From Mobile Phone to Urban Mine

An analysis of the potentials and process of mobile phone recycling in Belgium

Bachelor Thesis
Darell van der Voort
major Tropical Forestry

Supervisor: Erika van Duijl
Organisation: Catapa
University: Van Hall Larenstein

From Mobile Phone to Urban Mine

An analysis of the potentials and process of mobile phone recycling in Belgium

Preface

Over the last decades the prices for scarce resources like metals have skyrocketed whereas the demand for these precious metals is increasing every day. This demand is driven and promoted by the ‘endless-economic-growth’ model, in an illusion that our planet’s resources are infinite. Due to demographic growth and economic liberalization the number of big mining operations by multinationals in countries like Bolivia, Peru, Guatemala, Greece and other vulnerable countries boomed over the recent years. These mining operations are delving into new ecosystems and virgin territories, new depths of earth and sea, and exploiting the lands of local communities and protected areas (Sibaud, 2013). These, often unregulated, operations cause tremendous damage to the environment, affecting ecosystems, plants, animals and water supplies and have a huge social economic impact for the local communities which is fundamentally unjust. On top of that mining is one of the main causes of deforestation around the globe (Peterson, 2001). These big mining-multinationals are often very powerful and possess more money than the governments of the countries they are operating in, thus giving them a huge advantage over the local communities. The economic policy that allows this is set out in the West, while the South suffers the negative consequences.

I strongly believe that to reduce this relentless destruction of our environment we need to act in the West by investing in alternatives to traditional mining. One of these alternatives is the recycling of electronic waste, also known as e-waste or Waste Electrical and Electronic Equipment (WEEE). As 1 ton of e-waste contains about 50 times more gold than one ton of ore (Boliden, 2007) and the amount of gold above surface in today’s e-waste is 3 times higher than gold underground, there will be no other option for the future than to expand urban mining and effectively increase the recycling of our precious resources.

Darell van der Voort

Summary

With the ever increasing production of electronic devices the demand for resources that are used in such products increases proportional. Mining these resources requires open mining pits, causing environmental degradation and deforestation on a global scale. Mining has also been linked to a wide range of negative social impacts. By recycling electronic products this demand could be reduced and with the urban mining concept a city can be seen as a huge mine, with lots of recoverable resources from old electronic devices, or e-waste. Mobile phones are very interesting for this concept as they are sold in large quantities and have one of the lowest collection rates. Mobile phones have a lifespan of just 18 months before being replaced. This study looked at the current collection system of those replaced mobile phones in Belgium by the 3 biggest mobile phone operators (Base, Mobistar and Belgacom) as they have a combined market share of 80% and could have great potential for the Belgium recycle sector, or urban mine.

A mobile phone consists of lots of different resources, including copper, tin, cobalt and gold. But also toxic materials are found in these devices. By comparing different studies we found out that over 40 different elements can be found in a single mobile phone. The production of that single mobile phone will have an ecological rucksack, the amount of raw materials that needed to be mined, of 75 kilo's. In addition to that, about 17 elements are high risk elements according to the relative risk to the supply of the chemical elements to sustain the current global economy and lifestyle. Mining these resources will become increasingly more politicized. It is therefore important to recycle these mobile phones in environmentally sound ways and try to reduce loss of these resources as much as possible. The environmentally sound management of such wastes also contributes to promoting sustainable livelihood and achieving the Millennium Development Goals.

The 3 mobile phone operators all offer to take in EoL (end-of-life) mobile phones for recycling. This study however showed contradicting policies from the companies and in the retail stores itself. In regard to the possibilities for consumers to return/hand in old mobile phones, most shops appeared to have had certain restrictions such as the number of phones that could be handed in and the overall state of the phone. Also additional conditions often applied. Knowledge from personnel about recycling in these shops was low, meaning that the personnel did not actively encourage their customers to recycle EoL mobile phones.

The mobile phones that did get collected were all send to one company named 'Érecyclingcorps'. This Belgium based company refurbishes and exports around 97.5% of the collected phones by these 3 operators. Meaning that only around 2.5% of the collected mobile phones got recycled within Belgium, bringing the total recycling effectiveness rate of this whole system to just 0.28%. For gold this means that only 0.3% of the total recoverable gold got recycled, at least 10% got exported and 89% of the recoverable gold's fate is unknown by ending up in the 'hidden flow'.

This study also looked at the export of EoL mobile phones to non-OECD countries. Although this is forbidden by law it still happens on a large scale due to loopholes in the current inspection and exporting system in the port of Antwerp. The main loophole would be the lack of distinguishing between the labels for second hand goods and new electronic products, making it difficult for inspection agencies to indicate potential e-waste being disguised and exported as second hand goods.

With a hidden flow, meaning mobile phones that fail to be collected and recycled, of 85-89%, there are great potentials for the urban mining concept for the Belgium mobile phone market. However collection rates need to go up by training personnel and recycling needs to increase within Belgium instead of exporting the bulk to developing countries.

List of figures

List of Tables

List of abbreviaties

(A)EEA	Afgedankte elektrische en elektronische apparaten
EoL	End of Life
E-waste	Electronic Waste
FTE	Full-time Equivalent
OECD	Organization for Economic Co-operation and Development
OVAM	Openbare Vlaamse Afvalstoffen Maatschappij
PCB	Printed Circuit Board
PBB’s	Polybrominated biphenyls
PBDE’s	Polybrominated diphenyl ethers
WEEE	Waste Electrical and Electronic Equipment
WSR	European Waste Shipment Regulation

Table of Contents

1

Introduction

1.0 Introduction

The technological developments of the recent years have led to a huge increase of the production of electronic devices, especially small, portable communication devices such as mobile phones. The production of mobile phones has been associated with a wide range of negative social and environmental impacts. Recent research estimated that by 2014 the number of mobile phones will exceed the world population as the number of active cell phones will reach 7.3 billion (ITU, 2012). This means that there will be more mobile phones than there are people on the planet today. However this does not mean that everybody will own a cellphone or even that cell service will exist everywhere, given the fact that many people have multiple mobile phones. The materials that are used for producing these large amounts of mobile phones involve an intercontinental supply of resources. A mobile phone is made up of many elements, including scarce resources like copper, tin, cobalt and gold. Mining these resources require huge mining pits, destroying biodiversity and polluting water bodies and leaving toxic wastelands behind. On average a mobile phone has a life expectancy of 5 years; however most phones are already replaced for new models after just 18 months, wasting about 3 years of life expectancy of the phones. This generates huge amounts of obsolete phones which eventually become electronic waste, or e-waste.

1.1 Problem statement

E-waste is one of the biggest contributors to loss of gold. By exporting or not recycling e-waste a remarkable amount of gold is lost. Research shows that electronic waste contains 40-50 times the amount of gold in ore mined from the ground, nevertheless no more than 15% of the gold in e-waste is being recovered in recycling processes (United Nations University, 2012), while for small e-waste like mobile phones this percentage is even lower**.** The amounts of such e-waste have been growing exponentially in recent years, even though there are legislations in force within the European Union (EU) that promote the collection and recycling of e-waste. These legislations have been in force since 2003, however they seem little effective when it comes to the collection and recycling of small e-waste like mobile phones.

In addition, it is estimated that 40% of this e-waste is being transported illegally to countries in Asia and Africa, where the e-waste cannot be properly processed, valuable minerals are lost and hazardous health situation for the people involved arise (Cobbing, 2008). Because nowadays we are failing to close the loop on recycling systems a lot of our waste is being exported to developing countries, effectively turning those parts of the world into so called ‘digital dumps’.

With the urban mining concept we could close this loop. Urban mining sees a city as a huge mining concession with a large potential of metal supplies. Computers, laptops, mobile phones, televisions, batteries; they all contain valuable metals like copper, gold, silver, nickel, bronze. This study focuses on the recycling of mobile phones, as mobile phones are one of the most sold electronics but they have the lowest collection rate (Polák & Drápalová, 2012). For every 1 million mobile phones that are recycled, 16.000 kg of copper, 327 kg of silver, 34 kg of gold and 15 kg of palladium can potentially be recovered (U.S. Environmental Protection Agency, 2012). It is estimated that every year around 14 million phones dumped in the U.S. alone, containing as much as €46 million in gold and silver and releasing an astounding 36.300 kg of highly toxic lead (Electronics Take Back Coalition, 2012). Gold is very suitable for urban mining as 99.9% is recyclable. It is one of the best recyclable metals and gold melting has been practiced for centuries. It is probably one of the oldest, if not the oldest, form of recycling known by humans.

The essential transition into new models of recycling is already beginning to happen. Recycling, urban mining, waste management, lifecycle analysis, extended producer responsibility and cradle to cradle are concepts that are becoming more important every day. In Belgium the recycling and waste management industry is growing, with companies like Umicore and Sims Recycling trying to close the recycling loop. This industry and market however is mostly in its initial phase and more research still needs to be done.

1.2 Research objectives

The overall aim for this research is to get an insight of the **potentials** for mobile phone recycling in Belgium. This implies an understanding of the **current situation** of how the 3 biggest **mobile phone operators** in Belgium (Belgacom, Base, Mobistar) **handle** their collected end-of-life mobile phones**,** what **route** these mobile phones go through once collected, what **actors** are involved in the process and if the mobile phones are recycled within OECD countries or if there is any **export** to non-OECD countries and if so, how this is possible. Also **constrains** in this process and the **awareness** of all actors involved will be researched to look for possibilities to improve the recycling process in Belgium.

The figure below shows a simple schematic representation of the process WEEE normally goes through.

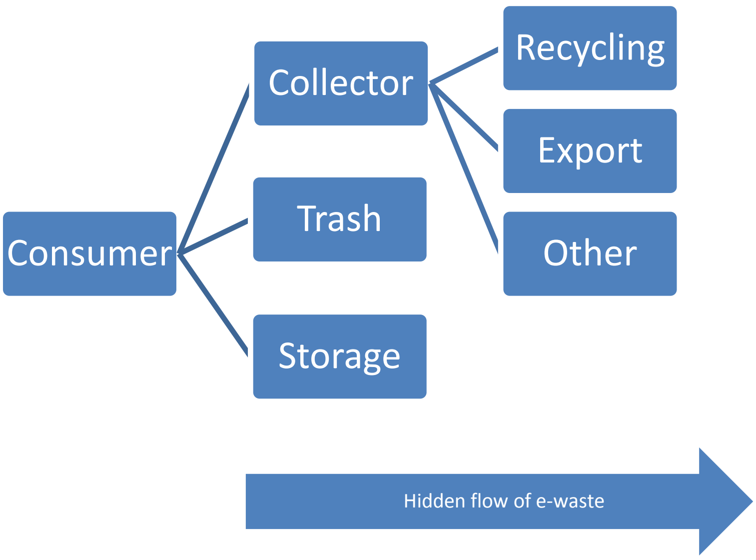


Figure 1 Simple schematic representation of e-waste path

The intention is to find out exactly what path the mobile phones in Belgium go through, what actors are involved, what percentage goes where and why.

To start with, a background analysis will be made of the natural resources used in mobile phones and some of the environmental impacts that the mining of these resources causes. We will then look at the types and amounts of resources that can be recovered from mobile phones. This is done to get an understanding of the potentials of mobile phone recycling.

Subsequently a description will be made of the current collection system of the 3 mayor phone operators in Belgium, what route these phones go through and which actors are involved in this process. We will look at the possibilities, awareness, constrains and potentials for all actors involved.

Finally we will look at the export of mobile phones to non-OECD countries and make an analysis of the national and international rules and regulations that are associated with the transboundary movement of end-of-life mobile phones to get an understanding of how these rules and regulations apply to Belgium to eventually determine if the recycling process is corresponding with national and international polices and/or laws.

The main objectives of this study are to:

- Define which elements can be recovered from recycling mobile phones.
- Get an understanding of the current situation on waste electrical and electronic equipment (WEEE) processing and recycling of end-of-life (EoL) mobile phones.
- Improve understanding of transboundary movement of end-of-life mobile phones to non-OECD countries.

The results of this study could be used for:

- Increasing awareness among Belgium customers and collectors;
- Improving recycling of end-of-life mobile phones in Belgium;
- Reducing loss of valuable resources;
- Reducing the demand for new mining operations around the world.

Considering that:

- The amount of gold above the surface in today's e-waste is 3 times higher than gold underground;
- 1 ton of e-waste contains about 50 times more gold than one ton of ore (Boliden, 2007);

Main question

- What happens with End-of-Life (Eol) waste electrical and electronic equipment (WEEE) collected by mobile phone operators in Belgium and what percentage (%) is being processed and recycled within OECD countries?

Sub questions

- Which resources are used in mobile phones, how much is recoverable and what are the environmental and economic impacts?
- How much mobile phones are sold in Belgium and how much resources could be yielded from EoL mobile phones in Belgium?

- Which actors are involved in the collection and recycling process of EoL mobile phones in Belgium, what is their recycle effectiveness rate and what are the current constrains in this system?
- What are the national and international policies for exporting EoL mobile phones, how are they implemented in the port of Antwerp and what are the current loopholes in this system?

2

Background

2.0 Background

2.1 The ambitious collection targets of the European Union

Europe is of the few unions in the world with legislations regarding to the collection and recycling of waste electrical and electronic equipment (WEEE). Current European legislation have set targets on the collection and recycling of e-waste in general. The European Union wants every member to collect, process and recycle at least 85% of its e-waste by the end of 2016. However no specific collection target for EoL mobile phone exists.

Research in the Czech Republic has estimated that only about 3-6% of EoL mobile phones were collected for recovery and recycling. If similar estimations would be made for an average EU value, then within the next 10 years about 1.3 billion of EoL mobile phones would be available for recycling in the EU. This would result in about 31 tons of gold and 325 tons of silver that is recoverable. (Polák & Drápalová, 2012) However nowadays the vast majority of those phones is not collected and is likely to disappear in the hidden flow.

2.2 Hidden flow of e-waste

“The hidden flow is the amount of WEEE arising based on past product sales that escapes responsible collection, reuse and recycling systems and as such is unaccounted for, but which can end up causing environmental damage, often in poorer parts of the world.” (Cobbing, 2008) Two kinds of hidden flows can be distinguished; the general hidden flow, which is all the e-waste that fails to be captured by recycling programs and the more specific producers hidden flow. “Producers hidden flow is the amount of own-branded WEEE arising (based on past sales) that escapes the control of a given producer (brand owner) and as such the rewards of better eco-designed products cannot be reaped by that producer.” (Cobbing, 2008) Producers take little responsibility when it comes to collecting their own-branded end-of-life products, especially with own-branded mobile phones. Studies show that only 2-3% of own-branded mobile phones that are available for collection are being recycled by the producers (Cobbing, 2008), causing the producers hidden flow to be as high as 98%. There are however exceptions, in Japan Sony reaches a recycling rate of 53% of their own-branded products. This is also due to the fact that Japan has strong WEEE legislations in force, showing that the combination of government legislation and company practice can achieve higher collection and recycling rates of producer’s own-branded products. In this research however the general hidden flow will be the main focus as we look at the amount of recycling by mobile phone operators in Belgium, which do not produce mobile phones themselves.

What happens with this hidden flow is unknown even though legislations are getting stricter within the EU. A study done by the Delft University of Technology shows that the current amount of all WEEE in Europe is estimated at 8.7 million tons a year, of which only 25% (2.1 million tons) is being collected and treated. (Huisman, 2007) This estimation includes all categories of e-waste as defined before. This leaves a total of 6,6 million tons, or 75%, as the EU’s general hidden flow of e-waste. Global estimations for mobile phones alone indicate a 554.571 metric ton of WEEE arising in 2016 (see appendix 6). No precise data is available on what happens with this hidden e-waste. Part of it is probably stored or disposed within the EU or OECD-countries, but large parts are being exported for reselling or recycling to developing countries in Asia and Africa, even though legislations like the Basel Ban should effectively stop all export of e-waste to non-OECD countries. Even the 25% that is collected is also potentially exported to developing countries for reselling and other uses. A good example is the collected mobile phones within the EU that are being resold by 3th parties to non-

OECD countries. These phones will eventually end up at the unregulated dump sites or at the large informal recycling sectors.

2.3 Export

Mobile phones are exported for three reasons; for re-use, for recovery and for disposal, of which the latter two are illegal for countries that have signed the Basel Ban. According to the 'ladder van Lansink' and the European waste hierarchy, re-using is preferable to recycling, although this will not always have the lowest environmental impacts (OVAM, 2012). Re-using old mobile phones also helps to reduce the demand for new resources as the re-used mobile phones will replace new appliances. This is also an opportunity for people in developing countries to have access to the mobile phones and to make an effort to bridge the digital divide. On average a phone that is handed in can still be used for another 3 years till its end-of-life (Attention A La Terre, 2010). However the exporting of old mobile phones to developing countries also has its negative impacts. Once a mobile phone reaches its end-of-life in the developing country, where little or no infrastructure is in place, it is highly unlikely that it will be processed and ultimately managed in a manner that protects public health and the environment. Instead the mobile phones will probably end up at one of the dump sites in either Africa of Asia, essentially missing the point for which they were collected in the first place.

The primary sets of actors who export mobile phones are; development organizations, immigrants and waste processing firms (Salehabadi, 2013). It remains however very challenging to find conclusive and reliable quantitative data on global transboundary e-waste flows. Therefore the focus of this study lies on the export carried out by the mobile device collection companies in Belgium to which the 3 mayor phone operators in Belgium sent their collected mobile phones.

These companies resell the mobile phones in developing countries and by doing so turn a profit. Because these goods are classified as ''reusable'', they automatically fall outside of the existing waste regulations. In fact, any type of used product that is exported (regardless of its nature) with the intention of re-use is not considered to be waste. The definitions are however vague and it remains difficult to really indicate that the goods being exported are in fact reusable, thus making it difficult to distinguish actual usable goods from waste. On top of that evidence is found during this study (see appendix 10) that Belgium based companies export BER (Beyond Ecomical Repair)-phones and damaged parts, like mainboards which contain the most precious metals, to developing countries. These exported goods are not functioning properly and can be seen as e-waste. The problem, at least partly, that makes this possible lies in the labeling system for exporting goods, which will be discussed later in this report.

This WEEE is most often destined for unregulated recycling markets, for which there is a huge market in India, China and countries in Africa. When this e-waste is being recycled in developing countries these toxics are often burned in uncontrolled environments, causing tremendous damage to the environment and generating hazardous health situations for the local communities. In these large informal recycling sectors the focus lies on recovering the valuable raw materials at the lowest possible cost instead of the health of the workers and environmental pollution. These primitive recycling methods result in a much lower processing cost than recycling within OECD countries. It is estimated that recycling a computer in OECD countries costs about 20 dollar, against the approximately 1 to 2 dollar cost in developing countries.(Cobbing, 2008) This cheap recycling drives the illegal import of e-waste from developed countries, which adds to the already large quantities of domestic e-waste of non-OECD countries. Therefore the Basel Convention has identified e-waste as hazardous and developed a framework for controls on transboundary movement of such e-waste.

This convention also strengthens and ensures the environmentally sound management of such wastes as a contribution to promoting sustainable livelihood and achieving the Millennium Development Goals. (Convention, 2011). The Basel Ban decision effectively banned as of 1 January 1998, all forms of hazardous waste exports from the 29 wealthiest most industrialized countries of the Organization of Economic Cooperation and Development (OECD) to all non-OECD countries. (BAN, 2012) For a figure of countries belonging to the OECD and the Basel Convention see chapter 6.

Notwithstanding this ban, the port of Antwerp is becoming an important hub for illegal transportation of e-waste to countries in Africa and Asia, with the Agbogbloschie dumb in Ghana as one of the top destinations. (Oost-Vlaanderen, 2009) Most of the containers are labeled as second hand goods, but research shows that a large part of these goods do not work and are considered to be e-waste. (Bisschop, 2012) Flemish MP Rudi Daems from the Flemish green party has been to Ghana at the Agbogbloschie dump to draw attention to the issue and to put it on the political agenda. Rudi Daems strongly reprehends the lack of control of this kind of illegal waste transport. Control measures in the Flemish harbors are limited, consisting of only two Federal and two Flemish environmental inspectors. It is currently not known via which European networks the electronic waste lands in these containers. Dealers in West Africa buy the e-waste per container, assuming that between 25 and 75 percent of the content is non-functional. (Oost-Vlaanderen, 2009) "In the containers to Ghana waste from Germany, England, and even the United States was found. Apparently people chose the easiest route to get rid of the hazardous waste, and Antwerp is the hub," says Mr. Daems.

The Mobile Phone Partnership Initiative (MPPI)

During the 6th meeting of the Parties from the Basel Convention in 2002 the Mobile Phone Partnership Initiative (MPPI) was launched. In this meeting 12 world leading manufacturers (Alcatel-Lucent3, LG, Panasonic, Mitsubishi, Motorola, NEC, Nokia, Philips, Samsung, Sharp, Siemens, Sony Ericsson) signed a declaration that started a sustainable partnership that, with the Basel Convention and in cooperation with other stakeholders, would develop and promote the environmentally sound management of end-of-life mobile phones (UNEP, 2010). Later in 2005 three telecom operators (Bell Canada, Vodafone, and France Telecom/Orange) also entered the Initiative.

The overall objective of the MPPI is to promote the part of the Basel Convention that considers the environmentally sound management of end-of-life mobile phones to protect human health and the environment.

Their most interesting objectives are:

- To influence consumer behavior towards more environmentally friendly actions;
- Promote the best refurbishing/recycling/disposal options;
- Mobilize political and institutional support of environmentally sound management.

These objectives are interesting for this research as we are trying to raise awareness for this matter for consumers as well as the collectors and look for room for improvement in the political and institutional context of this matter.
It is therefore important to discuss loopholes in rules and regulations to improve governance. This study aims to indicate such loopholes in the collection system in Belgium in order to reduce the

export of EoL mobile phones from Belgium markets to non-OECD countries. Increasing awareness for this matter can also be effective; Greenpeace has in the past shown to be successful in reducing illegal transport of e-waste from the port of Rotterdam by campaigning by campaigning and increasing awareness (Greenpeace, 2008).

3

Research methods

3.1 Introduction

For this research new and existing information and data will be used. Existing information will be gathered by studying available literature on the internet, on different research portals and library's. The new information will be gathered trough questionnaires and interviews with the involving parties. The collected data will be a combination of qualitative data and quantitative data. The interviews will be mostly qualitative data, while the literature research will partly consists of quantitative data.

The methods have been divided according to the three objectives of this study.

Part 1: Define which elements can be recovered from recycling mobile phones.

This part of the study consists of literature study. The literature reviewed came mostly from primary sources like scholarly journals and scholarly books from the university of Gent and papers from the recycle factory Umicore. It also includes secondary sources like internet articles from NGO's active in this field. Data from these sources was combined to come up with figures and tables indicating the precise metals used in mobile phones. Also an interview was held with staff from the NGO Catapa to get a better understanding of the environmental impacts of mining as they have years of experience researching the impacts of mining.

Part 2: Get an understanding of the current situation on waste electrical and electronic equipment (WEEE) processing and recycling of end-of-life (EoL) mobile phones.

This objective consists of different parts. Some literature study was used to gather background data like phone sales from research institutes like "Gesellschaft für Konsumforschung" and year reports from Mobistar, Belgacom and Base.

Field research

As it is practically impossible to investigate the whole Belgium mobile phone market a case study was chosen on the 3 biggest mobile phone operators in Belgium; Mobistar, Belgacom and Base. This target group should be a good indication on the current situation as they have a combined market share of more than 80%.

Information from the individual selling points from these operators was gathered by interviewing the employees. The purpose of going to these individual selling points of the mobile phone operators was to collect data from the employees about their information and options for returning and recycling old mobile phones. The individual selling points can be the very start of the recycling process and they have the opportunity to increase the recycling amount by properly informing their consumers about the importance of recycling and actively engage them in the process. It is important to know what information the local shops give to the consumers about recycling, how much the employees know about the subject and if the given information is consistent and in line with the overall policy of the company in order to indicate possible constrains during this phase.

The strategy was to go as a consumer to at least 28 different shops in different cities in Belgium from each mobile phone operator. In the shop questions were asked about the possibilities of returning an old mobile phone and the process this mobile phone will go through. The questions were the same for each shop to achieve consistency in the data. The following questions were asked;

- Is it possible for me to return my old mobile phone?
- What will happen with my old mobile phone, will it be recycled, resold or trashed?
  - Recycled; where, or at which company will it be recycled?
  - Resold; what company does reselling? Where will it be resold?

        - Trashing; in what country will it be trashed?
- If returning is not possible; do you have any other options for returning my mobile phone?
- Do you know about the benefits of recycling mobile phones?
- Do you actively advice consumers about recycling?

According to the answers the different mobile phone operator shops were ranked by the following system;

	Poor		Sufficient		Good
Possibilities for returning					
Knowledge about recycling from personnel					
Recycling options					
Actively encourage consumers to recycle					
Compliance with company policies					
	1	2	3	4	5

Table 1 Ranking system mobile phone shops

Ranking explanation:

Possibilities for returning
1= It is not possible to return an old mobile phone
2= It is possible to return 1 mobile phone, but a new one needs to be bought
3= It is possible to return more than 1 mobile phone, but a new one needs to be bought
4= It is possible to return 1 mobile phone without buying a new one
5= It is possible to return more than 1 mobile phone, without buying a new one

Requirements for returning
1= Phone cannot have any damage, needs to be fully operational and all accessories need to be included
2= Phone can have some damage, needs to be fully operational and all accessories need to be included
3= Phone can have some damage, needs to be fully operational and accessories are not required
4= Phone can be damaged, does not need to be fully operational and accessories are not required
5= Phone can be damage, does not need to be operational and even parts of phones can be handed in

Knowledge about recycling from personnel
1= Personnel knows nothing about recycling process at all
2= Personnel knows that phones are being collected, but not what happens with them
3= Personnel knows that phones are being recycled, but not at which company
4= Personnel knows that phones are being recycled and where
5= Personnel knows that phones are being recycled or resold, and at which company or country

Actively encourage consumers to recycle (when buying a new phone)
1= Personnel gives no information about recycling options
2= Personnel gives some information about recycling options
3= Personnel gives all the information about recycling options
4= Personnel actively encourages customers to recycle

5= Personnel even tells about recycling options even when no new phone is bought

Compliance with company policies
1= Policies in store are completely different with company policies
2= Policies in store are somewhat different with company policies
3= Policies in store are, excluding some details, the same with company policies
4= Policies in store are the same as company policies
5= Policies in store are better than company policies?

This data was compared with the data from the head offices from the mobile phone operators to test its consistency.

Sampling

Of the total group of shops a select number was questioned, these shops were chosen via the random sampling method.

The figure below is a schematic representation of this sampling method, with 'population' symbolizing al the mobile phone shops in Belgium and the 'sample' group which was investigated.

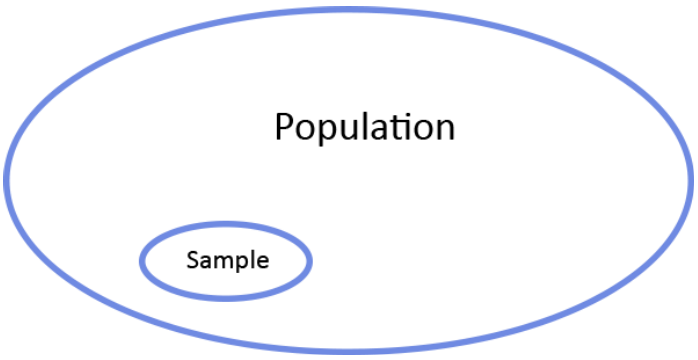


Figure 2 Schematic representation of the sampling method

Sampling is in fact a group of units that has been randomly chosen from the population by which certain data is being gathered. The sampling for this research was done at random and entirely by chance by letting a computer script choose the different shops.

Because population was smaller than 50.000 the formula for a finite population was used to determine the sample size:

$$SS = \frac{Z^2 \cdot (p) \cdot (1-p)}{C^2} \quad \text{-> } New\ SS \quad \frac{SS}{1+(SS-1/Pop)}$$

Equation 1 Sample size

In which:

SS = Sample Size
Z = Z-value
P = Percentage of population picking a choice, expressed as decimal
C = Confidence interval, expressed as decimal
Pop = Population

Due to the 329 shops which are located through the country combined with limited time a confidence interval of 15% was chosen which result in the following sample sizes:

Confidence level	Sample size
90%	28
95%	38
99%	61

Table 2 Different sample sizes with a 15% confidence interval

The aim was to sample at least 28 shops to achieve a confidence level of 90%.

Interviews

Also interviews were held with the different actors involved in the process like the head offices of the mobile phone operators and recycling companies. The interviews collected primary data and some of the interviews were open questions, which resulted in unstructured data. Although this made analyzing the data more difficult, it was a better option for this research as closed questions restrict the responses. It allowed subjects to respond freely and express shades of opinion rather than forcing them to have precoded opinions. The list of questions was however structured beforehand to form a guide approach. The guide approach was intended to ensure that the same general areas of information were collected form each interviewee. This provided more focus than a conversational approach, but still allowed a degree of freedom and adaptability in getting the information form the interviewee.

The interviews were either personal where the interviewer asked questions generally in a face to face contact to the other person or persons, or telephonic interviews when it was not possible to contact the respondent directly. A voice-recorder was used for later analyzing of the data.

The closed questions interviews can be found in appendix 7 and 9.

Calculation of recoverable metals

To find out the precise amount of metals that would be potentially available for recovery in recycling process in Belgium we started by calculating the average amount of phones sold in Belgium over a period of 90 months. These sales numbers were based on data from the three operators and general research institutes like "Gesellschaft für Konsumforschung, not taking into account the increasing number of sales each year because this would be too difficult to predict. We then looked at the average lifespan of a mobile phone in Belgium through literature study in order to calculate the amount of phones that become obsolete over a period of 90 months.

Recycle effectiveness rate

To calculate the effectiveness rate of each actor involved the following equation was used;

$$\varepsilon = \frac{Environmental\ value\ of\ material\ recycled\ from\ e-waste}{Total\ environmental\ value\ of\ materials\ contained\ in\ e-waste}$$

Equation 2 Effectiveness of recycling operations

With ε being the recycle effectiveness for each actor and the environmental value the amount of phones to were recycled.

Part 3: Improve understanding of transboundary movement of end-of-life mobile phones to non-OECD countries.

Literature study was used to formulate the current international rules and regulations applicable to this study. This literature consisted mostly out of governmental documents.

Also an interview was held with the department of external communication in the port of Antwerp. This interview was completely open and unguided as unforeseen circumstances were likely to happen and planning these interviews beforehand was difficult. Also a structured interview with the Department of Environment of the Flemish Government was held. This provided more focus than a conversational approach, but still allowed a degree of freedom and adaptability in getting the information form the interviewee. The list of questions can be found in appendix 8.

It was however fairly difficult to get information on this matter, given the illegal aspect. Research has however been done by Greenpeace and other organizations on the illegal transport of e-waste from Europe to developing countries, so these studies have also been used for gathering information.

4

Mobile phones, the new gold mines?

4.0 Mobile phones, the new gold mines?

4.1 Introduction

Research shows that the mobile phone market is growing exponentially, in 2006 already more than one billion mobile phones were shipped worldwide, which was a growth of 22.5% compared to the previous year. In 2008 there were more than two billion mobile phone users around the world and this continued to grow exponentially (United Nations, 2006). By 2011 roughly 6 billion phones existed, meaning that 87% of an estimated world population of 6.98 billion inhabitants owned a mobile phone. In other words, about one mobile phone per living person aged 15 years and above (ITU, 2012). Recent research estimated that by 2014 the number of mobile phones will exceed the world population as the number of active cell phones will reach 7.3 billion (ITU, 2012).

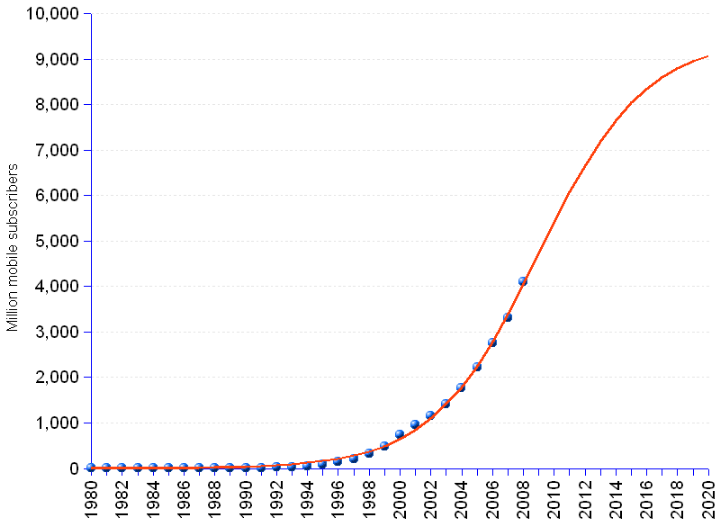


Figure 3 Mobile - or cellular - phone subscribers worldwide (ITU, 2012)

In Belgium an average of 4 to 4.5 million mobile phones are sold each year (Liesse, 2012) mostly by either Belgacom, Base or Mobistar (Deconinck, 2013). Research institute GfK calculated that in 2012 about 1.8 million of these were smartphones (Mobistar, 2012), which is a 27% increase of the smartphone market compared to 2011. On top of that about 800.000 tablets have been sold in 2012 which also contain the same or even more valuable minerals. These phones have a life expectancy of about 5 years, but most phones in Belgium are already replaced for new models after just 18 months, wasting about 3 years of life expectancy of the phones. It is estimated that in Belgium alone 25 million mobile phones are laying around in households (Attention A La Terre, 2010) which could potentially be recycled or re-used.

In this chapter we will discuss some of those environmental impacts. We will also look at the precise metals and chemicals used in mobile phones to determine the potential for recoverable resources and get an understanding of the profits from recycling mobile phones.

4.2 Raw materials, resources and elements used in mobile phones

In this chapter we will give an insight on the exact figures of metals and materials used in mobile phones. The composition as described here is however an average and is heavily subjected to change due to the constant developments of new designs in mobile phones such as bigger (touch) screens and the use of glass elements. Mostly the plastic and ceramics numbers will change significantly, however the amount of precious metals will stay relatively constant and that is where the largest part of the value lies. Combining the data from different studies resulted in the following list of materials used.

A mobile phone typically consists of the following materials:

- Plastic, mainly in the casing;
- Glass used for the screen;
- Ceramics;
- Base metals such as copper, cobalt, iron derivatives, nickel, etc. these are found in cables, electronic circuits and batteries;
- Precious metals like silver and gold;
- Hazardous substances like lead, mercury or cadmium, which are components of electronic circuits;
- Flame Retardants.

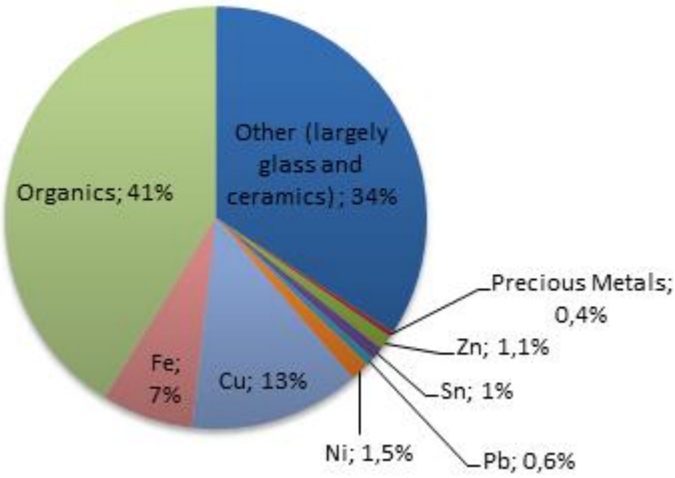


Figure 4 Main elements used in mobile phones (data from Verheage, 2010)

In the above list only the main components of a mobile phone are mentioned. To break it down even more the main components of a typical mobile phone are; the circuit board, the liquid crystal display (LCD) screen, and the battery (Sibaud, 2013). However in total a lot more different elements are used. On average 75 kilograms of raw materials, or the so called ‘ecological rucksack’ (which we will discuss later in chapter 4.3) and over 40 elements are used for 1 mobile phone (Frey, Harrison, & Billett, 2006). The periodic table below shows all the elements that can be found in a mobile phone:

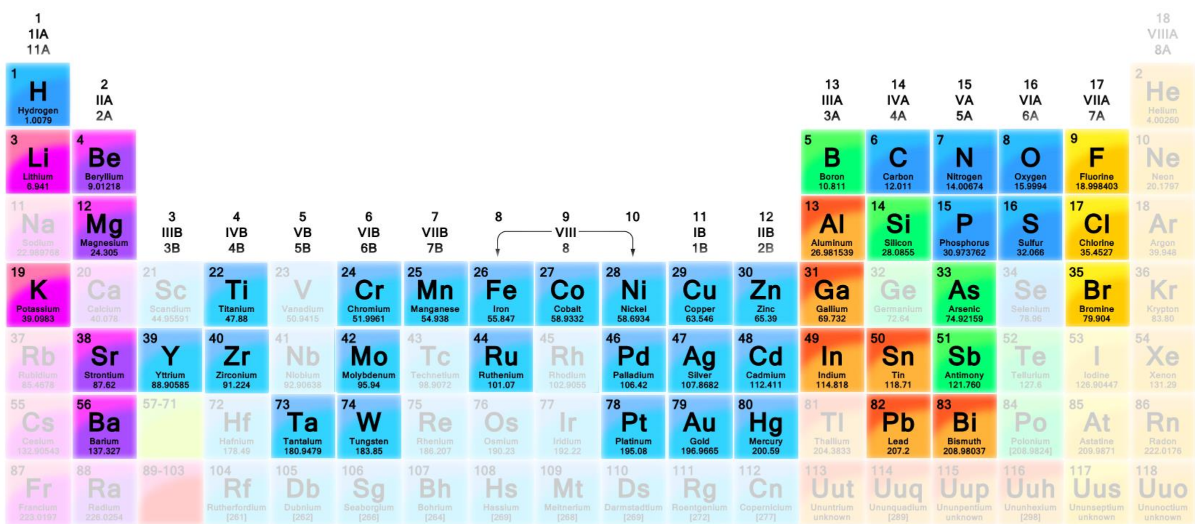


Figure 5 Elements found in mobile phones. Data from: (Boutet & Hagelüken, 2009) (HealthyStuff.org, 2012)

This chart has been put together with the data from different independent experiments and studies and represents the total of all the elements found in mobile phones.

The following elements are used in different parts of a mobile phone, however this list is not complete:

Circuit board: tin, lead, gold, silver, platinum, palladium, cobalt, beryllium, zinc, nickel, copper and tungsten

LCD screen: yttrium (this is rare earth element, later in this report we will discuss more about this rare earth element)

Battery: the following battery types are most often used in mobile phones; nickel-metal hydride (Ni-MH), lithium-ion (Li-Ion), nickel-cadmium (Ni-Cd), or lead acid. These batteries contain nickel, cobalt, zinc, cadmium and copper.

Other metals: arsenic, aluminum, antimony, gallium, manganese, molybdenum, magnesium, indium-tin oxide, iron, neodymium, chromium, selenium and cadmium.

4.2.1 Toxic Mobile Components

Mobile phones do not only contain valuable materials which make up 60%, but also consist of about 2.70% of highly toxic pollutants. (Widmer et al., 2005) As much as 1450 tons of a brominated flame retardant called TBBPA was used to manufacture 991 million mobile phones sold in 2006. This chemical has been linked to neurotoxicity (Cobbing, 2008).

These toxics have a huge impact on the environment and health when recycled unprofessionally, as what is often the case in developing countries. In the next chapter we will talk about some of the environmental and socio-economic impacts from mining these resources.

Toxic materials and substances that are found in almost all mobile phones;
lead, brominated flame-retardants, beryllium, hexavalent chromium, arsenic, cadmium and antimony (Widmer et al., 2005).

These substances are proven to cause diseases like;
neurological damages, cancers, beryllium disease, nervous system damage, skin diseases, brain damage, blood disorders etc etc (EMPA, 2009).

4.3 From mine to mobile phone: environmental and economic impacts

Mobile phones create a huge amount of so called baggage, also known as the 'ecological rucksack'. An ecological rucksack is the total quantity (in kg) of materials removed from the Earth to produce a product, minus the weight of the product (Sibaud, 2013). According to a study in the journal of industrial ecology the production of 1 mobile phone has an ecological rucksack of 75 kilograms (Frey, Harrison, & Billett, 2006).

Gold mining has the biggest environmental and social impacts of all the resources used and has the highest recycle potential (CATAPA, 2013). Gold used in electronic products consumed 5.3% (197 tons) of the world's supply in 2001 and 7.7% (320 tons) in 2012 (United Nations University, 2012).

4.3.1 The impact of gold used in mobile phones

For the gold used in mobile phones the various resources are used and/or emitted, based on the calculation from Umicore that 1 mobile phone on average consists of 24 mg of Gold. These are listed in table 3.

	For 1 kilogram of gold	For 1 mobile phone
Ore*	1.023 ton	24.552 kg
Waste**	2.272 ton	54.528 kg
Water usage	2.300.546 liter	55.2 liters
CO2 emission	23 ton	0.552 kg
Mercury production	358 gram	8.529 mg
Mercury emission	27 gram	0.648 mg
Arsenic emission	22 gram	0.528 mg
Cyanide usage***	238 kg	25.712 g

Table 3 Resources used/emitted for mining gold. Data from: (Umicore, 2012) (CATAPA, 2013)

*Stones from which the gold was mined.
** Polluted soil that is left after mining.
*** Chemical to extract the gold from the ore, 0.1 grams is enough to kill a human being.

Table 3 indicates that an ecological rucksack of 75 kilo's is very plausible, as 25 kilos of ore is needed for gold alone. In this table we also get an indication of the vast amount of water that is needed for the production of mobile phones, inevitably pollution surrounding water bodies and endangering the health of the local communities which heavily depend on these water sources. The amount of cyanide is also considerable, taking into account that 0.1 grams is enough to kill a human being.

4.3.2 Resources risk list

Many of the elements used in mobile phones are on the risk list of economic valuable elements. The risk list is an indication of the relative risk to the supply of the chemical elements to sustain the current global economy and lifestyle (MineralsUK, 2012). It highlights economically important metals which are at risk of supply, including many elements used in the production of mobile phones. The risk index on the list is determined by a number of factors which influence the availability of that particular element. These factors include the abundance of elements in the Earth's crust, the location of current production and reserves and the political stability of those locations (MineralsUK, 2012). Also the recycling rate and substitutability of these elements are included in the analysis.

The list indicates that the production of most groups of elements is concentrated in just a few countries. Most of these countries have low political stability ratings and restrictions on the distribution of their reserves, leading to a significantly increased risk to the supply. On top of that recycling rates are often low and there are only limited substitutes for many of these elements.

In total 32 elements that are used in mobile phones can be found on figure 6. Six of these elements have a risk factor of 7 or higher, 10 elements have a risk factor of 8 or higher and it even includes Yttrium, which is an rare earth elements and has the highest risk factor of 9,5. Bringing the total high risk elements used in mobile phones to 17.

It must be noted that environmental impacts are not calculated in this list. Therefore metals like gold and copper, which its extraction process causes huge environmental damage, do not get a high score on the list. The elements in this list were based on seven criteria scored between 1 and 3.

The criteria are:

- Scarcity
- Production concentration
- Reserve distribution
- Recycling rate
- Substitutability
- Governance (top producing nation)
- Governance (top reserve-hosting nation)

As the production of mobile phones will keep increasing, so will the demand for these high risk elements. Due to factors such as geopolitics and resource nationalism the supply of these high risk elements could be in danger in the future. Finding and mining these elements on the risk list for mobile production will become increasingly more politicized in the

What are Rare Earth Elements?

Rare Earth Elements, or REE's are the 17 elements in the bottom of the periodic table, namely; scandium, yttrium, lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium. The name would suggest that these elements are very rare, however this is not the case. These elements are spread out all over the globe, however not in large 'economically exploitable forms' and are therefore recognized as 'rare'.

These REE's are the components of many electrical devices, including solar panels, wind turbines and hybrid vehicles.

future as these resources are getting scarcer and nations competing for access to new mining areas, often causing conflicts (Custers, 2013).

In the next chapter we will look at the potentials of mobile phone recycling in Belgium and calculate the amount of resources that could be yielded from end-of-life mobile phones.

British Geological Survey

Risk list 2012 — Current supply risk index for chemical elements or element groups which are of economic value

Element or element group	Symbol	Relative supply risk index	Leading producer	Top reserve holder
rare earth elements*	REE	9.5	China	China
tungsten	W	9.5	China	China
antimony	Sb	9.0	China	China
bismuth	Bi	9.0	China	China
molybdenum	Mo	8.6	China	China
strontium	Sr	8.6	China	China
mercury	Hg	8.6	China	Mexico
barium	Ba	8.1	China	China
carbon (graphite)	C	8.1	China	China
beryllium	Be	8.1	USA	Unknown
germanium	Ge	8.1	China	Unknown
niobium	Nb	7.6	Brazil	Brazil
platinum group elements	PGE	7.6	South Africa	South Africa
colbalt	Co	7.6	DRC	DRC
thorium	Th	7.6	India	USA
indium	In	7.6	China	Unknown
gallium	Ga	7.6	China	Unknown
arsenic	As	7.6	China	Unknown
magnesium	Mg	7.1	China	Russia
tantalum	Ta	7.1	Brazil	Brazil
selenium	Se	7.1	Japan	Russia
cadmium	Cd	6.7	China	India
lithium	Li	6.7	Australia	Chile
vanadium	V	6.7	South Africa	China
tin	Sn	6.7	China	China
fluorine	F	6.7	China	South Africa
silver	Ag	6.2	Mexico	Peru
chromium	Cr	6.2	South Africa	Kazakhstan
nickel	Ni	6.2	Russia	Australia
rhenium	Re	6.2	Chile	Chile
lead	Pb	6.2	China	Australia
carbon (diamond)	C	6.2	Russia	DRC
manganese	Mn	5.7	China	South Africa
gold	Au	5.7	China	Australia
uranium	U	5.7	Kazakhstan	Australia
zirconium	Zr	5.7	Australia	Australia
iron	Fe	5.2	China	Australia
titanium	Ti	4.8	Canada	China
aluminium	Al	4.8	Australia	Guinea
zinc	Zn	4.8	China	Australia
copper	Cu	4.3	Chile	Chile

Supply risk index runs from 1 (blue — very low risk) to 10 (red — very high risk)

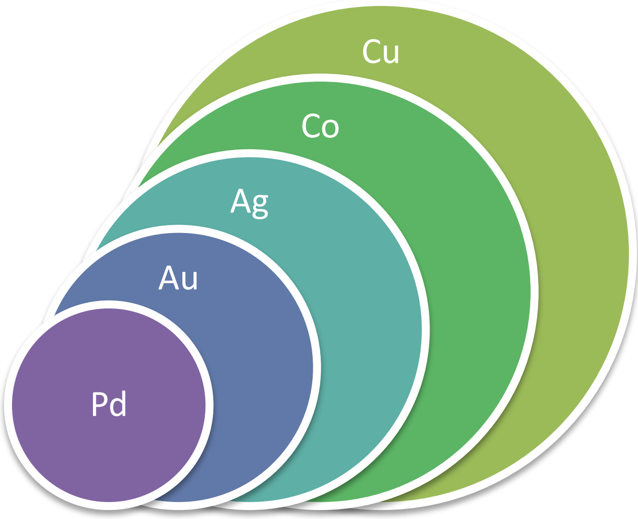
Limitations and methodology are set out in accompanying notes

Figure 6 Resources used in mobile phones risk list 2012 * Only 1 of the 17 rare earth elements is used; Yttrium

4.4 From mobile phone to urban mine; what are the potentials?

Studies show that end-of-life mobile phones contain about 40 to 50 times more recoverable gold than the same amount of newly mined ore (Boliden, 2007). Also considering that from 2001 to 2012 the price for gold rose from under $300 to more than $1,500 per ounce. It is estimated that a total of $21 billion in gold and silver is used in e-products worldwide annually (United Nations University, 2012). With just 15% of e-waste being recovered nowadays, there are obviously great potentials for urban mining.

To understand the potentials for mobile phone recycling we first have to determine what kind of recoverable resources are found in a mobile phone and in what quantity. By comparing different studies figure 7 gives the average outcome of resources used for one mobile phone.



Copper	9000 mg
Cobalt	3800 mg
Silver	250 mg
Gold	24 mg
Palladium	9 mg

Figure 7 Amount of recoverable metals in 1 mobile phone. Data from: (Umicore, 2012)

There is however still some discussion about the precise amounts. Studies in America sometimes indicate a higher amount of 32 mg of gold. This is due to the fact that the newer smartphones often contain more gold. However the bulk of the end-of-life mobile phones are not smartphones, as they are still relatively new to the market. Nevertheless these are significant amounts of recoverable resources.

Some examples of what can be done with recycled mobile phones;

- *200 mobile phones provide enough gold for 1 golden ring;*
- *200 mobile phones provide enough copper to make a gutter of 2,5m;*
- *1 million mobile phones is worth approximately $1.269.870 in gold;*
- *Recycling just one cell phone saves enough energy to power a laptop for 44 hours;*
- *Certain retrieved plastics are reused by the automotive industry;*
- *The remaining plastics or mineral products which cannot be recycled are used as fuel in cement (Fella, 2010).*

5

Exploiting the urban gold mine

Calculations of mobile phone recycling in Belgium

5.0 Exploiting the urban gold mine – calculations of mobile phone recycling in Belgium

Approximately 4.5 million mobile phones are sold on the Belgium phone market annually (Fella, 2010; Liesse, 2012: Deconinck, 2013; Mobistar, 2012). Different studies show that the average consumer from developed countries replaces their mobile phone approximately every 18 months (Polák & Drápalová, 2012; Paiano et al., 2013; Jang & Kim, 2010; Liesse, 2012).
Based on these numbers a calculation was made on the amount of phones sold and the amount of phones that become potentially obsolete on the Belgium phone market over a period of 90 months, assuming that the yearly sale is constant.

Figure 8 represents the phones sold and the phones becoming obsolete over a period of 90 months.

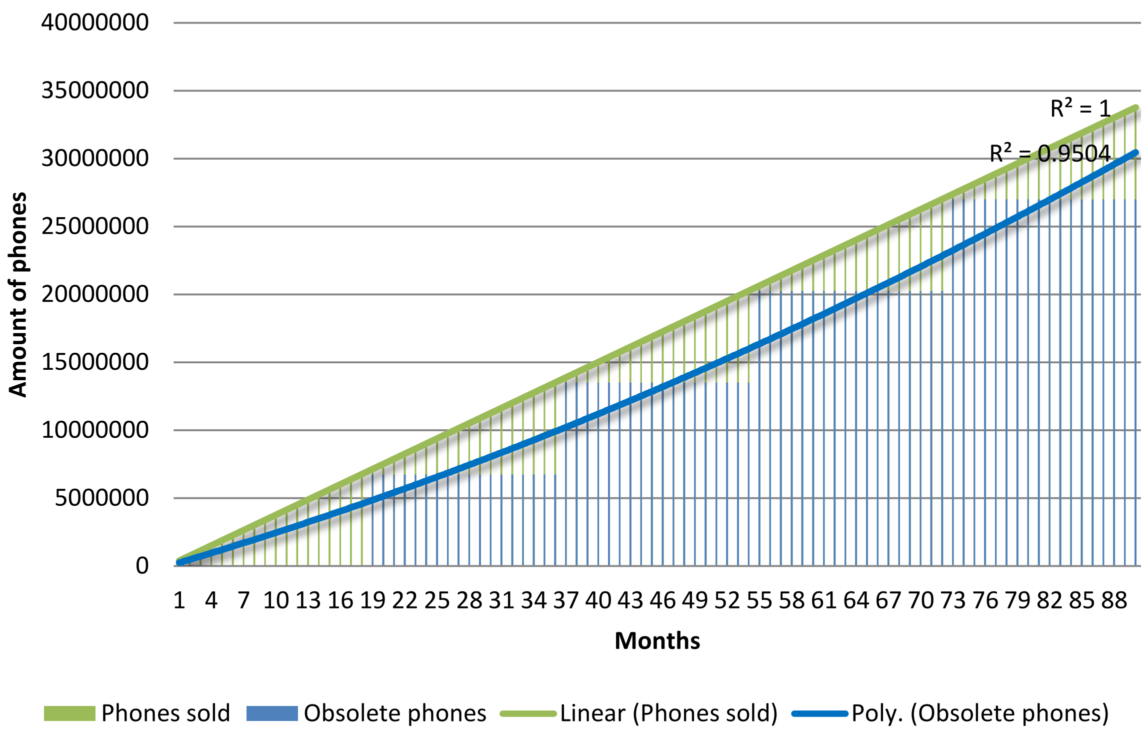


Figure 8 Estimated mobile phone sales in Belgium over a period of 90 months

The graph indicates that after 90 months about 33.75 million phones have been sold in Belgium. In those same 90 months at least 27 million phones became potentially redundant. These phones are either re-used, resold in other countries, laying around in households or end up in the trash. In an ideal situation, when every single one of these phones would be recycled, 648 kg of gold and 6750 kg of silver could be potentially recovered. Figure 9 shows the recoverable amounts for the other metals found in mobile phones.

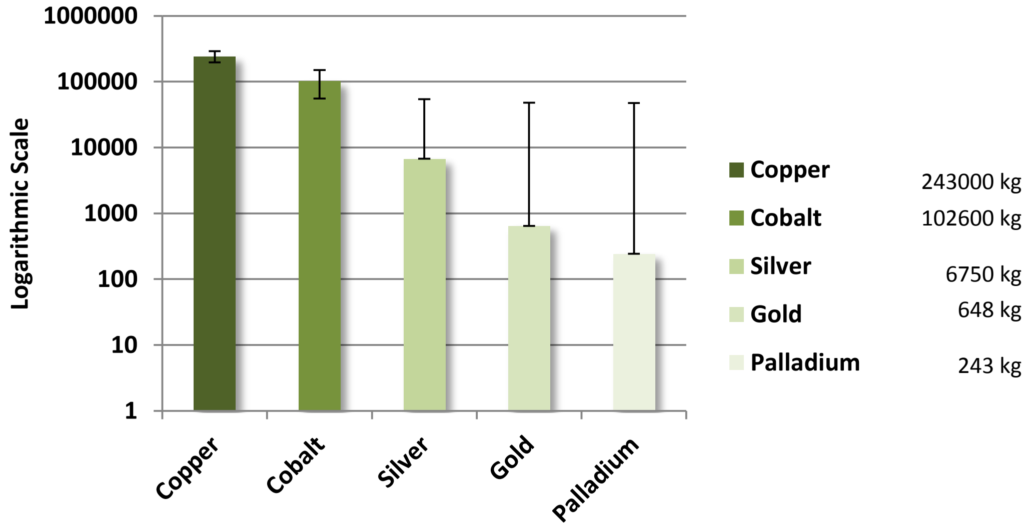


Figure 9 Logarithmic scale of potential recoverable resources from mobile phones of a period of 90 months in Belgium

These numbers would be in an ideal situation, were every mobile phone gets collected and recycled. Of course this is not the case and the efficiency of the entire recycling chain depends on the collection rate, the sorting & pretreatment and the metal recovery rate. These rates are calculated in chapter 5.3. First we will look at how the current collection system is set up, what percentage gets collected and why.

5.1 Current collection system of mobile phones – a comparison

Belgacom, Base and Mobistar all offer to take in old mobile phones and, depending on the brand, model and age, pay a fee to the consumer. Their company policy is to even take in old and non-working phones, just for recycling. However, the policies and the actual situation at the retailers-shops appeared to be very different. In regard to the possibilities for consumers to return/hand in old mobile phones, most shops appeared to have had certain restrictions such as the number of phones that could be handed in and the overall state of the phone.

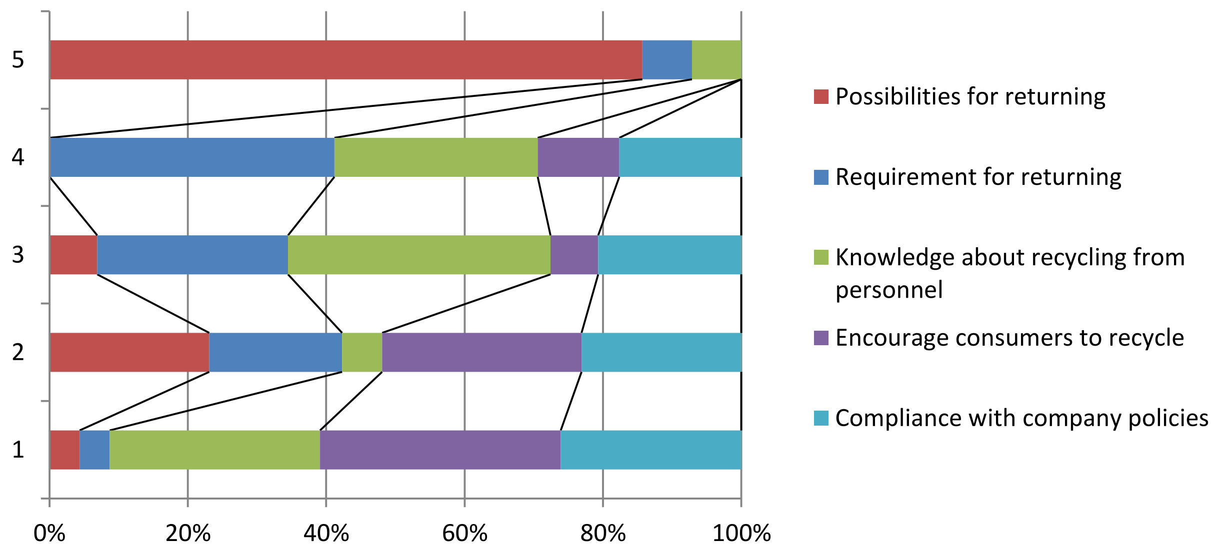


Figure 10 Graph representing the outcome of 27 interviews (1 low - 5 high)

At nearly half of the shops it was possible to hand in an old mobile phone, but only if a new one was bought at the same time. At 44.4% of the shops it was possible to hand in mobile phones, without a limit and without the need of buying a new phone. However at nearly three quarters of the shops these phones still needed to be fully operational, although in some cases they could have some damage and in 40% of the shops the accessories needed to be included.

Possibilities for returning	**Absolute number**	**Percentage %**
Not possible	1	3,7
Return 1, buy 1	12	**44,4**
Return 1+, buy 1	2	7,4
Return 1	0	0,0
Return 1+	12	**44,4**
Requirement for returning		
No damage, fully operational, all accessories	1	3,7
Some damage, fully operational, all accessories	10	**37,0**
Some damage, fully operational, no accessories	8	29,6
Damaged, not fully operational, no accessories	7	25,9
Damaged, not operational, even parts of phone	1	3,7
Knowledge about recycling from personnel		
Knows nothing at all	7	25,9
Knows about collection, but not about recycling	3	11,1
Knows about recycling, but not where	11	**40,7**
Knows about recycling and where	5	18,5
Know about collection, recycling and companies	1	3,7
Encourage consumers to recycle		
No information about recycling options	8	29,6
Some information about recycling options	15	**55,6**
All information about recycling options	2	7,4
Actively encourages to recycle	2	7,4
Actively encourages to recycle without buying phone	0	0
Compliance with company policies		
Completely different	6	22,2
Somewhat different	12	**44,4**
Same, excluding some details	6	22,2
Same	3	11,1
Better	0	0

Table 4 Outcome of 27 interviews with Belgacom, Base and Mobistar

The knowledge about recycling from the personal in these shops was quite low. Only about 20% of the employees knew about the recycling process, where the phones were send to and the importance of recycling. Subsequently 85% of the employees did not actively encourage consumers to recycle.

This leads us to the conclusion that the policies in the mobile shops are different than the company policies. Only about 11% of the shops followed the same policies as the head office intend to and more than 65% had some variation on those policies.

The three operators also differed from each other. Figure 11 shows how Belgacom, Base and Mobistar compare to each other with the average result on each question.

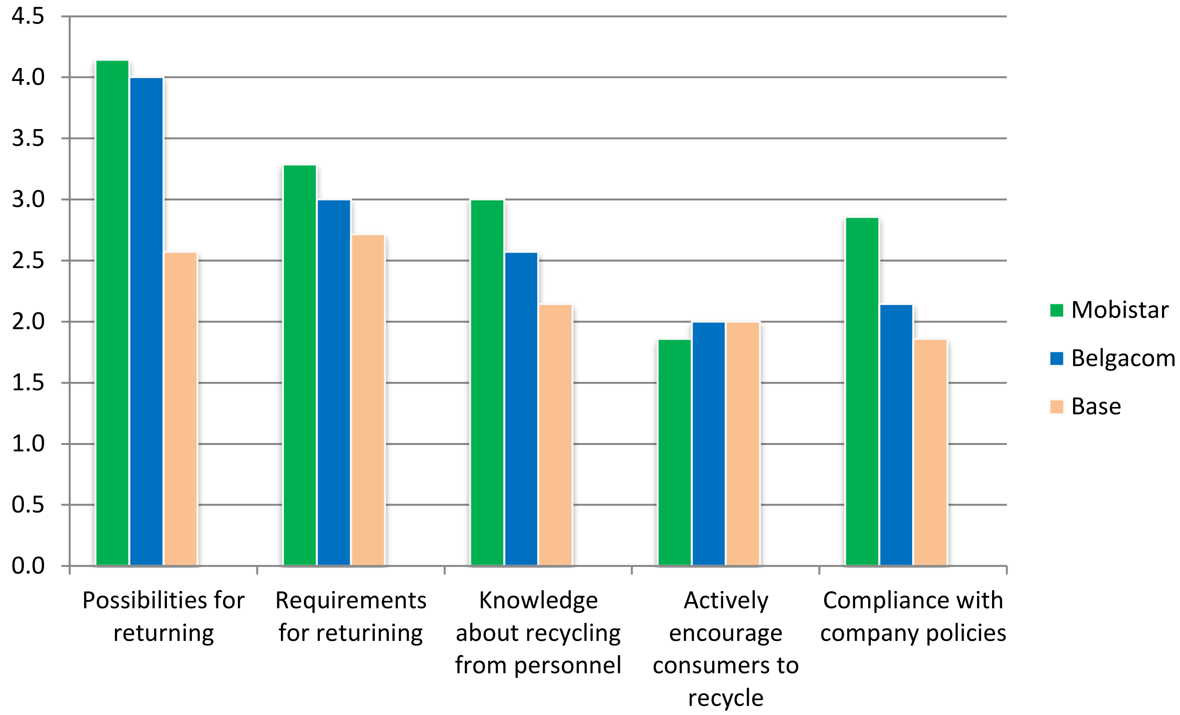


Figure 11 Comparing average results from Belgacom, Base and Mobistar based on 27 interviews

At both Mobistar and Belgacom it was almost always possible to hand 1 mobile phone, without buying a new one. However, it was nearly never possible to hand in more mobile phones, just for recycling. This is in contradiction with their company policies, which state that it is always possible to hand in old mobile phones for recycling at all of their shops. At Base it was obligatory to buy a new phone, if an old one was to be handed in.

There was little difference on the requirements for returning. At nearly all of the shops from all 3 operators the phone still needed to be working, although it could be damaged. Only Mobistar would take non-working mobile phones in some of their shops. Base even went as far as to make it necessary to include accessories like the charger.

On the knowledge part only most personnel at Mobistar knew what happened to the phones they collected and the importance of recycling. Both Belgacom and Base knew little about phone recycling at all.

Contradicting to this is the active encouragement of consumers for recycling their old mobile phone. Here Mobistar scores a little lower, but this is mainly due to the fact that Belgacom and Base offer discounts when an old phone is handed in and a new one is bought. In order to get the discount, the phones need to be fully operational.

For all the 3 operators the policies in most stores differ somewhat from the company policies.

Because of these limitations the collection rate of these 3 operators is rather low. Based on interviews with the head offices of Belgacom, Mobistar Base and the recycling company Erecyclingcorps, 12 to 15% of the phones are returned in Belgium of which, according to Erecyclingcorps, 80% is returned at one of the 3 operators. Although other studies contradict this number and show a lower percentage we will use the data obtained from the interviews with the target group. In the next chapter we will look at where those collected phones go to.

5.2 The sorting & pretreatment system.

An average of 13.5% of the total mobile phones on the Belgium market gets returned for either reselling or recycling. Data from Erecyclingcorps showed that 80% of those 13.5% collected are returned to one of the shops of Belgacom, Mobistar or Base. All three operators have a contract with Erecyclingcorps, which receives 100% of the collected mobile phones by Belgacom, Base and Mobistar. Erecyclingcrops then sorts out the working phones from the non-working and starts the refurbishment process.

The mobile phones which are suitable for reselling are first being checked if they are not 'lost' or stolen and are then being wiped form all personal data and brought to an auction in large batches. The buyer that places the highest offer gets the batch, but only after payment in confirmed. All these mobile phones are being resold in Africa, Asia, South America or Eastern Europe, depending on the phone's compatibility with the network. The resale on these markets can be around 50%-60% of the original price (Fella, 2010). A part of the generated money is then used for paying the consumer their fee for the submitted mobile phone.

Erecyclingcorps only sends 2.5% of the collected phones to Umicore for recycling and auctions 97.5%, of which almost all will end up in a developing country.

Figure 12 shows a schematic representation of the average route for end-of-life mobile phones in Belgium.

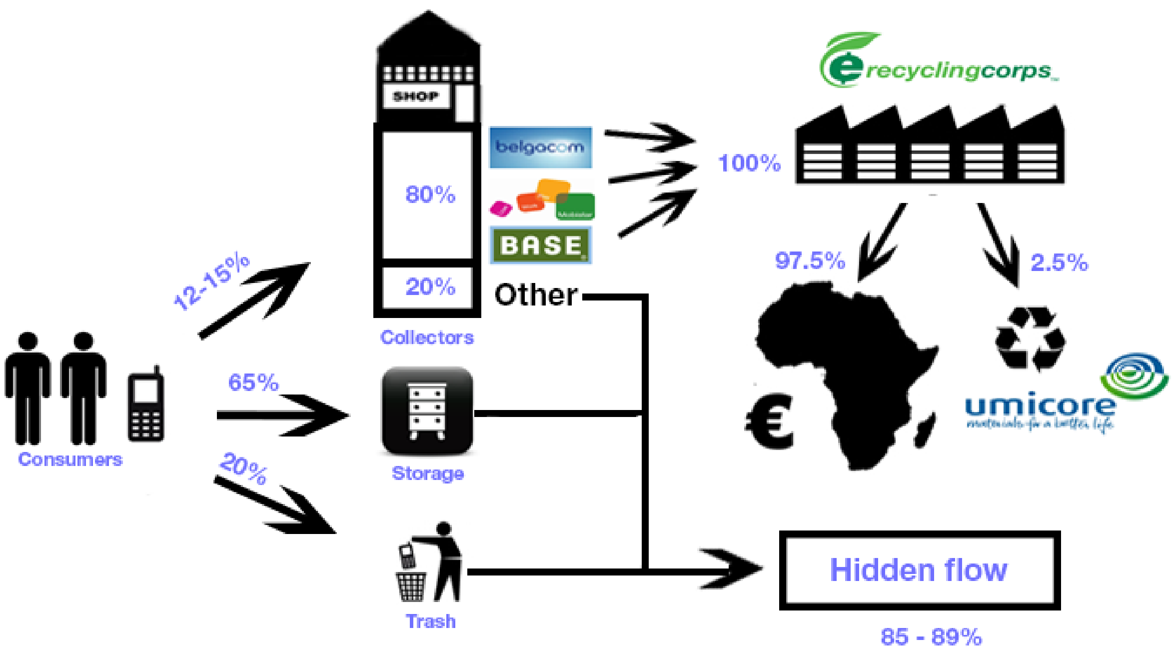


Figure 12 Route of end-of-life mobile phones in Belgium

These numbers are however an estimation of the current situation, based on data from all of these companies, and are subjected to change. With these numbers it was possible to make a calculation of the current effectiveness rate of mobile phone recycling in Belgium, which was done in the next chapter.

5.3 Exploiting the urban gold mine – recycle effectiveness rates

In recycling operations, the effectiveness should be as close as possible to a 100%. Such highly effective recycling requires the cooperation of all actors involved in the process. Starting with high collection rates of mobile phones, the proper storage and transportation of the collected e-waste to avoid damages, and finally the effective treatment processes. In this chapter we calculated the effectiveness rate of both the current collection and recycling system to eventually get the current total combined effective recycle rate of the 3 biggest mobile phone operators in Belgium.

5.3.1 Collection rate

Based on the current collection system we calculated the actual collection rate. We again used figure 8 which is based on a 4.5 million phone sales a year with a life expectancy of 18 months on a 90 months scale, creating a potential of 27 million obsolete phones.

Of these 27 million an average of 13.5% got returned to a collection point. This would result in **3645000** phones being returned.

80% of these phones were being returned at either Belgacom, Mobistar or Base, which is a total of **2916000** phones.

This brings the effective collection rate of the three mobile phone operators to;

$$\varepsilon = \frac{2916000}{27000000} \qquad \varepsilon = 0{,}11$$

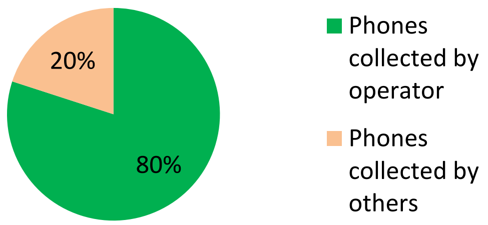


Figure 13 Pie chart of collection by different actors

In other words the current total effective collection rate of these operators in Belgium is only 11%.

5.3.2 Sorting and reselling rate

Of those 2916000 phones that end up at Erecyclingcorps, only 72900 phones are recycled at Umicore, bringing their effective recycling rate to;

$$\varepsilon = \frac{72900}{2916000} \qquad \varepsilon = 0.025$$

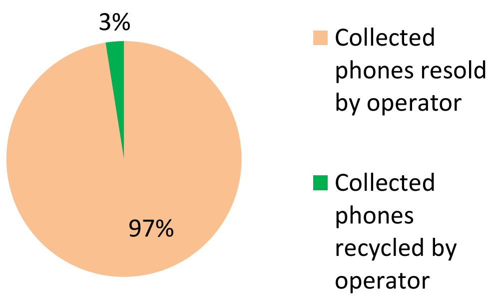


Figure 14 Pie chart of phones resold and recycled

5.3.3 Gold recovery rate

So what does this mean for gold recycling? In total 648 kg of gold would be available after 90 months (see table 5), however not all of this gold can be 100% recycled. For gold recycling out of WEEE, Umicore can reach a 95% recycling rate (Hagelüken, 2006). This would result in 615,6 kg of potential recoverable gold in Belgium every 90 months, based on current sales rates (see figure 8). Bringing their effectiveness to;

$$\varepsilon = \frac{615.6}{648} \quad \varepsilon = 0.95$$

Figure 15 shows the route to which the recycled phones go through and their corresponding effectiveness rate of recycling. Umicore is clearly the strongest actor in the cycle, the only problem is the low supply rate earlier up the chain.

Figure 15 Effectiveness rates of actors in recycle chain

Of those 11% collected phones, only 2.5% gets recycled, meaning that;

$$\varepsilon = \frac{2.5}{100} * \frac{11}{100} = \frac{27.5}{10000} = 0.00275$$

The current total combined effective recycle rate of Mobistar, Belgacom and Base combined is just **0.28%.**

Using the above calculations of recycling rates, table 5 presents the following data on recoverable gold from mobile phones on the Belgium market.

	Amount	Gold total	Gold recoverable	Gold %
Phones recovered by recycling	72900	1,743	1,66	0,3
Phones sold to developing countries	2843100	68,234	64,82268	10,5
Phones collected by other and unknown	24084000	578,016	549,115	89,2
Total	**27000000**	**647,9934**	**615,59768**	**100**

Table 5 Amount of gold over 90 month period

Table 5 indicates that more than 10% of all recoverable gold was exported to developing countries, where it would eventually end up at one of the unregulated dump sites. On top of that it is unknown what happened with almost 90% of the end-of-life phones. Studies however show that a big part of those phones were illegally transported to developing countries (Bisschop, 2012; CREM &

Greenpeace Nederland, 2008; Oost-Vlaanderen, 2009; Salehabadi, 2013; Wang, 2012) where they were recycled by the local communities, causing health hazards and losing valuable resources.

In Belgium we are able to extract 95% of the gold. However advanced technology is needed for this process, technology which developing countries do not possess and therefore are only able to extract 25% of the gold using crude dismantling or backyard recycling processes (GoodPlanet Belgium, 2013). Therefore the recycling efficiency in developing countries is significantly lower. Because most of the e-waste ends up in developing countries the global recycling rate of gold from developed and developing averages on just 10-15%; at least 85% of the gold in electronic products is lost (United Nations University, 2012).

Which brings us to the next chapter: Not in our backyard – the export of end-of-life mobile phones to developing countries. This chapter goes into more detail about the export of end-of-life mobile phones from Belgium to developing countries, gives an insight on the rules and regulations that try to stop these movements and shows some of the loopholes that still exist today.

6

Not in our backyard

The export of end-of-life mobile phones to developing countries

Not in our backyard: the export of end-of-life mobile phones to developing countries

6.1 Introduction

Although the huge potential of recycling old mobile phones in high tech facilities, most collected phones are, legally and illegally, exported to developing, or non-OECD countries. In this chapter we will explain how it is possible that, despite regulations, dumping of end-of-life (W)EEE is still occurring today. We will start with a background study on the current national and international policies regarding the transboundary movement of mobile phones and how they affect Belgium. We will then explain the current surveillance systems in the port of Antwerp, to conclude with the current loopholes in the system that make it possible to export (W)EEE to non-OECD countries.

6.2 International policy on transboundary movement of e-waste

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, usually known simply as the Basel Convention, is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed (OECD) to less developed (non-OECD) countries.

This treaty is a legally binding agreement between the countries that signed and ratified it. The treaty can be loosely compared to a contract; all the countries that signed it have done so willingly and thereby put obligations among themselves. A country that fails to live up to its obligations can be held liable under international law.

Transboundary movement in this treaty means; ''Any movement of hazardous wastes or other wastes from an area under the national jurisdiction of one State to or through an area under the national jurisdiction of another State or to or through an area not under the natural jurisdiction of any State (meaning any land, marine area or airspace within which a State exercises administrative and regulatory responsibility in accordance with international law in regard to the protection of human health or the environment), provided at least two states are involved in the movement.'' (UNEP, 2011) This means that it is prohibited for countries that signed and ratified this treaty to export or move e-waste to or through non-OECD countries.

Belgium is one of the 172 parties to the Convention. Only Afghanistan, Haiti, and the United States have signed the Convention but have not yet ratified it;

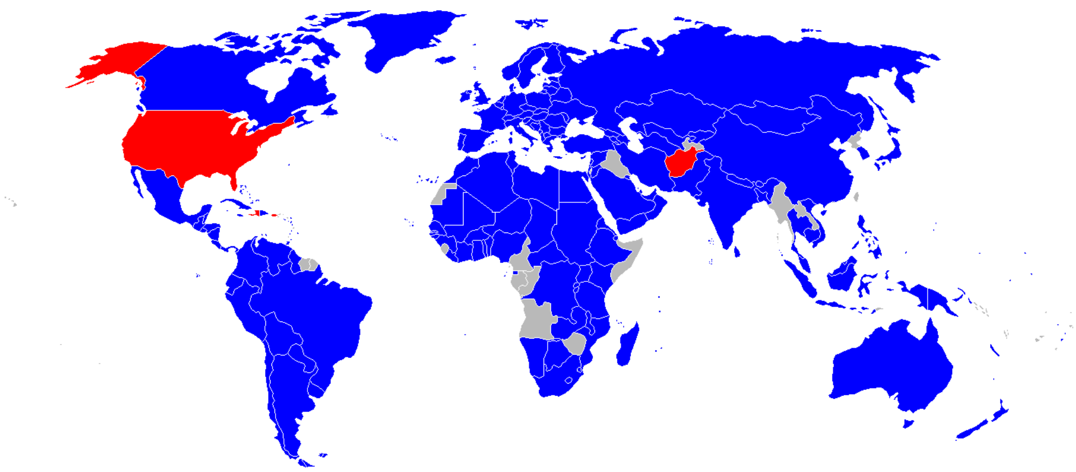


Figure 16 Blank world map, colored as per the signatories and ratification of the Basel Convention

Blue	= Signed and ratified
Red	= Signed, but not ratified
Grey	= Not a signatory

6.2.1 Definition of hazardous waste

For waste to be considered hazardous and to fall under the scope of the Convention it must be listed in Annex I of the Convention and it must exhibit one of the hazardous characteristics contained in Annex III (UNEP, 2011). In other words it must both be listed and possess a characteristic such as being toxic, flammable or corrosive. If certain waste is considered to be hazardous under the laws of either the importing, exporting or transit country then this waste also falls under the scope of the Convention.

Among the wastes defined as hazardous in the Basel Convention are circuit boards containing lead-based solder. These circuit boards are used in almost all mobile phones (INFORM, 2003). In addition to that mobile phones also can also leach toxic substances in the environment. The Toxicity Characteristic Leaching Procedure (TCLP) test is a globally accepted test that determines whether waste possesses the hazardous characteristics of being able to leach harmful substances from soil to groundwater. Waste is widely considered as hazardous if it is able to leach harmful substances into the environment and has indeed been stated in the Basel Convention in Annex III (H13 characteristic) as being one of the defining hazardous characteristics (UNEP, 2011).
The H13 characteristic (leachable at hazardous levels as demonstrated by the University of Florida and Cal EPA tests) qualifies mobile phones, even without the batteries as hazardous waste under the Convention (Basel Action Network, 2004). If we look at Annex VIII of the convention, which is derived from Annex I and III, we find entry number A1180 that clearly includes mobile phones that fail the TCLP test as hazardous. Therefore we can state that mobile phones are considered to be hazardous waste under the scope of the Basel Convention.

6.2.2 Definition of disposal

The definition of disposal of waste is described in Article 2 al 4 and refers to annex IV of the Basel Convention. This annex gives a complete list of actions and operations which fall under the definition of disposal or recovery. The examples of disposal are broad and also include recovery and recycling. This is important because under this definition it is prohibited to export second hand electronic goods with the intention of recycling in non-OECD countries.

This effectively means that the transboundary movement of hazardous waste is illegal under international law for the countries that have signed and ratified the Basel Convention. Mobile phones are considered as hazardous waste under the scope of the Convention, making it illegal to export phones for recycling or recovery to non-OECD countries. Belgium is one of the countries that signed and ratified the Basel Convention, meaning it can only export hazardous waste with a permit which will only be granted where it can be shown that the wastes will be managed in an environmentally sound manner in the country of import. Exporting for re-use is still allowed, however initiatives from OVAM are trying to come up with better rules and regulations regarding the export of mobile phones for re-use.

6.3 Belgium: A code of good practice on the subject of re-use of (W)EEE

Independent of the Basel Convention, Belgium has set up its own set of regulations regarding the export of second hand goods and e-waste to developing countries. It has been written by OVAM; the Flemish Public Waste Organization and is called 'Code van goede praktijk inzake hergebruik van

(A)EEA'. Currently this document has the status of 'guideline', which means that it is not yet legally enforceable. However plans are to turn these guidelines into national law at the next Ministerial review.
OVAM conducted a study with the purpose of creating a list of criteria for different electronic product categories which determines the environmental sustainability of exporting a certain electronic product for re-use.

OVAM states that if a product does not meet the criteria's it should, from an environmental point of view, not be re-used in developing countries. They go even further and state that if a product does not meet all the criteria it should not be put on a market anywhere, or exported as a second hand good. It rather should be considered as e-waste and treated as such.

Used electronic products that do not meet all the criteria, but have the potential of being refurbished (repaired to meet all the criteria) can be prepared for re-use in a recycling center. If this recycling center is located in Belgium than the process is considered a waste treatment process and has to meet certain conditions.

The purpose of the code of good practice is to give exporting companies a set of criteria which should be met to qualify a product as usable second hand. It is also a set of guidelines for organizations that inspect and check on transboundary movement of used e-products to determine if goods should be considered as second hand or e-waste to try to reduce the export of such e-waste disguised as second hand goods to non-OECD countries, which is often the case. It is a tool for inspection officers to make a better distinction between waste and usable products and to enforce conform the law.

The aim of the code of good practice is to;

- Improve the environmental performance of the electronic products that are exported for re-use;
- Prevent the export of e-waste disguised as second hand goods;
- Encourage the reuse of second hand goods that meet the criteria.

6.3.1 The criteria

For mobile phones the following specific criteria have been set up;

Condition of the phone

- The phone is fully functional;
- The phone is electrical safe;
- The casing is complete;
- All essential parts are included;
- Parts are in working order and good shape.

Intention for re-use

- There is a regular market for the phone in the country where it is exported too;
- The phone is sufficiently secured and protected during transport.

Environment-related criteria

- The absence of hazardous substances such as PCBs, PCBs, PBDEs, lead, mercury, cadmium, hexavalent chromium, asbestos.

We then looked at the current surveillance systems in the port of Antwerp to be able to determine if this system complies with all the rules and regulations on national and international level, which we will discuss in the next chapter.

6.4 Inspections in the port of Antwerp

The main 'line of defense' of stopping illegal export of (W)EEE is the surveillance system in the port of Antwerp. This system consists of several different parts, each of which we will discuss in this chapter.

6.4.1 The different actors involved

The Flemish Ministry of Environment has an Environmental Inspection Agency who conducts investigations in the port itself as well as the examination of digital information like permits and data from customs. The department is authorized to check all WEEE coming from within Belgium and going to countries within or outside the European Union. They work together with the Federal Environmental Inspection Agency, who is authorized to also check WEEE coming from outside Belgium. Those two departments carry out about 10 to 15 inspections each year in the Port itself, where they investigate suspicious containers. However they also check the data coming from customs whole year round. This implies checking every export declaration form to screen it for criteria on waste codes to identify suspicious cargoes and noting it down for further inspection. The agency also inspects the records of waste processors upstream to look for irregularities. On the export of WEEE the Flemish agency uses 1.5 Full-time Equivalent (FTE), this includes all the inspection operations.

The agency started the inspection system since the mid-nineties, when the Regulation 259/93/EEC or the European Waste Shipment Regulation (WSR) came into force.

Waste fraud Antwerp

This project is especially aimed at stopping illegal export of waste from the port of Antwerp and to obtain the judicial powers to prosecute waste fraudsters. The project is part of an international security plan and it brings together the most important inspection agencies of the port of Antwerp; the Flemish and Federal Environmental Inspection Agencies, Customs, Waterway Police, Harbourmaster's Office and the Federal Judicial Police.

6.4.2 The criteria for checking cargoes

The first criterion of determining if a specific cargo needs to be inspected is on the basis of the sender and/or the agent of that cargo. The agencies have a list of companies which have committed fraud in the past or regularly export to developing countries and a list of companies which are, according to them, trustworthy. These trustworthy companies automatically get ignored by the system for inspection. If an unknown company or a so called 'dodgy' company wants to export, chances are higher that their cargo gets inspected.

The second criterion is the destination of the cargo. Destinations to non-OECD countries have more chance of being inspected than cargos going to OECD countries.

The criteria for inspection on site self is mainly on how the devices are stacked. Although bad stacking, or just throwing the devices in the container used to happen in the past, nowadays it is rare because exporters know that this is too obvious.

6.4.3 The inspection of electronic products

The current testing is as simple as to test the devices with an extension cord in the port itself. The devices only get checked on the electrical function and some appearance features like severed cables and rusted parts. No other functionality is currently being tested by the inspection agencies.

Despite all these inspections and checking, exporting of WEEE still happens. During this research we found several loopholes which we will discuss in the next chapter.

6.5 Loopholes in the system

Labeling system

The biggest problem for all inspection agencies is the lack of options to distinguish second hand electronic goods from new electronic goods. When exporting goods the agency who is exporting has to declare the goods using the Customs Office's IT system ATLAS, on paper documents, on data carriers or over the internet (Wang, 2012). However in the case of EEE, the goods codes do not distinguish between used and new equipment (Sander, 2010), making it fairly easy to export second hand EEE, or even WEEE outside the EU.

Insufficient legal basis for prosecution

The 'Code van goede praktijk inzake hergebruik van (A)EEA' from OVAM is currently just a guideline, meaning inspection agencies do not possess the legal basis to stop electronic products which would be indicated as waste according to this guideline.

The use of different codes

Because most exporters know that inspection agencies are looking into specific export codes like monitors and mobile phones for investigation, some exporters turn to using other codes, like kitchen equipment or hairdressing equipment. These codes are checked less often for irregularities.

Using the invoice from a trusted company

Exporters sometime buy a small amount of new electronic goods from a trusted company to use that invoice at customs. Customs then thinks that the cargo load comes from a trusted company so they are less likely to do an inspection on the cargo. This also happens with invoices from companies that refurbishes mobile phones, leading customs to think that the whole cargo consist of refurbished phones.

Lack of database for environmentally hazardous substances

Currently there is no database with environmentally hazardous substances that is linked to the customs labeling system.

Loading of old vehicles

Annually about 400.000 old vehicles are being shipped from the port of Antwerp. Officially only working 2nd hand goods are allowed to fill these vehicles with, but due to the sheer amount of vehicles and the impracticality of doing inspections on these loads, this is almost impossible to control.

7

Conclusions

7.0 Conclusions

In this thesis we researched several things. We looked at the different amounts of minerals used in mobile phones and some of the impacts that mining of those minerals causes, showing the importance of recycling and that today's mobile phones are deeply connected with the Earth and its environment. We also looked at what minerals and in what quantity are recoverable from those mobile phone, through which we saw that the so called 'urban mine' is not just an ideal, but a very feasible and profitable business. We then made an estimation of the total obsolete phones in Belgium over a period of 90 months to make an estimation of the total potential recoverable minerals from obsolete mobile phones. Subsequently we determined what route the obsolete phones go through once collected by one of the 3 mayor mobile phone operators in Belgium and looked into the current restrains in that process. This was done in order to come up with improvements for this process to increase effective recycling rates. To conclude we investigated the current rules and regulations that should stop those obsolete phones from being exported to developing countries and encountered several loopholes in this system.

The main conclusion is that Belgium has enormous potential for mobile phone recycling but that recycling rates are however significantly low due to several main causes.

Belgacom, Base and Mobistar only collected 0.28% of all obsolete phones in Belgium. This is 0.3% of the total potential recoverable gold from mobile phones. The main factors for this low collection rate were the high requirement for handing in mobile phones as well as the awareness of both customer and salesmen on the importance of recycling. In only under half of the shops it was possible to hand in more than 1 mobile phone, however in over three quarters of those shops these phones still needed to be operational and sometimes the accessories needed to be included. In nearly 45% of the shops it was only possible to hand in a mobile phone when a new one was bought in that same shop. In some shops (3.7%) it was not possible to hand in any mobile phone at all.
This clearly showed that those shops do not follow their overall policies, which indicate that it should always be possible to hand in a mobile phone. Nearly 90% of the shops maintained different policies. The main reason for this is the low knowledge about recycling from the personnel of these shops. More than a quarter of the employees did not know anything about recycling at all and only 3.7% did know everything about this process and its importance. This of course led to a low encouragement from these employees to their consumers to recycle. Only 7.4% of the employees indicated to actively encourage their customer to recycle.

Of the phones that do get collected by Belgacom, Base and Mobistar 80% was send to the company Erecyclingcorps, which exported 97,5% of those phones to other, often developing, countries. This made Erecyclingcorps the weakest link in the whole process, due to its low recycling effectiveness rate. Evidence was found during this research that this company was selling end-of-life mobile phones and mobile phones parts to any country in the world. This evidence can be found in appendix 10. Most of those phones however got refurbished and resold in developing countries, where the phones will eventually turn obsolete and no adequate recycling methods are forehand. This means that 10.5% of the total potential recoverable gold was being exported and potentially lost.

These numbers are only on the mobile phones that were collected, there was a remarkable percentage of mobile phones that was not collected and which could be illegally exported. Due to the lead content in circuit boards and leaching characteristics as defined in H13 in the Basel Convention, mobile phones are considered to be hazardous waste under the scope of the Basel Convention, making it illegal to export end-of-life mobile phones.

This research could not determine on what scale exporting happened, but only the loopholes through which this was possible. Further research on this matter could give a better understanding of the total amount of phones being illegally exported to non-OECD countries.

The biggest loophole in the system would be the current labeling system, making it impossible for inspection agencies and governments to distinguish new electronic goods from second hand goods, inevitable creating an environment where it is easy for second hand goods to avoid governmental inspections. Because of this, the main criteria of the inspection agency is the company which exports and the destination of that cargo. This essentially means that companies who are trusted can export carefree, with very low chances of being inspected. This also creates an opportunity for illegal exporters, who are known for buying a small stock of trusted companies and using that invoice at customs.
So even if there would different labels for new and second hand goods, this problem would still exist. Illegal exporters would have to use the second hand label, but are still able to use the invoice from a trusted company, effectively avoiding inspections. Illegal exporters are even known for using completely different labeling codes from goods which are known to have a very low interest from inspection agencies, again avoiding inspections.

By increasing the amount of FTE on inspections in the port of Antwerp the illegal export could reduce. But even then the inspectors need to be empowered with more legal basis and more advanced selection systems.
The 'Code van goede praktijk inzake hergebruik van (A)EEA' from OVAM is currently just a guideline. By turning this guideline into law, inspectors would have a much bigger legal basis for inspections and most of the goods which are indicated as second hand under current laws would then be indicated as electronic waste, effectively stopping a huge part of the flow. On top of that advanced databases which indicate environmentally hazardous substances are currently not implemented; making it very difficult for inspectors to stop these hazardous substances, for it is indeed difficult to see if a good contains such substances just by looking at it.

Then there is the possibility of loading old vehicles with second hand electronic goods. With over 400.000 old vehicles leaving the port of Antwerp, it is near to impossible to also check the loads of these vehicles, creating another huge loophole in the system to effectively transport e-waste to non-OECD countries.

Combining the low collection rate of the 3 mayor mobile phone operators, the low recycling rate from the refurbish companies like Erecyclingcorps and the many loopholes by which it is still possible to export non-working mobile phones, creates a huge hidden flow of obsolete mobile phones in Belgium.
A staggering 89.2% of the total potential recoverable gold in mobile phones is in this hidden flow. These mobile phones can be stored, thrown away, exported or collected via another route. This leaves huge potential for collection programs like 'goud:eerlijk?' and other projects which aim to collect obsolete mobile phones and close the recycling loop.

However even with streamlined enforcement (by the exporting countries) the problem of e-waste will persist. After all, there is no local processing in developing countries at the time the second hand mobile phones finally become obsolete. Solutions could include the polluters pay principle where the manufactures need to guarantee and care for the environmental sound way of recycling their own products. In Japan Sony reaches a recycling rate of 53% of their own-branded products. This is also due to the fact that Japan has strong WEEE legislations in force, showing that the combination of government legislation and company practice can achieve higher collection and recycling rates of producer's own-branded products. Initiatives like the mobile phone partnership between different companies also improve recycling for their own products as they try to promote the best recycling options and mobilize political and institutional support of environmentally sound management of their products.

Another solution could be the reverse recycling concept, where OECD countries bring back their own waste which was once exported as second hand goods in order to recycle this waste in modern facilities. Although these developments are still rare to see, reverse recycling does happen.

However the most critical issue around the whole recycling process and the generating of e-waste could be that today's mobile phones are 'designed for the dump'. The economic system is set out to consume exponentially more in ever greater speed, with the mobile phone market being a perfect example of this. The mobile phone market wants consumers to buy more than one phone and replace it as quickly as possible for an infinite chain of ever newer phones. This is done with the help of marketing strategies that constantly market newer phones with technical upgrades making the current mobile phone, which often is not older than 12 months, make look obsolete.

8

Recommendations

8.0 Recommendations

To improve recycling rates and reduce illegal transport of e-waste to non-OECD countries the following recommendations have been formulated.

Collection

- Increase knowledge of personnel in mobile phone shops about recycling and the possibilities for customers to hand in old mobile phones.
- Increase awareness among customers with the help of campaigning. This should be done on governmental level.
- Increase the options for handing in old mobile phones in mobile phone shops. For example; it should be possible to hand in as many mobile phones as desired, no matter the condition of the phones. It should even be possible to hand in (broken) parts of mobile phones.
- Move the selection procedure from 3th parties to the mobile phone shops themselves. This would make it possible for mobile phone shops to send old mobile phones directly to recycling facilities like Umicore, effectively removing the chance of those phones being exported to non-OECD countries. Only mobile phones that are not obsolete and in working condition should be send to 3th parties like Erecylingcorps.

Export

- Implement a labeling system which makes a clear distinguish between second hand electronic goods and new electronic goods.
- Establish a database with risk profiles for different waste-categories, which is linked to the electronic customs declaration system.
- Establish criteria for determining whether there is a market in the country of destination for the goods that are being exported. If there is no feasible market for the exported goods which are labeled as second hand, it should be treated as waste instead.
- Increase monitoring capacity in the port and conduct more inspections upstream in the supply chain.
- Ban the loading of old vehicles with second hand electronic goods.
- Implement tools for better detection of waste shipments by increasing visibility. This should be done with the help of signaling boards, realizing at European level.

Bibliography

Bibliography

Attention A La Terre. (2010, April 26). *Comment revendre et recycler votre vieux gsm.* Retrieved june 04, 2013, from Attention A La Terre: http://attentionalaterre.blogspot.be/2010/04/comment-revendre-recycler-gsm.html

BAN. (2012). *What is the Basel ban?* Retrieved April 10, 2013, from ban.org: http://ban.org/about_basel_ban/what_is_basel_ban.html

Basel Action Network. (2004). *Mobile Toxic Waste: Recent Findings on the Toxicity of End-of-Life Cell Phones.* BAN.

Belgacom. (2011). *Jaarverslag 2011.* Belgacom.

Belgacom Kerncijfers. (2011). *Kerncijfers.*

Belgacom MVO. (2011). *Een koolstofarme maatschappij stimuleren.*

Bisschop, L. (2012). Is it all going to waste? Illegal transports of e-waste in a European trade hub. *Crime, Law and Social Change*, Volume 58, Issue 3 , pp 221-249.

Boliden. (2007). *Sustainability Report.*

Boutet, L. G., & Hagelüken, C. (2009). *Recycling Technology - Environmentally sound metals recovery from e-scrap.* Hoboken: Umicore.

CATAPA. (2013). *Is uw gsm goud waard?* Gent: MO: Mondiaal Nieuws.

Cobbing, M. (2008). Toxic Tech : Not in Our Backyard. Creating a Toxic-Free Future, (February 2008).

Convention, B. (2011). *Strategic Framework 2012-2021 for the implementation of the Basel Convention.*

CREM & Greenpeace Nederland. (2008). *Een analyse van de stromen elektronica-afval in Nederland.* Amsterdam: CREM.

Curtis, A. (2011). *The Review of Literature for Research.* Retrieved april 15, 2013, from www.uncp.edu: http://www.uncp.edu/home/acurtis/Courses/ResourcesForCourses/LitReview.html

Custers, R. (2013). *Grondstoffenjagers .* Gent: Epo.

Deconinck, P. (2013, June 12). Questions to Belgacom about their recycling programme. (D. v. Voort, Interviewer)

Electronics Take Back Coalition. (2012, February 12). *Facts and Figures on E-Waste and Recycling.* Retrieved May 3, 2013, from www.electronicstakeback.com: http://www.electronicstakeback.com/wp-content/uploads/Facts_and_Figures_on_EWaste_and_Recycling.pdf

EMPA. (2009). *Hazardous Technologies*. Retrieved july 2, 2013, from ewasteguide.info: http://ewasteguide.info/node/10

European Commission. (2013, may 7). *Recast of the RoHS Directive*. Retrieved may 7, 2013, from European Commission - Environment: http://ec.europa.eu/environment/waste/rohs_eee/

European Union Journal. (2003). DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. *Official Journal of the European Union*, 19-23.

Fella, B. (2010). *La résurrection du GSM.* Lalibre.

Frey, S., Harrison, D., & Billett, E. (2006). Ecological footprint analysis applied to mobile phones. *Journal of industrial ecology*, 199 -216.

Global e-Sustainability Initiative. (2012). *E -waste contains $21 billion worth gold and silver.*

Global Reporting Initiative. (2011). *G3.1 GUIDELINES*. Retrieved april 18, 2013, from globalreporting.org: https://www.globalreporting.org/reporting/latest-guidelines/g3-1-guidelines/Pages/default.aspx

GoodPlanet Belgium. (2013). *Naar een duurzam consumptiepatroon voor onze gsm en/of smartphone.*

Greenpeace. (2008). Gif voor Ghana. De dump van Nederlands elektronica-afval in Ghana.

GSM Retourplan. (2010). *GSM Retourplan Jaaroverzicht 2010*. Retrieved april 17, 2013, from gsmretourplan.nl: http://www.gsmretourplan.nl/over-ons/jaarverslag

Hagelüken, C. (2006). Recycling of electronic scrap at Umicore's integrated metals smelter and refinery. *Erzmetall*, 152-161.

HealthyStuff.org. (2012). *2012 Mobile Phone Study.* Retrieved june 03, 2013, from Healthy Stuff - Researching toxic chemicals in everyday products: http://www.healthystuff.org/findings.100312.phones.php

Huisman, J. (2007). *Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE).* United Nations University.

IDC. (2007, august 02). *Samsung Beats Motorola for No. 2 Spot as Apple Joins the Handset CLub with Iconic Device.* Retrieved may 01, 2013, from IDC: http://www.idc.com/getdoc.jsp?containerId-pr2007_01_17_133455

INFORM. (2003). *The Basel Convention and Its Mobile Phone Partnership Initiative (MPPI).* New York.

ITU. (2012). *Key Global Telecom Indicators.*

Jang, Y.-C., & Kim, M. (2010). Management of used & end-of-life mobile phones in Korea: A review. *Resources, Conservation and Recycling*, *55*(1), 11–19. doi:10.1016/j.resconrec.2010.07.003

Kvale, S. (1996). *InterViews: An Introduction to Qualitative Research Interviewing.*

Liesse, D. (2012, may 13). *GSM La Deuxième Vie MSG.* Retrieved june 03, 2013, from Preciousmetals.Umicore.com:

http://www.preciousmetals.umicore.com/PMR/Media/localPress/2012/show_20120513_echo_gsm.pdf

MineralsUK. (2012). *Centre for Sustainable Mineral Development.* Retrieved June 07, 2013, from Risk list 2012: http://www.bgs.ac.uk/mineralsuk/statistics/riskList.html

Mobistar. (2012). *Jaarverslag 2012.* Brussels.

Muijs, D. (2004). *Doing Quantitative Research in Education: With SPSS.*

Natuurpunt. (2011, march 2). *Natuurpunt en Belgacom planten een boom in ruil voor je oude gsm*. Retrieved april 18, 2013, from natuurpunt.be: http://www.natuurpunt.be/nl/vereniging/actua/natuurpunt-en-belgacom-planten-een-boom-in-ruil-voor-je-oude-gsm_401.aspx

Oost-Vlaanderen, M. D. (2009, Februari 9). *Antwerp centre of illegal waste transport*. Retrieved April 10, 2013, from ewasteguide.info: http://ewasteguide.info/antwerp-centre-illeg

OVAM. (2012). *Code van goede praktijk inzake hergebruik van (A)EEA.* OVAM.

Peterson, G. D. (2001). Deforestation and forest regeneration following small-scale gold mining in the Amazon: The case of Suriname. *Environmental Conservation 28*, 117-126.

Paiano, A., Lagioia, G., & Cataldo, A. (2013). A critical analysis of the sustainability of mobile phone use. *Resources, Conservation and Recycling*, *73*, 162–171. doi:10.1016/j.resconrec.2013.02.008

Polák, M., & Drápalová, L. (2012). Estimation of end of life mobile phones generation: the case study of the Czech Republic. *Waste management (New York, N.Y.)*, *32*(8), 1583–91. doi:10.1016/j.wasman.2012.03.028

Rossem, C. V., Tojo, N., & Lindhqvist, T. (2006). *Lost In Transposition? A study of the implementation of individual responsibility in the WEEE directive.* Greenpeace, Friends of the Earth and the European Environmental Bureau .

Salehabadi, D. (2013). *Solving the E-Waste Problem (StEP) Green Paper: Transboundary Movements of Discarded Electrical and Electronic Equipment.* Cornell University.

Sander, K. &. (2010). *Optimierung der Steuerung und Kontrolle grenzüberschreitender Stoffströme bei Elektroaltgeräten/Elektroschrott.* Ökopol.

Sibaud, P. (2013). *Short Circuit: The lifecycle of our Electronic Gadgets and the True Cost to Earth.* London: The Gaia Foundation.

U.S. Environmental Protection Agency. (2012, november 14). *Resource Conservation - Common Wastes & Materials.* Retrieved may 3, 2013, from www.epa.gov: http://www.epa.gov/osw/conserve/materials/ecycling/faq.htm

Umicore. (2012). Gsm is echte goudmijn. *Recyclage van oude toestellen booming business*. Roger Huisman.

UNEP. (2010). *Information Note Mobile Phone Partnership Initiative.* Basel Convention.

UNEP. (2011). *Basel Conventionon the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.*

United Nations. (2006, Novmeber 27). *Basel Conference Addressed Electronic Wastes Challange.* Retrieved may 1, 2013, from unep.org: www.unep.org/Documents.Multilingual/Default.asp?DocumentID=485&ArticleID=5431&l=en

United Nations University. (2012). *E-waste: Annual Gold, Silver "Deposits" in New High-Tech Goods Worth $21 Billion+; Less Than 15% Recovered.* Bonn.

Verheage, P. D. (2010). *Jouw GSM is goud waard!* Ghent: Ghent University.

Wang, F. H. (2012). *The Best-of-2-Worlds philosophy: Developing local dismantling and global infrastructure network for sustainable e-waste treatment in emerging economies.*

Widmer, R., Oswald-Krapf, H., Sinha-Khetriwal, D., Schnellmann, M., & Böni, H. (2005). Global perspectives on e-waste. *Environmental Impact Assessment Review*, *25*(5), 436–458. doi:10.1016/j.eiar.2005.04.001

Appendices

Appendix 1 Elements found in mobile phones

Other (largely glass and ceramics)	34%
Precious Metals	0,4%
Zn	1,1%
Sn	1%
Pb	0,6%
Ni	1,5%
Cu	13%
Fe	7%
Organics	41%
	100%

Appendix 2 Recoverable metals of mobile phones calculation

Metal	Amount	Total of 27.000.000 phones	In KG
Copper	9000 mg	243.000.000.000,00	243000 KG
Cobalt	3800 mg	102.600.000.000,00	102600 KG
Silver	250 mg	6.750.000.000,00	6750 KG
Gold	24 mg	648.000.000,00	648 KG
Palladium	9 mg	243.000.000,00	243 KG

	Amount	Gold	Recoverable	Recoverable %
Recycled phones	72900	1,743	1,66	0,3
Sold phones by Erecyclingcorps	2843100	68,234	64,82268	10,5
Phones collected by other and unknown	24084000	578,016	549,115	89,2
Total	**27000000**	**647,9934**	**615,59768**	**100**

Appendix 3 Ranking system mobile phone shops

Ranking

Mobistar	Mo1	Mo2	Mo3	Mo4	Mo5	Mo6	Mo7	Mo8	Mo9	**Total**
Possibilities for returning	5	2	2	5	5	5	5	2	5	**4,1**
Requirements for returining	2	2	3	4	4	4	4	2	2	**3,3**
Knowledge about recycling from personnel	3	2	3	3	3	3	4	3	4	**3,0**
Encourage consumers to recycle	1	1	2	2	2	2	3	2	3	**1,9**
Compliance with company policies	3	1	2	3	3	3	4	2	3	**2,7**

Belgacom	Be1	Be2	Be3	Be4	Be5	Be6	Be7	Be8	Be9	**Total**
Possibilities for returning	2	1	5	5	5	5	5	2	2	**4,0**
Requirements for returining	3	1	4	3	2	4	4	3	3	**3,0**
Knowledge about recycling from personnel	3	1	4	3	1	4	2	3	3	**2,6**
Encourage consumers to recycle	1	1	4	2	2	2	2	1	2	**2,0**
Compliance with company policies	2	1	4	2	2	3	2	2	2	**2,3**

Base	Be1	Ba2	Ba2	Ba4	Ba5	Ba6	Ba7	Ba8	Be9	**Total**
Possibilities for returning	2	5	2	2	2	2	3	2	3	**2,6**
Requirements for returining	3	5	2	2	2	2	3	2	3	**2,7**
Knowledge about recycling from personnel	1	5	4	1	1	1	2	1	3	**2,1**
Encourage consumers to recycle	1	4	2	2	2	2	1	1	2	**2,0**
Compliance with company policies	2	4	2	1	1	1	2	1	2	**1,9**

Appendix 4 Calculation recycle effectiveness rates

Name	Value	Percentage
Phones returned total	3645000	13,5
Phones unknown total	23355000	86,5
Total phones obsolete 90 months	**27000000**	**100%**
Phones collected by operator	2916000	80
Phones collected by others	729000	20
Total phones collected	**3645000**	**100**
Collected phones resold by operator	2843100	97,5
Collected phones recycled by operator	72900	2,5
Total Phones recycled or resold by operator	**2916000**	**100**

Appendix 5 Mobile phones sold

Month	Phones sold	Obsolete phones
1	375000	0
2	750000	0
3	1125000	0
4	1500000	0
5	1875000	0
6	2250000	0
7	2625000	0
8	3000000	0
9	3375000	0
10	3750000	0
11	4125000	0
12	4500000	0
13	4875000	0
14	5250000	0
15	5625000	0
16	6000000	0
17	6375000	0
18	6750000	0
19	7125000	6750000
20	7500000	6750000
21	7875000	6750000
22	8250000	6750000
23	8625000	6750000
24	9000000	6750000
25	9375000	6750000

26	9750000	6750000
27	10125000	6750000
28	10500000	6750000
29	10875000	6750000
30	11250000	6750000
31	11625000	6750000
32	12000000	6750000
33	12375000	6750000
34	12750000	6750000
35	13125000	6750000
36	13500000	6750000
37	13875000	13500000
38	14250000	13500000
39	14625000	13500000
40	15000000	13500000
41	15375000	13500000
42	15750000	13500000
43	16125000	13500000
44	16500000	13500000
45	16875000	13500000
46	17250000	13500000
47	17625000	13500000
48	18000000	13500000
49	18375000	13500000
50	18750000	13500000
51	19125000	13500000
52	19500000	13500000
53	19875000	13500000
54	20250000	13500000
55	20625000	20250000
56	21000000	20250000
57	21375000	20250000
58	21750000	20250000
59	22125000	20250000
60	22500000	20250000
61	22875000	20250000
62	23250000	20250000
63	23625000	20250000
64	24000000	20250000
65	24375000	20250000
66	24750000	20250000
67	25125000	20250000
68	25500000	20250000
69	25875000	20250000
70	26250000	20250000
71	26625000	20250000
72	27000000	20250000
73	27375000	27000000

74	27750000	27000000
75	28125000	27000000
76	28500000	27000000
77	28875000	27000000
78	29250000	27000000
79	29625000	27000000
80	30000000	27000000
81	30375000	27000000
82	30750000	27000000
83	31125000	27000000
84	31500000	27000000
85	31875000	27000000
86	32250000	27000000
87	32625000	27000000
88	33000000	27000000
89	33375000	27000000
90	33750000	27000000

Appendix 6 Estimated global WEEE arising in 2010 and 2016 from mobile phones

Units sold in 2006	Typical weight (kg)	Typical life (years)	Estimated weight sold in 2006 (Metric Tons)	Estimated WEEE arising in 2010 (Metric Tons)	Estimated WEEE arising in 2016 (Metric Tons)
1 billion	0.113	2 (+22%)	113,000	168.189	**554,571**

Appendix 7 Interview Erecyclingcorps

Introduction

I am currently conducting a research for my University on recycling businesses in Belgium and I'm mainly focused on mobile phone collection *(as mobile phones are the most sold electronic devices on the planet today, but have the lowest collection rate).* I choose your company because I believe you are an innovative and leading company in the recycle business. Your policy and commitment to improve recycling really appeal to me.
I'm conducting this research as part of my studies and will only be used by Larenstein University

1. When did ErecyclingCorps started and in what countries are you currently operating?

2. When did ErecyclingCorps took over Zone Impact? And in what way did that change the policies of Zone Impact? *(e.g. were original policies from zone impact completely taken over by erecyclingcorps?)*

3. In the newspapers I read that Zone Impact/ErecyclingCorps collects as much as **80%** of all mobile devices in Belgium. Would you say that this statement is true, and do you see yourself as the **biggest mobile device collector in Belgium**?

4. I am mainly interested in the mobile phone operators in Belgium from which you collect old mobile devices, like Mobistar, Base, and Belgacom. Are there also other Belgium (phone) companies from which you collect old mobile devices?

5. (if in Belgium) Are you registered at OVAM (Openbare Vlaamse Afvalstoffenmaatschappij) as a waste collecting company?

General/numbers

1. Could you explain to me the process of the collection, pre-selection, refurbishment and reselling process of your company?

2. Where *(in what country and at which company)* do does the **pre-selection** take place?
3. Where *(in what country and at which company)* do you **refurbish** the collected phones?
4. Where *(in what country and at which company)* do the mobile phones get **recycled**?

5. Do you collect the phones directly from the mobile phone operators? *(Base Mobistar, Belgacom)* How does this process work?

6. Could you give me an indication of the **amount of phones** you collect **annually** in Belgium? And possibly the **individual collection rate** for each mobile phone operator *(Base Mobistar, Belgacom)*?

7. Could you tell me, or give me an **approximate number** of how much phones are being **refurbished** and resold and how much phones are being **recycled**?

Criteria/testing

1. Are the phones you export **fully operational**? And if so, what criteria do you use to determine if a phone is fully operational or not? *(phone response test, testing of microphone and speaker; sound quality, no distortion, input sound=output sound. Testing of display and keypad; every button needs to be working and display must be readable)*

2. Are all the **essential parts**, that are needed for the device to be fully operational included? *(charger, connections, switches and buttons)*

3. Are the **batteries included**? And if so, what criteria do you use to determine of the battery is still useful? *(battery needs to charge, needs to reach a charge of 80% minimal, **battery protection unit** needs to be functioning)*
4. Are the exported phones **electrical safe**? *(e.g. tested on electrical safety conform 3.2.2)* If so, could you explain to me what sort of testing you do?

5. Do the exported phones have **complete casings**?

6. Are all the parts in **good shape**? *(E.g. working, no water damage etc.)*

7. Do the phones have a lot of **cosmetic damage**? Are there criteria for the amount of cosmetic damage?

Refurbishment
If phones do not meet these criteria they can be refurbished. Refurbishing has to meet the following criteria;

Checking, cleaning or fixing products or components that are essentially e-waste to prepare them for reuse without the need of any further refurbishment so that they are ready for direct reselling.

1. What **kind of replacement-parts** do you use for refurbishing damaged parts? *(e.g. original parts or 3th party parts)*

2. Do you **wipe** the phones from all personal **data**? And if so, what kind of **software** do you use?

3. Do you give a **guarantee** on the resold mobile phones?

4. What kind of information is put on refurbished phones? (Does each phone that is selected for reuse and reselling get a unique **identification code** and **reuse-check/marker**? And if so, what kind of information can be found on these markers?) *(Name of device and category, identification number f device, production year, doxs of company that has checked the device, results of tests including date)*

5. Are the **steps** that have taken place in pre-selection and refurbishment **documented** for each phone? (electrical or on paper)

Exporting
1. To **what countries** do you **export** the mobile devices? And could you tell me a little more about this process *(e.g. do you have regular partners in those countries, are phones being auctioned, labeling system containers etc.)*

2. Who *(what companies, brokers, resellers, organizations)* **buys** the mobile devices from ErecyclingCorps?

3. Does ErecyclingCorps export the mobile devices themself? And if so, in what way and **route**? *(E.g. ship, plane etc.)* If not, who does the export?

4. What **criteria** do you use to **determine** in what country a **regular market** for **obsolete phones** still exists? *(if there is no market anymore for really old phones, they will end up at dump sites)*

5. How do you **package** the phones for **transport**? In bulk, or packed separate? *(this determines whether it is seen as waste or second hand goods, transport must be such so that phones will not damage)*

6. Zone Impact also exported BER (beyond economical repair) phones, damaged mainboards, LCD's, used spare parts and used batteries. Does ErecyclingCorps continue to sell and export these products and parts?

7. Zone Impact only dealt with **large volume buyers**. Does ErecyclingCorps work in the same way?

Appendix 8 Interview Flemish Department of Environment

Introductie

1. Wat zijn de hoofdactiviteiten van de Milieu inspectie, gericht op de Antwerpse haven?
2. Kunt u mij iets meer vertellen over het project 'Afvalfraude Antwerpen'?
3. Sinds wanneer worden deze controles uitgevoerd?
4. Hoeveel mensen zijn er bij de Vlaamse milieu-inspectie effectief bezig met deze controles?.

Controle criteriums

1. Hoe onderscheiden jullie elektronisch afval van tweedehands elektronische goederen? Immers deze grens is niet altijd duidelijk en hier zijn nog geen wettelijke regels voor. Passen jullie de Code van goede praktijk inzake hergebruik van (A)EEA van OVAM toe?

   Gebeurt dit in de container zelf?
2. Op basis van welke criteria selecteren jullie de te controleren containers?
3. Op basis van welke criteria selecteren jullie de traders en opslagplaatsen voor de stroomopwaarts controles?
4. Hoe maken jullie het verschil tussen een eenmalig incident of toevallige vergissing en grootschalige fraude?

   Dus dit zijn wel goede ontwikkelingen volgens u?
5. Waar letten jullie op bij het transport van tweedehands elektronische goederen m.b.t. de bescherming van de apparaten tijdens het transport?
6. Testen jullie de elektronische apparaten daadwerkelijk op hun functionaliteit? Zo ja; wat zijn de criteria?

Afvalstromen

1. Naar welke landen gaan de grootste elektronische afval stromen? En zit er nog verschil in de typen producten die naar verschillende landen gaan?
2. Controleren jullie ook of er voor de geëxporteerde goederen een reguliere markt bestaat in het land van bestemming? M.a.w. mag een lading zeer verouderde telefoons nog steeds onder de noemer tweedehands goederen geëxporteerd worden?.
3. Kunt u mij iets meer vertellen over de kennisgevingsprocedure voor export naar niet-OESO landen en het uitvoerverbod op landen waarop het OESO-besluit niet van toepassing is? In het bijzonder hoe dit in de praktijk toegepast wordt.

Aangiftesystemen van Haven

1. Studies hebben aangetoond dat er geen verschil zit in de labelings-code voor nieuwe elektronische producten en tweedehands elektronische producten bij het douane-aangiftesysteem. Dit maakt het onderscheiden en identificeren van containers waar mogelijk illegaal afval in zit nog moeilijker. Hoe kijken jullie hier tegenaan?

2. Welke zogenaamde ‘achterpoortjes’ bestaan er nog meer om afval the vermommen als tweedehands goederen?

3. Bestaan er al risicoprofielen voor gevoelige afvalstromen die het elektronisch douane-aangiftesysteem meteen kan aanmerken als risicovol?

4. Bestaat er een database van milieu gevaarlijke stoffen zoals PCB’s, PBB’s, PBDE’s, lood, kwik, cadmium etc die gebruikt worden in verschillende elektronische apparaten? Immers, visueel is het zo goed als onmogelijk vast te stellen of een elektronisch product gevaarlijke stoffen bevat.

Toekomst

1. Hoe kijkt u aan tegen het feit dat op het ogenblik dat het tweedehands apparaat definitief afgeschreven wordt in een ontwikkelingsland waarna het geëxporteerd is, er nog steeds geen adequate verwerkingscapaciteit is? Ziet u een toekomst in reverse recycling (het terughalen van geëxporteerde tweedehands goederen) of het “polluter pays”-principe?

2. Welke beleidsaanbevelingen en maatregelen zouden kunnen helpen om dit probleem tegen te gaan?

Zone impact specifiek

3. Kennen jullie het bedrijf Zone Impact / ErecyclingCorps? (iets vertellen hierover)

4. Is dit bedrijf al eens naar boven gekomen tijdens controles?

5. Dit bedrijf geeft aan BER (Beyond Economical Repair) telefoons, beschadigde printplaten, gebruikte onderdelen en batterijen te exporten, enkel in grote volumes. (eventueel advertentie laten zien). Hoe kijken jullie hier tegenaan?

Appendix 9 Interviews Belgacom, Base and Mobistar

Geachte Heer,

Zoals reeds eerder telefonisch afgesproken hier de mail met mijn vragen.

Ik doe op dit moment een studie over recyclage van Belgische telecom bedrijven voor de Hogeschool Van Hall Larenstein in Nederland. De rede van het onderzoek is om te kijken welke recyclage mogelijkheden er op dit moment zijn voor telecom bedrijven, om in de toekomst het recycleren te bevorderen. Belgacom doet veel aan maatschappelijk verantwoord ondernemen en heeft een uitgebreid recyclage programma, vandaar de interesse in Belgacom.

Voor mijn onderzoek zou ik graag het volgende weten;

Cijfers

- In 2011 heeft Belgacom 40.328 telefoons ingezameld bij hun verkooppunten, heeft u ook het aantal van 2012?
- Hoeveel mobiele telefoons zijn er door Belgacom verkocht in 2009, 2010, 2011 en 2012? (eventueel verkoopcijfer rapporten, indien mogelijk)
- Hoeveel procent van de ingezamelde mobiele telefoons wordt gerycleerd en hoeveel procent wordt doorverkocht/hergebruikt?

Beleid

- Wat is jullie beleid m.b.t. het inleveren van mobiele telefoons in de Belgacom centers? Hier heb ik tegenstrijdige informatie over gekregen in de centers zelf, soms zegt men dat het inleveren van oude mobiele telefoons voor recyclage helemaal niet mogelijk is, andere verkopers vertelde mij dat inleveren enkel mogelijk is indien een nieuwe telefoon wordt aangeschaft en enkele verkopers zeiden dat het inleveren voor recylage geen enkel probleem was en dat men, ook zonder een nieuwe telefoon te kopen, zo veel mogelijk oude telefoons kon inleveren bij de Belgacom centers. Wat is jullie officiele beleid omtrent het inleveren van oude mobiele telefoons in Belgacom centers? (voor zowel voor het verkrijgen van korting als het enkel inleveren voor recyclage zonder verdere voordelen voor de klant)
- Hebben jullie buiten de ‘Plant een boom in ruil voor je oude gsm’ campagnes in 2010 en 2011 nog andere campagnes gehad om het recycleren van oude mobiele telefoons te stimuleren?
- Doen jullie buiten deze campagnes nog dingen om recyclage te bevorderen? (bijvoorbeeld het informeren van personeel en klanten over de voordelen van recyclage)

Recyclage

Volgens het schema van Belgacom in het MVO rapport van 2011 gaan de ingezamelde gsm’s van het Belgacom center naar het sorteercentrum waar beslist wordt of de gsm’s worden gerycleerd of worden hergebruikt. Hierover heb ik de volgende vragen;

- Is dit soorteercentrum intern van Belgacom, of is dit uitbesteed aan een extern bedrijf? En zo ja, welk bedrijf?
- Welk bedrijf zorgt voor de recyclage van de gsm’s?
- Welk bedrijf zorgt voor de herconditionering en verkoop van de nog bruikebare gsm’s?

- Waar worden de hergeconditioneerde gsms verkocht en naar welke landen worden deze het meeste gexporteerd?

Mobistar:

Cijfers

* In 2012 heeft Mobistar 34.925 mobiele telefoons ingezameld. Hoeveel mobiele telefoons zijn er in 2012 verkocht door Mobistar?
* Hoeveel mobiele telefoons zijn er door Mobistar verkocht in de voorgaande jaren 2009, 2010, 2011? En hoeveel telefoons zijn toen ingezameld? (eventueel verkoopcijfer rapporten, indien mogelijk)
* Hoeveel procent van de ingezamelde mobiele telefoons wordt gerecycleerd en hoeveel procent wordt doorverkocht/hergebruikt?

Beleid

* Wat is jullie beleid m.b.t. het inleveren van mobiele telefoons in de Mobistar centers? Hier heb ik tegenstrijdige informatie over gekregen in de winkels zelf, soms zegt men dat het inleveren van oude mobiele telefoons voor recyclage helemaal niet mogelijk is, andere verkopers vertelde mij dat inleveren enkel mogelijk is indien een nieuwe telefoon wordt aangeschaft en enkele verkopers zeiden dat het inleveren voor recyclage geen enkel probleem was en dat men, ook zonder een nieuwe telefoon te kopen, zo veel mogelijk oude telefoons kon inleveren bij de Mobistar centers. Wat is jullie officiële beleid omtrent het inleveren van oude mobiele telefoons in Mobistar centers? (voor zowel voor het verkrijgen van korting als het enkel inleveren voor recyclage zonder verdere voordelen voor de klant)
* Stimuleert Mobistar recyclage door bijvoorbeeld het informeren van personeel en klanten over de voordelen van recyclage? Navraag in verschillende winkels leerde dat veel personeel niet wist wat er met de ingezamelde telefoons gebeurde.

Recyclage

Volgens het Mobistar jaarverslag van 2012 gaan de ingezamelde gsm's van de winkels naar een sorteercentrum waar beslist wordt of de gsm's worden gerecycleerd of worden hergebruikt. Hierover heb ik de volgende vragen;

* Is dit sorteercentrum intern van Mobistar, of is dit uitbesteed aan een extern bedrijf? En zo ja, welk bedrijf?
* Welk bedrijf zorgt voor de recyclage van de gsm's?
* Welk bedrijf zorgt voor de herconditionering en verkoop van de nog bruikbare gsm's?
* Waar worden de hergeconditioneerde gsms verkocht en naar welke landen worden deze het meeste geëxporteerd?

Base

Cijfers

- Hoeveel mobiele telefoons (aantal) zijn er in 2012 verkocht door Base en hoeveel zijn er ingezameld?

- Hoeveel mobiele telefoons (aantal) zijn er door Base verkocht in de voorgaande jaren 2009, 2010, 2011? En hoeveel telefoons zijn toen ingezameld? (eventueel verkoopcijfer rapporten, indien mogelijk)
- Hoeveel procent van de ingezamelde mobiele telefoons wordt gerecycleerd en hoeveel procent wordt doorverkocht/hergebruikt?

Beleid

- Wat is jullie beleid m.b.t. het inleveren van mobiele telefoons in de Base winkels? Hier heb ik tegenstrijdige informatie over gekregen in de winkels zelf, soms zegt men dat het inleveren van oude mobiele telefoons voor recyclage helemaal niet mogelijk is, andere verkopers vertelde mij dat inleveren enkel mogelijk is indien een nieuwe telefoon wordt aangeschaft en enkele verkopers zeiden dat het inleveren voor recyclage geen enkel probleem was en dat men, ook zonder een nieuwe telefoon te kopen, zo veel mogelijk oude telefoons kon inleveren bij de Base winkels. Wat is jullie officiële beleid omtrent het inleveren van oude mobiele telefoons in Base winkels en verkooppunten? (voor zowel voor het verkrijgen van korting als het enkel inleveren voor recyclage zonder verdere voordelen voor de klant)
- Stimuleert Base recyclage door bijvoorbeeld het informeren van personeel en klanten over de voordelen van recyclage? Navraag in verschillende winkels leerde dat veel personeel niet wist wat er met de ingezamelde telefoons gebeurde.

Recyclage
Volgens het Base/KPN jaarverslag van 2012 gaan de ingezamelde gsm's van de winkels naar een sorteercentrum waar beslist wordt of de gsm's worden gerecycleerd of worden hergebruikt. Hierover heb ik de volgende vragen;

- Is dit sorteercentrum intern van Base/KPN, of is dit uitbesteed aan een extern bedrijf? En zo ja, welk bedrijf?
- Welk bedrijf zorgt voor de recyclage van de gsm's?
- Welk bedrijf zorgt voor de herconditionering en verkoop van de nog bruikbare gsm's?
- Waar worden de hergeconditioneerde gsms verkocht en naar welke landen worden deze het meeste geëxporteerd?

Appendix 10 Advertisement Zone Impact / Erecyclingcorps

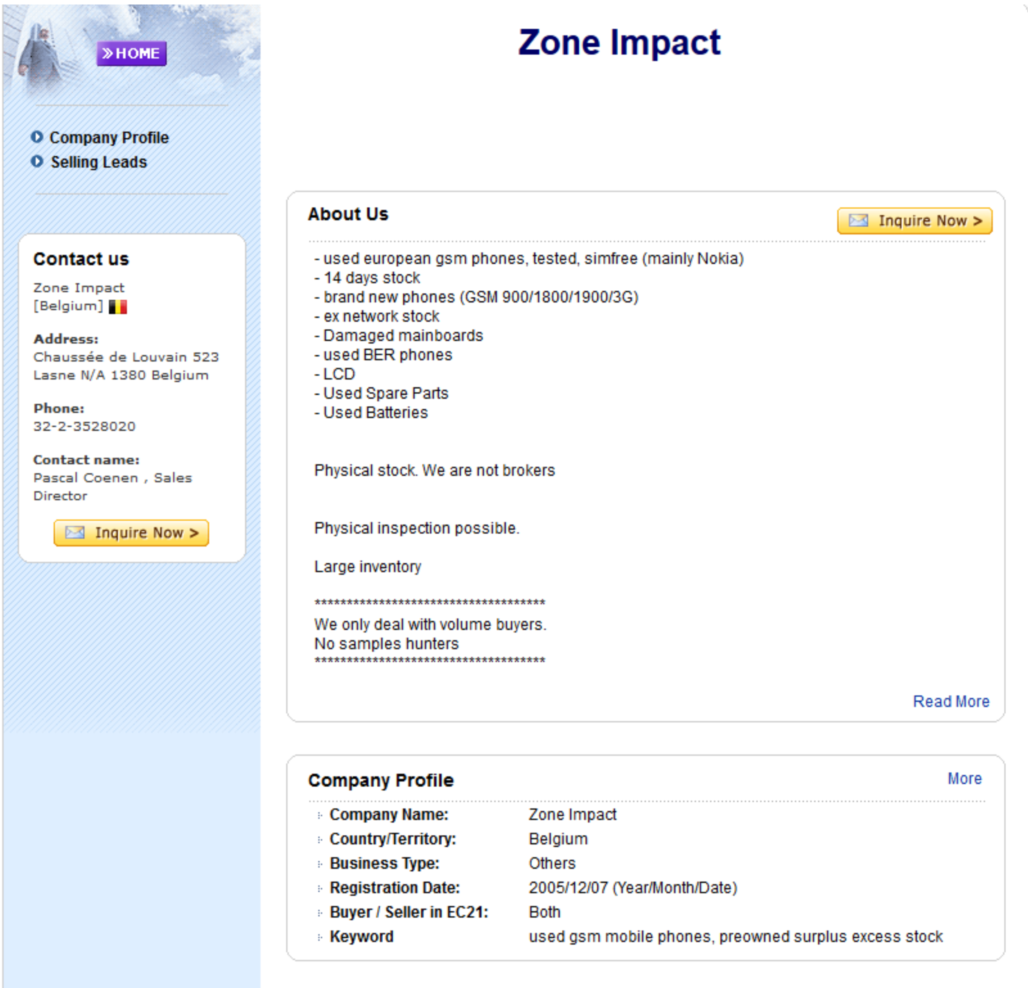


Figure 17 Advertisement from Zone Impact on ec21.com

Description:

The used European mobile phones are stated to be working. The reselling of working second hand mobile phones currently have no restrictions other than the technical restrictions of the phone itself due to the network restrictions outside Europe.

The 14 day stock phones are mobile phones that have been returned to the shops by costumers under the 14 day money back guarantee. The phone could be returned for the following reasons; the phone had the wrong color, the features were not as expected, wrong model etc. The phones cannot be damaged and come as new, with the original box and accessories.
Brand new phones is self-explanatory, these can be collected in various ways.

Ex-network stock are unused phones which are collected when the network operator has too much units of a specific type of phone and cannot sell them anymore because the phone is obsolete due to new models. Companies like Zone Impact can then buy these obsolete stocks for reselling in other countries, where these phones are still wanted.

Damaged mainboards is the part of the mobile phones that contains almost all the gold and other valuable metals. It is considered waste because the main boards are damaged and it is not a fully operational second hand product. It is therefore illegal to export this waste to non-OECD countries under the Basel convention.

Used BER phones, meaning ‘beyond economic repair phones’

Appendix 11 Background on policies

European Policies

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) is the European Community directive 2002/96/EC on WEEE which, together with the RoHS Directive 2002/95/EC **,** became European Law with their publication in the Official Journal of the European Union on 13 February 2003 (European Union Journal, 2003). The objective of this policy is to specify the applicable products affected by this directive and to detail the policy and procedures for the return and safe disposal of WEEE to preserve, protect and improve the quality of the environment, with a minimum rate of 4 kilograms per head of population per annum recovered recycling. The RoHS Directive set restrictions for European electronic goods producers for the materials used in new produced electronic equipment. The EU WEEE Directive 2002/96/EC requires that producers of electronic equipment be responsible for the collection, reuse, recycling and treatment of WEEE which the producer places on the EU market after August 13, 2005. This is known under a policy known as Extended Producer Responsibility (EPR). EPR is seen as a useful policy as it internalizes the end-of-life costs and provided a competitive incentive for companies to design equipment with fewer costs and liabilities when it reached its end of life (Rossem, Tojo, & Lindhqvist, 2006)

Figure 18 European WEEE logo

Any product marked with the WEEE logo should be separated from other waste streams to ensure that it can be recycled in an environmentally sound manner

WEEE Directive

The WEE directive is very similar to the RoHS Directive, but it differs in that the WEEE is no ‘single market directive’. This means that each Member State of the European Union must follow some minimum standards of the European directive but has the right to interpret the guidelines and develop own custom laws for each particular Member State. These laws often do not fully comply with the WEEE guidelines. For example; none of the member countries has implement article 4, which should stimulate producers to a more sustainable design of their products, also known as ecodesign. (CREM & Greenpeace Nederland, 2008)

RoHS Directive

The aim of the Restrictions of Hazardous Substances Directive is to increase the amount of e-waste that is appropriately treated and to reduce the volume that goes to disposal or is being exported to developing countries. Due to the increasing amounts of e-waste being generated in the EU in recent years and the environmental and health risks that come with it, the European Commission therefore proposed to revise the RoHS policy in December 2008 to make the policy more effective. The aim of this recast was to reduce administrative burdens and ensure coherency with newer policies and legislation covering, for example, chemicals and the new legislative framework for the marketing of products in the European Union. The RoHS Recast Directive was published in the official Journal on 1 July 2011 (European Commission, 2013). The new RoHS Directive 2011/65/EU (RoHS 2) entered into force on 21 July 2011 and required Member States to transpose the provisions into their respective national laws by 2 January 2013.