activity line of the company and also includes specific processes such as degassing of refrigerators and granulation of cables.
- FIDEV Recycling is a company mainly focusing on dismantling and trading of scrap metals, including e-waste and is in business for more than 20 years.
- Blancomet Recycling Ltd. is a business mainly engaged in local and international scrap metal trade. Although the company has own recycling activities such as ULAB-breaking and cable stripping, it serves as a major intermediary in the Ghanaian scrap trade, in particular related to exports of scrap commodities.

Table 3-1: Existing Ghanaian recycling companies with activities or planned activities in e-waste recycling

No.	Name	No. of employees in Ghana	Businesses in other countries	Non-e-waste activities						E-waste related activities				
				Plastic Recycling	Solid waste manage-ment	Sewage sludge manage-ment	composti ng	Hazardou s waste manage-ment	Other recycling activities	Research / business develop-ment	E-waste dismant-ling	Cable recycling	Fridge degassing	ULAB manage-ment
1	Agbogbloshie Recycling Center	~ 2										X		
2	Atlantic Recycling International Syst	6								X	X			
3	Blancomet Recycling Ltd.	300	X	X (h)					X (i)			X		X
4	City Waste Recycling	n.d.		X				X (b)	X (e)	X	X	X	X	X
5	FIDEV Recycling Ltd.	30		X										X
6	Goldline Ghana Ltd.	n.d.		X (h)						X	X	X		X
7	Gravita Ghana Ltd.	25(P) 75(T)	X	X (h)					X (g)					X
8	J. Stanley-Owusu & Company Ltd	n.d.			X	X	X	X (a)	X (b)	X				
9	Presank Enterprise Ltd	108				X		X (c,d)		X	(X)	X (Obu-ase)	X	
10	Success Africa Ghana Ltd.	9(P) 49(T)	n.d.	X (h)										X
11	Vemark Environmental Services	n.d.		X	X	X	X	X (a)	X (b)	X				

No.	Name	No. of employees in Ghana	Businesses in other countries	Non-e-waste activities						E-waste related activities				
				Plastic Recycling	Solid waste manage-ment	Sewage sludge manage-ment	composti ng	Hazardou s waste manage-ment	Other recycling activities	Research / business develop-ment	E-waste dismant-ling	Cable recycling	Fridge degassing	ULAB manage-ment
12	Zeal Environmental Technologies (Takoradi)	76 (P) 50 (T)	X (reg in Liberia)		X			X (c,d)	X (f)	X	X			X
13	ZOIL Services	40		X	X			X (c,d)		X				
14	Zoomlion Ghana Ltd	88,000	X	X	X	X	X	X (a-e)		X				

(a) Hospital waste, (b) Paper & cardboard, (c) Waste oils, (d) Chemicals, (e) Saw dust, (f) CFL and FL, (g) Al-scrap, (h) ULAB-cases (i) International scrap metal trading

n.d.: no data available

Source: SRI Project Team

4. Update on informal e-waste recycling in Ghana

The scrap market located at Agbogbloshie, Accra is well known as major hot spot for informal e-waste recycling activities. The situation and activities in Agbogbloshie are described and studied in almost all publications on the e-waste situation in Ghana (see Table 2-1). Nevertheless, there are two recent developments described in section 4.1 and 4.2, which might influence both, the further development of this scrap market, and also the willingness of scrap dealers to co-operate in efforts aiming at a transformation of this cluster.

In addition, other less prominent informal e-waste recycling activities in Kumasi are described in section 4.3.

4.1. Floods and evictions in Agbogbloshie in June 2015

Early June 2015, torrential rains caused flooding of large parts of Accra. On 3rd of June, flood-water entered the gasoline-tank of a filling station located at a major traffic intersection. The gasoline leaked from the tank and ignited at a nearby food-stall. The fire caused 159 fatal casualties. As a reaction, the blocking of drainage channels with waste and illegal settlements were blamed to be a main reason for Accra's flood risks. Subsequently, the government took action end of June and – with the support of policy and military – cleared informal settlements located within 100m of the banks of Odaw River. In fact, this forced eviction and bulldozing of houses affected the Old Fadama settlement, which is located close to the Agbogbloshie scrap market. Many people engaged in the scrap business live in this settlement, so that many informal scrap collectors and recyclers lost their shelter and belongings. Nevertheless, the evictions did not affect the scrap metal businesses directly. Although also the whole Agbogbloshie scrap market was flooded during the rains, the lower parts of the cluster close to Odwa River have always only been used for open burning and disposal activities. Thus, the 100m area has already been free from permanent structures before. It seems likely that the forced evictions might have negative impacts on the scrap dealers' willingness to co-operate with projects and initiatives linked to the government. Nevertheless, at first encounters with representatives from the Greater Accra Scrap Dealers Association (GASDA), no negative attitudes towards e-waste related projects could be sensed.

4.2. The new waste transfer station in Agbogbloshie

The area northwest of the scrap market has recently been transformed into a solid waste "transfer station" by the Accra Metropolitan Assembly (AMA), which effectively means that solid waste from households and businesses is disposed there[2]. The waste is disposed onto the ground without prior preparation such as lining. The trucks delivering solid waste are charged by an AMA-representative at delivery. Subsequently, the Agbogbloshie area is now not only subject to scrap recycling, but also to disposal of solid waste with all typical side-effects such as the emission of leachates and the increased presence of informal waste pickers searching for recyclable materials such as plastics, metals and glass-bottles. It is noteworthy that the solid waste disposal is not linked to the activity of the scrap dealers organized in GASDA. In turn, in an interview with SRI experts, a representative from GASDA complained about this new development as the scrap

[2] The move was motivated by the severe shortage of solid waste disposal options in and around Accra. To date, there is only one sanitary landfill in the Accra-Tema region. It is located in Tema and was initially planned to serve for the waste disposal in Tema only (see (Manhart, Schleicher et al. 2014)).

dealers fear that negative side-effects will be blamed onto the scrap recyclers. Although the AMA claims that solid waste disposal at Agbogbloshie is temporary limited until mid-2016 and that the disposed waste will be removed to other waste disposal sites afterwards, the situation is somehow in contrast to the plans of AMA to transform Agbogbloshie scrap market and its surroundings into a recreational area (Manhart, Kükenshöner et al. 2015).

4.3. Informal e-waste recycling in Kumasi

Most of the past reporting on e-wastes recycling in Ghana exclusively focused on Accra and most specifically the informal recycling in Agbogbloshie. But a visit to two informal scrap recycling clusters in Kumasi - *Dagomba Line* and *Suame Magazine* - revealed that the magnitude of informal e-waste recycling and its associated environmental and human health implication is on a comparable or even bigger in these locations compared to Agbogbloshie. In a conversation with a local e-waste dismantler from Dagomba Line (an area which is named after the local railway line), it was mentioned that there were over thousand people working on e-waste and general scrap processing. Although this number appears to be a clear overestimate, it can be confirmed by visual impressions that scrap processing is done on a large scale in the area. The local interview partner mentioned the quarters of Aboabo and Angloga as some of the places where e-waste processing takes place on the large scale. An important spokesmen of the informal dismantlers in this area reported that he and his colleagues collect large proportion of their e-waste from households. In addition they also purchase from business that discard the end-of-life materials. The area also has many TV and radio repair and refurbishing shops dotted along the railway line. A repairer at Dagomba Line mentioned that most of the televisions they are not able repair are sold to the scrap dealers. Once the items arrive at the scrap yard they are manually disassembled and the valuable parts sold to dealers. Copper cables with insulation are burnt in locally construct stack (see Figure 4-1).

Figure 4-1: Locally made emission stack for burning copper cables

Source: SRI Project Team

According to the interview partners, this is done to avoid the pollution of the local area. The stacks actually disperse the thick smoke over a wider area but do not reduce the total emissions of burning processes. Based on the impressions from interactions with some of the scrap dealers/dismantlers, it is assumed that most of them have little knowledge about the environmental and human health implications of their activities. The non-valuable components such ABS plastics and low grade mother boards from tape recorders and radio sets are openly burnt which further exposes workers and local residents to contamination. In addition, it became obvious that most of the information relating to health and safety of unsound e-waste recycling has not reached them yet.

Figure 4-2: Dismantled flat screens and other e-waste at Dagomba Line

Source: SRI Project Team

Another major hub of scrap activities in Kumasi is Suame Magazine. It is a wide area and has a population running into thousands of people. The area is mostly dominated by end-of-life vehicle processing. Mr. Ibrahim Dagadu, the organiser of the Kumasi Scrap Dealers Association, mentioned that the scrap work started in Kumasi even before it moved to Accra. However he believes that most of the interventions to solve e-waste related problems are more focused on Accra to the detriment of other regions. It was observed at Suame that the e-waste buying (middle men) is largely dominated by women while the men do the collection and manual disassembly. At Suame local emission stacks have been constructed for the burning of plastic coated cables. Also vehicle tyres are openly burnt to recover the steel which is sold to the local market (see Figure 4-3). The aluminium rims from the tyres are smelted at high temperature for the production of local industrial machinery parts. The exposure to high temperature fires is major risk to the workers at the site.

The scrap dealers in Suame face several other risks. For instance Mr. Abdul Aziz, the secretary of the Kumasi Scrap Dealers Association, informed the project team that their members face various dangers, including risk of chemical poisoning from the variety of materials they handle. Another challenge faced by the informal sector in Kumasi is the fact that members are often perceived as thieves by other societal groups, which negatively affect the inflow of materials. Know-how on downstream markets seems to be insufficiently developed. In addition it is observed that non- or low-value fractions such as CRT glass, plastics and low grade printed circuit boards are discarded indiscriminately.

Figure 4-3: Ferrous metals from burning tyres at Suame Magazine

Source: SRI Project Team

5. The lead-acid battery recycling industry in Ghana

Although lead-acid batteries (LABs) are most commonly used as starter batteries in vehicles, they are also widely used for stationary power storage. This function is particular importance in Ghana, as the frequent blackouts require power back-up systems for many electrical and electronic appliances. Amongst others, desktop PCs can only be operated without risking data-losses in Ghana if connected to an uninterruptible power supplies (UPS). Each of these small-size UPS is equipped with one lead-acid battery. In addition, LABs are used in decentralised power generation systems (solar power for local use) and as power back-ups for server systems, cell phone towers and critical infrastructure such as hospitals. According to Seeking Alpha (2015), 10% of the world's LABs are used for uninterruptible power supplies of various types.

5.1. Estimation of annual ULAB volumes

There is no accurate data on the volumes of used lead-acid batteries (ULABs) generated per year in Ghana. Nevertheless, such a figure can be estimated using the following baseline data and assumptions:

- 0.82 million passenger vehicles in Ghana in 2015 (Manhart, Schleicher et al. 2014)
- 0.54 million trucks and buses in Ghana in 2015 (Manhart, Schleicher et al. 2014)
- 2.51 million desktop PCs in Ghana in 2015 (Manhart, Schleicher et al. 2014)
- Average life-time of vehicle LABs in Ghana: 2 years[3]
- Average life-time of stationary LABs in Ghana: 5 years
- Average weight of LABs per passenger vehicle: 20 kg
- Average weight of LABs per bus or truck: 2 x 50 kg
- Average weight of LABs per small UPS (one per desktop PC): 3 kg

With this data, the total annual generation of ULABs for recycling can be estimated (see Table 5-1) resulting in a total amount of 36,706 t of ULABs per year in Ghana. A minimum of 4% of these batteries can be clearly attributed to e-waste (uninterruptible power supplies for desktop computers). As this figure does not include ULABs used for stationary power storage others than desktop PC-UPS, it has to be regarded as a conservative estimate.

Table 5-1: Estimation of annual generation of used lead-acid batteries

Type of appliance	Devices in use	Average weight of LAB	Average life-time of LAB	ULAB generation
Passenger vehicles	0.82 million	20 kg	2 years	8,200 t / year
Buses & trucks	0.54 million	2 x 50 kg	2 years	27,000 t / year
Desktop PCs + UPS	2.51 million	3 kg	5 years	1,506 t / year
Total				**36,706 t / year**

Source: Own calculation

[3] Warm climate and rough roads are both factors that shorten the life-time of vehicle batteries. Thus, two years seem plausible in the West-African context.

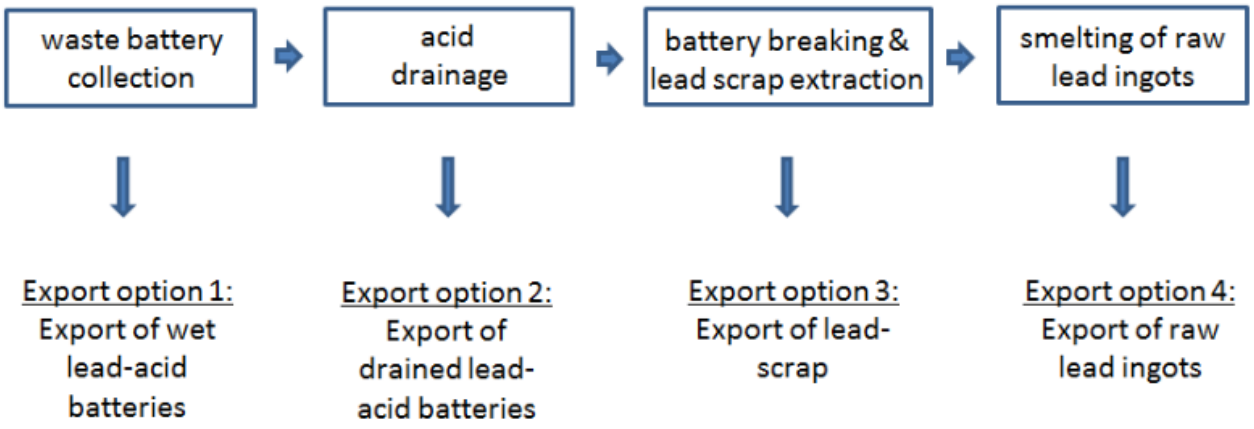
5.2. The recycling chain for ULABs in Ghana

The recycling chains and management paths for used lead-acid batteries were studied by (Manhart & Schleicher 2015) and can be summarised as follows:

Due to the high intrinsic value of lead, ULABs are economically very attractive for recycling so that devices are collected throughout Ghana and channelled to traders and recycling companies. ULABs often accumulate at car-repair shops and clusters where they are picked-up by scrap collectors typically offering cash money for ULABs. While most of the collected ULABs are passed-on to recyclers, some devices might undergo reconditioning practices carried-out in small workshops. These workshops produce and sell functioning second-hand batteries to the local market.

Apart from these reconditioning practices, all other management paths are tied to downstream markets in other world regions, mostly in Asia and Europe. This is because there is no significant demand for secondary lead in Ghana[4]. In total, there are four major export paths of used lead-acid batteries and secondary lead out of Ghana (see Figure 5-1).

Figure 5-1: Management paths of ULABs in Ghana



Source: (Manhart & Schleicher 2015)

The export of wet lead-acid batteries (batteries including the containing sulfuric-acid) is practiced by City Waste Recycling Ltd., which is described in Annex 9.3. In 2013 and 2014 two 40 feet container with approx. 20 t of batteries each were exported from Ghana. Bothe exports followed all applicable international standards for sound handling, packaging and transport, including the notification process required by the Basel Convention. The case was extensively photo-documented and transformed into training material for sound packaging of lead-acid batteries for bulk transports. The material is available in various languages (including English, Hausa and Twi) and can be downloaded free of charge from http://www.econet.international/index.php?id=3. Although the process can be regarded as environmentally sound, its cost-structure is currently not competitive so that businesses following this option have difficulties acquiring used lead-acid batteries on the Ghanaian market.

[4] As there is no lead-acid battery production in Ghana, the only domestic downstream markets for secondary lead are limited to small-scale production of fishing-equipment (e.g. weights fir fishing nets and boats) and ammunition. Both applications are likely to be quite limited in terms of total lead demand.

A significant share of ULABs in Ghana are either exported as drained batteries (export option 2) or as lead scrap extracted from broken batteries (export option 3). These practices are conducted by Blancomet Recycling and Commodities Procurement. The sulfuric acid is often already drained by small scale collectors to reduce the battery weight and subsequently transport efforts[5]. In addition, it was reported that some traders and companies explicitly motivate collectors to drain batteries prior to delivery (Partners in Development 2009). Batteries that are delivered with acid are drained at the companies' premises, mostly by punching holes into the batteries with hammers or machetes. The further management practices for the battery-acid is widely unknown. A recent fatal accident at Blancomet Recycling (The Lead Recycling Africa Project 2015) suggests that at least some of the acid is drained into septic tanks and/or in another uncontrolled manner. In parallel to management option 1, the export options 2 and 3 require notification according to the procedures of the Basel Convention.

There are currently four secondary lead smelters operating in Ghana that are all specialised on the recycling of used-lead acid batteries (see Table 5-2). They buy ULABs from the Ghanaian scrap market and produce raw lead ingots for export (export option 4). Additionally, they also recycle the plastics from battery cases (mostly polypropylene – PP), which is sold to the domestic or international market to produce consumer goods such as chairs, tables and kitchenware.

Table 5-2: Secondary lead smelters operating in Ghana

Company name	Location	Business Profile	Monthly capacity
Gravita Ghana Ltd.	Tema	Profile #7 in the Annex	1200 t
Goldline (FZE) Ghana Ltd.	Tema	Profile #6 in the Annex	1200 t
Success Africa Ghana Ltd.	Tema	Profile #10 in the Annex	1200 t
Non-Ferrous Metals Ghana Ltd.	Tema	-	600 t

The secondary lead-smelters do not only recycle ULABs from the Ghanaian market, but also from neighbouring countries such as Mali and Burkina Faso. One company manager even reported to receive supplies shipped from various coastal African countries such as Madagascar. In early December 2015, the managers of Goldline and Gravita reported that their business environment is becoming increasingly difficult so that recycling activities have been stopped four months before at Goldline and significantly reduced at Gravita. The following reasons were given for these difficulties:

- Low lead-prices on the international commodity markets
- High fuel price, mainly caused by the temporary shut-down of the Tema oil refinery[6]
- Competition from scrap exporting companies (see export options 1-3 in Figure 5-1)

[5] The battery acid typically makes-up 10-15 % of the total battery weight.

[6] The smelters are all equipped with two types of furnaces: Blast furnaces fuelled with charcoal and rotary furnaces fuelled with oil. At high oil prices, the companies mainly use the charcoal-fired blast furnaces. Nevertheless, this type of furnace cannot deal with the recycling of slags and filter dusts (internal recycling loop) so that – in the long run – operations are dependent on the oil fired rotary furnaces.

As a reaction, the four companies (which are organised in the Lead Manufacturers Association of Ghana) filed a “petition for the ban on exportation of used lead acid batteries & lead waste” to the Ministry of Environment, Science, Technology and Innovation in October 2015. Amongst others, the association argues that the secondary lead smelters provide jobs and economic growth, while operating under safe conditions for the environment. On that basis, the association suggests an export ban for ULABs and lead scrap.

Figure 5-2: Rotary furnace at the Gravita secondary lead smelter in Tema

Source: SRI-project

Until some years ago, also small-scale backyard smelting of lead from ULABs was observed in Ghana (Amoyaw-Osei et al. 2011; Prakash & Manhart 2010). Nevertheless, there are no recent reports about this practice anymore and it is assumed that this management path was given up due to low efficiencies[7].

[7] Backyard lead smelting processes are mostly incapable of reducing lead-oxide into elementary lead. Thus, backyard smelters can only recycle part of the lead contained in ULABs. The cathode-plates that are made from lead-oxide have to be sorted out prior to smelting (Manhart & Schleicher 2015; Secretariat of the Basel Convention 2003).

5.3. Impacts on environmental and human health

The recycling of lead-acid batteries is a very critical process as the contained acid and lead pose significant hazards to human health and the environment. Due to widespread problems with ULAB-recycling – in particular in developing countries and emerging economies – the process was ranked as the world's worst polluting practice in 2012 (Green Cross & Blacksmith Institute 2012). Most ULAB recycling practices observed in Ghana have obvious shortcomings and are far from fulfilling the basic recommendations laid-out in the internationally accepted Technical Guidelines by the UNEP Basel Secretariat (Secretariat of the Basel Convention 2003). Amongst others, this includes:

- The widespread practice of uncontrolled battery drainage
- Hazardous methods for battery breaking (e.g. machetes)
- Insufficient dust-control measures in recycling and smelting facilities
- Insufficient ground-cover (broken and uneven prohibiting proper cleaning)
- Insufficient washing of secondary plastics (danger of cross-contamination with lead-oxide)
- Insufficient personal protective equipment for workers
- Insufficient infrastructure for personal hygiene, storage of private belongings and rests (canteens)
- Complete absence of health and safety monitoring for workers and neighbouring communities / industries

As a consequence it has to be assumed that acid, lead-dust and fumes pose severe health risks to workers and management of the lead-acid battery recycling facilities. This was dramatically illustrated in December 2014 when at least three sanitary workers died at Blancomet during the attempt to clean a septic tank (The Lead Recycling Africa Project 2015). Although, the exact circumstances of this accident are still unclear, drained sulfuric acid might have led to the formation of poisonous gases).

In 2010 a health study was carried-out at the facility of Success Africa (Lomotey 2010). Amongst others, the study team took air, dust and soil samples at the facility and conducted blood and urine tests with 20 employees. The results support the conclusion that the recycling process has severe health impacts on the personnel: 19 out of the 20 examined individuals (95 %) showed seriously elevated or even extremely dangerous blood-lead levels (> 40 µg/dl). Here, it is noteworthy that the only individual with a blood-lead level < 40 µg/dl was newly employed and therefore had a shorter exposure time compared to his colleagues. 16 out of 20 employees (80 %) even had blood lead level surpassing 80 µg/dl with a peak value as high as 278 µg/dl. These levels are considered extremely dangerous and do very likely correlate with symptoms of lead-poisoning such as weakness, headache, pain in arms and legs, memory loss, delayed reaction times, and might also lead to forms of acute poisoning and death.

In Table 5-3, the results of (Lomotey 2010) are compared with two surveys carried-out as reaction on mass-poisoning incidents related to ULAB recycling in Africa. The first case from Senegal 2008 caught international attention after 18 children died lead poisoning in 2008. The second case from Kenya led to the closure of a secondary lead smelter after claims that at least 3 workers had died from acute lead poisoning (Human Rights Watch 2014).

Table 5-3: Comparison of survey results of blood-lead levels in and around ULAB recycling industries in Ghana, Senegal and Kenya

	Ghana	Senegal	Kenya
Location	Kpone industrial area, Tema	Thiaroye sur Mer, Dakar	Owino-Uhuru settlement, Mombasa
Facility	Success Africa Ghana Ltd.	Informal ULAB recycling cluster	Kenya Metal Refinery
Year of survey	2010	2009	2015
Scientific reference	(Lomotey 2010)	(Haefliger et al. 2009)	(Kenyan Ministry of Health 2015)
Group tested	Employees of secondary lead smelter	Residents within informal recycling cluster	Residents of community next to secondary lead smelter
Number of tested individuals	20 adults	81 (50 children, 31 adults)	50 adults (10 former employees)
History of case	See above	Prior to survey 18 children died from lead poisoning	Public complaints and claims that at least 3 workers had died from lead-poisoning
Mean blood-lead level	146.34 µg/dl	101.1 µg/dl	43.66 µg/dl
Minimum blood-lead level	3 µg/dl	32.5 µg/dl	< 4.7 µg/dl
Maximum blood-lead levels	278 µg/dl	613.9 µg/dl	420 µg/dl

Source: (Haefliger et al. 2009; Kenyan Ministry of Health 2015; Lomotey 2010)

Although the studies are not fully comparable due to different groups tested, it shows that the situation at Success Africa in 2010 was comparably severe as in documented cases in Senegal and Kenya. Although the maximum blood-lead levels were found to be higher in Senegal and Kenya, it should be taken very seriously that mean blood-levels at Success Africa were found to be considerably higher than in the other cases.

6. Status of regulatory initiatives on e-waste in Ghana

6.1. Regulations on the import and end-of-life management of refrigerators, freezers and air conditioners

As part of the national policy measures to ensure efficiency in the use of electrical appliances and environmental protection, the Government of Ghana passed the following legislative instrument to ban the importation of used refrigerators and freezers in Ghana: The Energy Efficiency (Prohibition of Manufacture, Sale or Importation of Incandescent Filament Lamp, used Refrigerator, used Freezer and used Air conditioner) Regulations, 2008 (L.I.1932).

The ban was opposed by various stakeholders including the importers and retailers of refrigerators leading to a moratorium on the implementation of the ban for the following five years. However, after extensive deliberations and consultation with importers and retailers of the affected appliances, the ban was implemented in January 2013. Thus, Ghana became the first country in the region to introduce a ban on old fridges with the hope of reducing the quantities of toxic and ozone-unfriendly chlorofluorocarbons (CFCs) and reduce the energy burden on its national grid.

Furthermore, in 2006 a national study was conducted by the Energy Commission which revealed that a majority of the used refrigerators and freezers consumed twice as much as energy as new ones. Hence, the main aim of the ban was to conserve energy which was badly needed for other sectors.

The L.I. (1932) makes it a criminal offence to (a) transport a used refrigerator, refrigerator-freezer, or freezer, or (b) offer for sale or distribute an imported used refrigerator, refrigerator-freezer or freezer. It also mandates the Energy Commission to search and seize such appliances when they are stored or offered for sale or being distributed.

The L.I. also mandates the Commission to seize such appliances when they are imported and must not return them to the owner. Any such item seized must be destroyed within four weeks. The Energy Commission thus entered into agreement with a private entity (Presank Company Limited) to establish a fridge recycling company where all seized refrigerators, air conditioners and freezers are destroyed at Afienya near Tema.

The L.I. imposes fines of up to 250 penalty units (GHc 3,000.00) or a prison term for infractions.

The law has been vigorously implemented by the Energy Commission which has led to several seizures of fridges at the Tema main harbour. As required by the L.I. such fridges are immediately transported to Presank Limited for recycling.

6.2. The hazardous and electronic waste control and management bill

Within the framework of the UNEP E-wastes Africa Project, EPA developed a national e-waste strategy, which served as a guiding document for further policy steps towards sound e-waste management in Ghana. The strategy among others called on private companies to consider establishing take-back schemes in Ghana or support private/public partnership projects to set up collection systems for end-of-life electrical and electronic equipment for environmentally sound disposal. To achieve financial sustainability of the initiatives, the strategy was to hold consultations with producers of electrical and electronic equipment to implement Extended Producer Responsibility (EPR) in Ghana (Pwamang & Amoyaw-Osei 2011).

As a consequence of this strategy, in 2011 the hazardous and electronic waste control and management bill was drafted. The consultation towards the passage of the bill started in 2012. The bill was eventually laid before the Parliament of Ghana on the 16th March 2016 and was immediately referred to the Subcommittee on Environment. The bill is divided into two parts; general hazardous waste management and was related electrical and electronic equipment (e-waste).

Key highlights of part 1 of the bill include:

- Prohibition of importation of hazardous wastes and other wastes into Ghana;
- Providing for the export of hazardous wastes and other wastes from Ghana for environmentally sound disposal;
- Providing for safe transport of hazardous waste and other wastes;
- Providing for notification procedure for transboundary movements of hazardous wastes and other wastes.

The key highlights related to the e-waste section include:

- Registration of importers of both new and used equipment;
- Payment of e-waste levy for all imported EEE;
- Take back used or discarded electronic equipment;
- Provide storage disposal containers for the disposal of discarded electronic equipment;
- Promotion of public private partnerships in setting up e-waste recycling facility;
- Prohibition of crude e-waste management such burning and provides for environmentally sound management of electrical and electronic wastes;
- Setting up of e-waste fund which will be used for:
    - the construction and maintenance of electronic waste recycling or treatment plants;
    - to support research into methods of electronic waste prevention, control and management;
    - research into electronic waste treatment and recycling;
    - publication of reports;
    - education of the public on the safe disposal of electronic waste and the negative effects of electronic waste; and
    - offer incentives for collection and disposal of electronic waste.

Additionally the bill establishes designated deposal site for e-wastes to be managed by the respective district assemblies. It is from this point that e-waste will be auctioned to the selected recycling companies. The bill also encourages optimization of reuse and recycling of electrical and electronic waste. Within the process of drafting the bill, several stakeholders gave inputs into the

process. Amongst others, the SRI project submitted suggestions for improvements on the Draft version from December 2013. The respective SRI-comment document is annexed to this report.

6.3. Legislations used to regulate e-waste recycling in absence of a specific e-waste bill

6.3.1. WEEE Related Policies and Legislation

(a) The 1992 Constitution of the Republic of Ghana

The 1992 Constitution of Ghana provides the broad basis for the protection of the environment in general. The relevant sections are as follows:

- Economic Development - Article 36 (9): The State shall take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek co-operation with other states and bodies for the purposes of protecting the wider international environment for mankind.
- Economic Development - Article 36 (10): The State shall safeguard the health, safety and welfare of all persons in employment, and shall establish the basis for the full deployment of the creative potential of all Ghanaians.
- Duties of a Citizen - Article 41 (k): The exercise and enjoyment of rights and freedoms is inseparable from the performance of duties and obligations, and accordingly, it shall be the duty of every citizen to protect and safeguard the environment.

(b) National Environmental Policy

The National Environmental Action Plan (NEAP), which incorporates the Environmental Policy of Ghana, was published in 1991. The aim of the environmental policy is to improve the surroundings, living conditions and the quality of life both of the present and future generations. The policy requires the State to take appropriate measures to control pollution and the importation and use of potentially toxic substances (which include EEE). The policy among others seeks to:

- Ensure sound management of natural resources and the environment against harmful impacts and destructive practices;
- Guide development in accordance with quality requirements to prevent, reduce, and as far as possible, eliminate pollution and nuisances;
- Integrate environmental considerations at all levels of development; and
- Seek common solutions to environmental problems in West Africa, Africa and the world at large.

The environmental policy provides broad framework for the control and management of potentially toxic substances, which include releases from uncontrolled management of Electrical and Electronic Wastes in Ghana.

(c) International and Multilateral Environmental Agreements

Ghana has ratified a number of chemical and waste related Multilateral Environmental Agreements (MEAs) and adopted a number of codes and international declarations including the following:

- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal;
- The Vienna Convention on Protection of the Ozone Layer;
- Montreal Protocol on Control of Substances that Deplete the Ozone Layer;
- The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure of certain Hazardous Chemicals and Pesticides in International Trade;
- The Stockholm Convention on Persistent Organic Pollutants;
- ILO Convention on the Safety of Chemicals at the Workplace;
- London Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer;
- The Johannesburg Plan of Implementation on Environment and Development;
- The Rio Declaration on Environment and Development - Agenda 21; and
- The Strategic Approach to International Chemicals Management (SAICM).

6.3.2. Specific WEEE Management Legislation

There are a number of laws and regulations that have some relevance to the control and management of hazardous wastes (including WEEE), but they do not address the dangers posed to humans and the environment from such wastes. The existing law in Ghana that is closely related to WEEE is the Environmental Protection Agency Act, 1994 (Act 490), which established the Environmental Protection Agency, with the mandate to regulate, coordinate and manage the environment. Section 2 of the Act requires the EPA to, among others:

- Prescribe standards and guidelines relating to the pollution and the discharge of toxic wastes and control of toxic substances;
- Coordinate activities and control the generation, treatment, storage, transportation and disposal of industrial wastes; and
- Control the volumes, types, constituents and effects of waste discharges, emissions, deposits or other sources of pollutants and/or substances which are hazardous or potentially dangerous to the quality of life, human health and the environment.

Section 10 of the Act establishes the Hazardous Chemicals Committee required to monitor the use of hazardous chemicals by collecting information on the importation, exportation, manufacture, distribution, sale, use and disposal of such chemicals, etc. Although this Act does not make specific reference to WEEE, it provides a framework for the management of hazardous substances. Other related laws in the country with some relevance to WEEE control and management include:

- The Factories, Offices and Shops Act, 1970 (Act 328) - which seeks to protect the health and safety of workers from the dangers posed by chemicals to employees in the working environment;
- The Standards Act, 1973 (NRCD 173);
- The Draft Policy and Bill on Occupational Safety and Health, 2000 - which seeks that measures are instituted to ensure the attainment of optimum health for workers in all occupations in Ghana;

- The Mercury Act, 1989;
- Merchant Shipping (Dangerous Goods) Rules, 1974 (LI 971);
- Customs, Excise and Preventive Service Law, 1992 (PNDCL 330);
- Local Government Act, 1992 (Act 458);
- Export and Import Act, 1995 (Act 528); and
- Environmental Assessment Regulations, 1999 (LI 1652)

The L.I. 1932 (see also section 6.1) is a regulation pertinent to EEE and WEEE. It is on energy efficiency on prohibition of manufacture, sale or importation of incandescent filament lamps, used refrigerators, used refrigerator-freezers, used freezers and used air-conditioners. The regulation also prohibits the importation as well as the sale and distribution of used refrigerators, freezers and air-conditioners. Under this regulation a take back program has been established in which citizens who return old inefficient refrigerators containing ozone depleting substances receive assistance to purchase efficient ones. This is spearheaded by the Energy Commission. Currently there is a ban in place and such imports into the country are confiscated and sent to recyclers or shipped back to the countries of shipment.

7. The role of standards and guidelines in Ghana

Standards and guidelines are routinely used as regulatory instruments in Ghana. To date, there are no standards and guidelines in the Ghanaian system to regulate the management of e-waste or other types of scrap material. The following sections give an overview on the established standard and guideline setting processes in Ghana.

7.1. The standard setting process

For most types of standards, the Ghana Standards Authority has the mandate to initiate standard setting processes. Nevertheless, for environmental issues also EPA has this mandate. Standard-setting processes related to recycling practices would clearly fall under this EPA mandate.

Standards have a legally binding function in Ghana. If there would be a standard on recycling practices, enterprises violating this standard could be sanctioned by the authorities. Below the level of standard, there are also guidelines, which could be used to fulfil the same function. Nevertheless, sanctions on the basis of guidelines could be contested juristically. Compared to the standards setting process the process for guidelines is less complex (see section 7.2).

The following chart described the standards setting process in Ghana for environmental standards:

Concept Paper ↓	A concept paper has to be written that lays out the rational and need for a new standard. Typically such concept papers are written by EPA officers.
EPA Management Board ↓	The EPA Management Board has to approve the Concept Paper. After approval, the paper is given to the Ministry of Environment (MESTI).
EPA Executive Director issues mandate to draft version 0 ↓	EPA mandates a team to draft a first version of the standard (version 0).
EPA management ↓	The EPA management has to approve standard version 0.
1. Stakeholder Consultation ↓	Standard version 0 is discussed in a first Stakeholder Consultation
EPA team + team of Attorney General Department: Version 1 (Technical Information) ↓	The stakeholder comments need to be considered in a revised version (version 1). This version has to be drafted by the EPA team together with a team from the Attorney General Department.
Presentation to EPA senior management from all regions ↓	Version 1 has to be presented to EPA senior management representatives from all regions.
2. Stakeholder Consultation ↓	Standard version 1 is discussed in a second Stakeholder Consultation
Person with technical background and EPA team + Attorney General Department: Version 2 ↓	An expert (or expert team) with technical background with Environmental Protection Agency team and the Attorney General's draft standards regulations according to the Ghana legal format (version 2)
Draft Cabinet Memo and Draft Standard ↓ ↓	
Minister / Parliament Select Committee	A cabinet memo and draft standard (version 2) is prepared and sent to the Minister and also sent to

↓ ↓	the Parliament Select Committee (PSC) on Environment on the blind side of the minster so they can be abreast with the information ahead of formal presentation to parliament.
Cabinet	If approved by the cabinet, it is passed-on to the Parliament
↓	
Parliament	The Parliament publishes the draft for comment.
↓	
Publishing for comments for 21days	If no comments are received within 21 days, the draft is going to the parliament
↓	
Publishing of final version / Gazette	

7.2. The guideline setting process

Compared to the standard setting process, the process to establish guidelines requires less procedural steps. The following chart gives an overview on the foreseen process.

Concept Paper ↓	A concept paper has to be written that lays out the rational and need for a new guideline. Typically such concept papers are written by EPA officers.
EPA Management Board ↓	The EPA Management Board has to approve the Concept Paper. After approval, the paper is given to the Ministry of Environment (MESTI).
EPA Executive Director issues mandate to draft version 0 ↓	EPA mandates a team to draft a first version of the guideline (version 0).
EPA management ↓	The EPA management has to approve guideline version 0.
1. Stakeholder Consultation ↓	Guideline version 0 is discussed in a first Stakeholder Consultation
EPA team + team of Attorney General Department: Version 1 ↓	The stakeholder comments need to be considered in a revised version (version 1). This version has to be drafted by the EPA team together with a team from the Attorney General Department.
Presentation to EPA senior management from all regions ↓	Version 1 has to be presented to EPA senior management representatives from all regions.
2. Stakeholder Consultation ↓	Guideline version 1 is discussed in a second Stakeholder Consultation
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