

E-WASTE CHALLENGES IN DEVELOPING COUNTRIES: SOUTH AFRICA CASE STUDY

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This discussion paper, commissioned by the APC, aims to raise the profile of e-waste issues in developing countries so that the implications of information and communications technology (ICTs) for development initiatives can be better understood – particularly in the context of the increasing flow of old technology from developed to developing countries.

South Africa is thought to be at the forefront of waste management in Africa, and practitioners aim to develop an e-waste model in the country that can serve as a blueprint for an

approach to e-waste elsewhere on the continent. While the overall waste management strategies in the country are highly regarded by experts, this document suggests that South Africa faces a number of key challenges in dealing with e-waste and that its 'e-waste readiness' is mixed rather than certain.

Three APC members contributed to this document, and offered e-waste perspectives from the United Kingdom and the Asia-Pacific region. Summaries of these contributions are included in the appendices.

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1. SOUTH AFRICA: SUMMARY OF FAULTLINES AND ACTION POINTS

E-WASTE FAULTLINES	
Absence of legislation dealing specifically with e-waste	This is true for most countries in Africa. Some disagreement about whether or not this is necessary, or whether sectors can self-regulate.
Most e-waste in storage	Current recycling capacity could not absorb e-waste supply if this was released into waste stream .
Differences of opinion on extent of problem of disposing e-waste on (non-hazardous) landfills	Some feel this is safe. However, others disagree in practice and policy.
Some recycling operations result in storage of hazardous waste because of cost of disposal	Cost-effective disposal facilities currently not available.
Cost of disposal may upset financial model of current recyclers	The financial sustainability of some e-waste recyclers has not yet been proven under current conditions.
All major e-waste recyclers are based in Gauteng	Unless more recycling operations are established, this may impact on the viability of recycling elsewhere in the country.
Some importing of e-waste. Potential for this to escalate	Particularly from African countries which may not have the technology for recycling.
Some exporting of 'raw' e-waste	Is South Africa 'dumping' in Asia? Considered a lost opportunity for local economic empowerment.
Many ICT multinationals have shown little interest in e-waste in South Africa	Waste practitioners have battled to get them on board.
Potential threat of small-scale electro-chemical processes being introduced	Scenarios similar to those found in India or China are feared.
A lack of general awareness of e-waste amongst public	e-What?

POTENTIAL ACTION POINTS FOR CIVIL SOCIETY	
Raising awareness in NGO sector	The sector needs to better understand the implications of e-waste, and where it can take old technology for refurbishment or recycling.
Representation of NGO sector in e-waste Working Group	There is currently little representation of the NGO sector in the e-waste Working Group, resulting in a communication gap and a potential misalignment of e-waste initiatives. In particular, the sector's knowledge about the pros and cons of refurbished PCs could be invaluable.
Develop collection and recycling capacity	There is potential for NGOs to develop collection capacity servicing homes, small businesses, and the sector itself. There may also be potential for recycling capacity to be developed, perhaps in partnership with those with the technical know-how. Both these may provide an opportunity for socio-economic development.
Lobby through consumer or other campaigns for ICT vendors to take e-waste seriously	

2. INTRODUCTION

A recent assessment conducted by the Pretoria-based Basel Convention Regional Centre (BCRC)¹ suggested that, with the exception of South Africa, electronic waste (e-waste) was given little or no priority in the countries surveyed.² Instead, the problems with waste management were far more basic, and included a lack of awareness of hazardous waste, and inadequate legislation, controls and facilities to deal with waste.

While there have been improvements in waste legislation in the region over the past few years (Ecroignard, 2005. Int), emphasizing the poten-

tial hazards of e-waste in many instances remains premature:

It's difficult because in most countries in the region basic waste removal is a problem; basic decent landfill is a problem. Very few countries have landfills. Mostly they are dumps. So the problem is much bigger. We would like to go in and say 'be careful of hazardous waste'; but they first have to sort out their waste to begin with, before they can go to the levels of looking at different kinds of wastes, such as plastics or e-waste. (ibid.)

Within this context, South Africa poses a unique opportunity. Its level of economic development means that it is likely to be amongst the first countries in Africa to encounter e-waste as a serious concern. It therefore offers a learning opportunity, and the potential for developing best practices that could be applicable elsewhere on the continent.

This discussion document presents a case overview of the 'e-waste readiness' in South Africa. It is not intended to be comprehensive, but

1 Although the centre is one of four in Africa, in this document it is referred to throughout as the BCRC. The Basel Convention includes Iran as one of its African centres – making five centres in Africa. However, Iran has been excluded for the purposes of this document.

2 The BCRC oversees the implementation of the convention in 22 countries in Africa. For a list, see the Appendix. 18 countries were analysed in the 2001 assessment (Carl Bro, 2001).

rather to provide a litmus test of where the country is, and potential challenges it faces. It also broadly suggests possible civil society interventions.

3. METHODOLOGY

This document has been developed through a literature review, interviews with stakeholders,³ and two site visits: Universal Recycling Company in Johannesburg, and Enviroserv's Holfontein hazardous waste disposal facility in Springs, Gauteng province. Informants are referenced in the form (name, date. Int).

4. DEFINITIONS

E-waste (electronic waste): The standard definition of e-waste includes all end-of-life electronic products, components and peripherals, such as computers, cell phones, fax machines, photocopiers, radios and TVs. In this document it refers to all disposed electronic products, *whether new or end-of-life*, as well as decommissioned electronic products held in storage.

Hazardous materials: E-waste contains a number of hazardous or toxic substances in various quantities, such as lead, mercury, arsenic, chromium and cadmium. In particular, Cathode Ray Tubes (CRTs) and nickel-cadmium batteries are posing problems for recyclers in South Africa:

CRTs: CRTs are found in monitors and TVs. They contain lead, phosphorous, cadmium, barium and mercury. Can be compared to the more environmentally friendly Liquid Crystal Display (LCD) screens.

Nickel-cadmium batteries: These are rechargeable batteries typically used for portable electronic devices. Found in some personal computers (PCs), particularly older ones.

Dump: For the purposes of this document, an unregistered landfill is described as a dump. A dump is an area allocated for the public to dispose of unwanted waste. In South Africa a number of old landfills are unregistered. Although they are serviced by the city council or private companies, waste disposed at these sites is often not closely monitored. Dumps are also

not prepared in the way that registered landfills are. (van Rensburg, 2005. Int)

Registered landfill: Landfill that has been prepared (for instance, with protective layers to prevent leaching and the contamination of underground water). The water and soil is tested from time to time for contamination. (van Rensburg, 2005. Int)

Hazardous waste landfill: A specially prepared landfill where hazardous waste can be disposed safely. Access to the landfill is restricted. Methods of disposal include encapsulation (burying waste in concrete). Hazardous waste landfills are expensive to run, with a high onus on the operator to ensure the hazardous materials are contained (even after the landfill is closed). As a result, in South Africa the public pays to have their hazardous waste disposed at the these landfills.

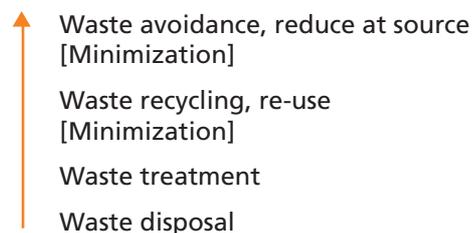
Ferrous versus non-ferrous metals: Ferrous metals contain iron. Non-ferrous metals do not. Examples of non-ferrous metals contained in e-waste include aluminium and copper.

Technology: Used in this document loosely to refer to a wide range of electronic products.

5. BASIC CONCEPTS

5.1. General principle of good waste management

A hierarchy of best practices for waste minimization is shown below:



Source: Holfontein site visit, 2005

There is an upward 'push' in the hierarchy, with the preference being that waste avoidance and recycling or re-use are maximized (so that downstream waste can be minimized).⁴

³ See appendices for list of informants. Interviews were conducted face-to-face, telephonically and by e-mail.

⁴ Similarly, the key principles governing hazardous waste disposal are: polluter pays, duty of care, avoidance and minimization and best practical environmental option (Holfontein site visit, 2005).

5.2. E-waste drivers

The level of e-waste found in the waste stream is dependent on a number of inter-related factors.⁵ In South Africa, these include:

Historical and current economic conditions

Both past and current economic conditions need to be considered when estimating potential e-waste levels. Historical economic conditions determine the level of potential e-waste (e.g. the level of old PCs or mobile phones in circulation). Current economic conditions impact on the readiness with which an owner will dispose of the old technology. If a country's currency is strong, imported technology will be cheaper, and old technology will be more readily replaced.

The life cycle or useful life of technology

While the life cycle of technology is generally taken to be longer in Africa than in industrialized nations (people hold onto their technology for longer), the strengthening of the rand means that this is changing. For some recyclers, cheaper technology is expected to impact dramatically on the levels of e-waste, and a rapid escalation of e-waste volumes is predicted in the near future (van Rensburg, 2005. Int).

The level of refurbishment of old technology

Refurbishment can increase the useful life of technology, and delays the entry of old technology into the waste stream.

The extent to which technology is stored, rather than disposed

The storage, rather than the disposal or re-use of old technology, is a crucial factor shaping the e-waste landscape in South Africa. Reasons for storage include difficulties in writing assets off from registers, fears relating to data security, a lack of awareness of where to dispose

old technology, and psychological factors, such as the belief that old technology has some value.

The balance between the importing of new or second-hand technology, and the export of waste products

The potential levels of e-waste in South Africa are affected by importing new and refurbished or second-hand technology into the country. There are also indications that some e-waste is imported into South Africa from other African countries for recycling. (Lombard, 2004). South Africa also *exports* a substantial amount of recycled electronic waste in a refined or raw form. Export destinations include Europe and Asia.

6. BACKGROUND STATISTICS

Recent reports from the International Telecommunication Union (ITU) suggests that Africa is the world's fastest growing market for cell phones. Mobile subscribers on the continent now stand at 51.8-million, a staggering 1000% increase since 1998. Projected growth of the number of subscribers puts it anywhere between 100- and 200-million by the year 2010. (ITU, 2004)

While research puts the number of TVs in Africa at 62-million and radios at 200-million, estimates on the number of PCs range from 1.5- to 7.5-million – or anything between 1 per 500 people and 1 per 100 people (Jensen, 2003).

Evidence of higher-than-anticipated imports of old technology into Africa is surfacing. According to the Basel Action Network, as many as 400-thousand secondhand PCs are imported through Lagos in Nigeria each month (Warwick, 2005).

1.2 to 1.5-million computers enter the South African market each year (Lombard, 2004). Cell phone users in the country are projected to be 19-million by 2006 (www.cellular.co.za).

⁵ Most of these can be applied to other African countries. However, some countries may not, for instance, export recycled e-waste or import refurbished PCs.

7. POLICY AND LEGISLATIVE STATUS

7.1. International conventions

South Africa has effectively ratified⁶ the Basel Convention. The convention seeks to restrict the movement of hazardous waste between countries and specifically from developed to

developing countries. It is also concerned with waste minimization and the environmentally sound management of waste.

7.2. Legislation

There is no specific legislation that deals with e-waste in South Africa (Lombard, 2004). However, various legislation can be read to impact on e-waste. These are summarized in the table below:⁷

LEGISLATION	SUMMARY
Constitution	Deals with basic environmental rights (including access to information). Sets out the allocation of powers for different levels of government. While provinces set the standards of environmental control within a national framework, local authorities are expected to administer the legislation, supplementing it with by-laws where necessary.
The National Environmental Management Act (Act 107 of 1998) (NEMA)	Amongst other things, NEMA lays out principles for waste management. These include avoidance or minimization, and the "remediation of pollution" (Lombard, 2004). Waste reduction, re-use, recycling and proper disposal, as well as the 'polluter pays' and 'cradle to grave' principles are emphasized.
The Municipal Services Act (Act 32 of 2000)	Includes principles for effective local governance.
The Occupational Health and Safety Act (Act 85 of 1993)	Deals with health and safety in the workplace.
The Environment Conservation Act (ECA)	Deals with the protection and controlled utilization of the environment. The ECA makes provision for an Environmental Impact Assessment (EIA) which is needed for any waste disposal activities. An amendment delegates the administration of waste disposal to the Department of Environmental Affairs and Tourism (DEAT). The permitting of waste disposal sites is guided by a series of documents dealing with minimum requirements.

⁶ The official word is "accession", which carries the same legal weight as ratification. South Africa has also effectively ratified the Rotterdam Convention, which monitors and controls the trade of certain hazardous chemicals (www.pic.int) and has ratified the Stockholm Convention, which deals with persistent organic pollutants (POPs). However, unlike countries like Tanzania, Nigeria and Mauritius, South Africa has not yet ratified the Basel Convention's Ban Amendment. The amendment prohibits *any* export of hazardous waste from developed countries to developing countries. (www.baselpretoria.org.za)

⁷ For a more detailed summary, please see Lombard, 2004.

LEGISLATION	SUMMARY
The White Paper on Integrated Pollution and Waste Management	Deals with the allocation of environment and waste management functions and powers. Has also included the development of the National Waste Management Strategy, which is a Danish-funded joint venture between the DEAT and the Department of Water Affairs and Forestry. The emphasis is on "holistic waste and pollution management" (Lombard, 2004). Recycling is one of the short-term priority areas identified.
The Health Act	Promotes healthy living and working conditions. Relevant to the potential health risk implications of e-waste.
The Hazardous Substances Act	Regulates the management of hazardous substances and hazardous waste.

Source: Lombard, 2004.

According to Lombard, the legislative scenario has not changed since 2004. However, due to awareness-raising activities, the DEAT now considers e-waste a priority waste stream. (Lombard, 2005. Int).

8. E-WASTE ESTIMATES

About 70% of the country's e-waste is thought to be in storage – most of this held by the government. This percentage represents about 10-20 thousand tons of e-waste, which is expected to double in 10 years time to 30-40 thousand tons. (Lombard, 2005. Int)

The high level of storage in government departments is attributed to difficulties in writing off technology from asset registers (ibid.). Other reasons include a lack of public awareness of what to do with old technology, and a general absence of processes that facilitate its easy collection and disposal. Psychological factors, such as the belief that old technology has a latent value, and issues such as fear of data theft also contribute to the storage of disused technology.

9. RECYCLING CAPACITY

The current capacity of e-waste recyclers is not considered high enough to absorb the potential e-waste quantities should decommissioned technology that is being stored be released into the waste stream (ibid.).

There are only three main recyclers who accept

e-waste: Universal Recycling Company, Desco Electronic Recyclers, and African Sky. All of them are based in Gauteng.⁸ While Desco has a branch in Cape Town (which processes about 100 tons of e-waste a year), there are, according to Lombard, no other notable recycling operations that can accept e-waste anywhere else in the country.⁹

Desco processes about 400 tons of PC boards, and 2000 tons of varied electronic waste per year, including telecommunications equipment, PCs, and medical and radio equipment (Lombard, 2004). Universal Recycling processes 1800 tons a year, representing only 2% of its entire waste stream processed (Lombard, 2004; van Rensburg, 2005. Int).

At the same time, there is a high level of interdependence between the recyclers. The majority of Universal Recycling's e-waste comes from Desco (van Rensburg, 2005. Int). Reclam, which is said to be the largest recycling organisation in South Africa, accepts e-waste itself, but passes it on to Universal Recycling. Similarly, smaller operations, which say they accept e-waste, typically pass these on to one of the larger recyclers (Lombard, 2004).

⁸ Gauteng is one of nine provinces in South Africa. It is where Johannesburg is situated, and is the economic hub of the country. About 7-million of the country's 42-million people live in the province.

⁹ Similarly, Enviroserv's hazardous waste landfill at Holfontein 'imports' hazardous waste from other provinces.

10. RECYCLING PROCESSES

The recycling processes amongst the current operators are not uniform, and depend on proprietary knowledge or systems developed.¹⁰ In the case of Universal Recycling, the processes are highly mechanized and can deal with ferrous and non-ferrous metals. Desco, which was established in 1992, uses machinery it designed and built to process PC boards (Lombard, 2004). However, unlike Universal Recycling, Desco relies heavily on hand-sorting and dismantling – and even removes some parts for resale (Lombard, 2004. van Rensburg, 2005. Int). According to Lombard, African Sky, based in Benoni, does some elementary dismantling of e-waste received. Plastic and metal components are recycled locally, while electronic components are exported to Asia (www.e-strategy.co.za).

The processes at Universal Recycling – which has reportedly impressed international inspection teams, including Swiss inspectors and German visitors from Hewlett Packard (HP) – has not been specifically modified for e-waste extraction.

Instead, it tests the stockpiled fraction which it cannot sell for toxicity every 4-6 months, before it is sent to a registered landfill site. According to van Rensburg, introducing electronic products into its recycling processes has not yet impacted on the hazardous levels of the fraction: “So far it’s been fine for registered landfill sites, because it’s so diluted.” (van Rensburg, 2005. Int). Water and air (released from an air plant) is also regularly tested.

The recycling process at Universal Recycling includes a sophisticated combination of conveyor belts, shredding, pulverizing, rotary magnets, extractors, granulation, shears and balers. It does not melt down any of its waste. (Site visit, Lombard, 2004)

We don’t do anything by hand. It goes through a shredder, then over a heavy-media plant. Through a water separation process light fraction, like plastic and glass floats, and the heavy stuff sinks. It goes through various heavy-media plants, then goes through an eddy current. Then we slowly separate the different metals. (van Rensburg. Int. 2005)

Universal Recycling deals with ‘dirty metals’, or mixed loads, because it is too time consuming to sort by hand. The water used at the plant is recycled, which is not necessarily cheap: “It costs us millions of rands to recycle water. But in the long term we’re recycling water we’d buy from council. We don’t release any water into the system.” (ibid.)

A key concern for Lombard – and one which he says has raised the level of attention the government has given e-waste – is the potential threat of backyard electrochemical processes being set up, similar to India and China. Electrochemical processes allow for precious metals to be easily extracted. However, if the process is unregulated, dangerous toxic chemicals which are casually disposed can become a health hazard.

Although electrochemical processes are currently being used in South Africa, they are under highly regulated conditions. One recycler has, however, expressed an interest in using the process, posing the threat that the knowledge can be easily passed on (Lombard, 2005. Int).

11. KINDS OF E-WASTE RECEIVED BY RECYCLERS

Although Universal Recycling makes no specific provision for e-waste (it is simply included in its non-ferrous recycling processes), it says it can cope with any kinds of electronic equipment. The e-waste it does receive includes cell phones (which are only slowly getting into the e-waste stream), PCs, photocopies and telephonic equipment. It has also received the occasional TV, but not in bulk. (van Rensburg, 2005. Int) This is similar to Desco, which receives amongst other things, PCs, telecommunications equipment, mainframes, and medical and radio equipment (Lombard, 2004).

Universal Recycling prefers the nickel-cadmium batteries to be removed from waste it receives, but this doesn’t always happen. Printer cartridges are donated to charity for recycling (Site visit; van Rensburg, 2005. Int).

Some vendors, such as IBM, put out tenders for recyclers to dispose of unwanted technology. According to Universal Recycling – which has in the past been awarded an IBM contract – some of the technology it disposed of was new: “If there’s a tender from IBM or HP we’ll tender for it. A lot of people prefer us because we don’t dismantle or take parts off for resale. They don’t

¹⁰ During my site visit to Universal Recycling, it was preferred that I didn’t take photographs.

want it to be resold. They want it scrapped. We had IBM's contract for a while. Some of it was new, but they wanted it out. Some was still in boxes." (van Rensburg, 2005. Int)

Universal Recycling pays about 43c/kg for a mixed load of e-waste. (ibid.)

12. RECYCLED MATERIAL

Universal Recycling makes its money by reselling the 'cleaned' material it recycles. This includes aluminium, copper wire, zinc, ferrous metals and PC boards, if the boards can be extracted. It can only take the refining process to a certain level – after which the product is sold locally, exported, stockpiled or sent to a registered landfill.

The table below gives an indication of the percentages of some of these products found in a PC:

Plastic	23%
Ferrous metals (e.g. outer casing)	32%
Glass	15%
Non-ferrous metals (e.g. zinc, copper, lead, aluminium)	18%
PC boards (includes precious metals like gold, palladium, silver and platinum)	Small amounts

Source: van Rensburg, 2005. Int

A certain volume of cleaned materials are sent to local refineries so that precious metals can be extracted. Rand Refinery, the major refinery in Gauteng, says it processes "hundreds of tons" of material from e-waste recyclers each year. It says its main suppliers are Desco and Universal Recycling (Lombard, 2004).

While there are fewer and fewer precious metals in new technology products, Lombard says old technology, such as XT computers, can contain as much as 4 grams of gold – richer than the richest ore bodies by mass (Lombard, 2005. Int).

13. THE BALANCE BETWEEN IMPORT AND EXPORT

Current estimates suggest that a third of all PC hardware sold in South Africa is second-hand (Lombard, 2005. Int). However, it is unclear how much of this is imported. Computer Aid International, which exports refurbished PCs to Africa, suggests that there is a 'return-for-recycle' model possible for international refurbishers:

Our research showed that for large volume projects to ship computers to refurbishers in Africa it made sense to build in reverse logistics for disposal of waste, like a container to Belgium or Germany when necessary - particularly for monitors which contain particularly hazardous waste. (Sinanan, 2005. Int)

There are also indications that some e-waste is imported into South Africa from other African countries for recycling (Lombard, 2005. Int). According to Universal Recycling, because of the low level of waste disposal technology or know-how in many other African states, this is likely to increase in the future (van Rensburg, 2005. Int).

Perhaps surprisingly, South Africa exports a substantial amount of recycled e-waste in a refined or raw form, with Asia and Europe being prime destinations. Universal Recycling says as much of 80% of cleaned material is exported. Although its recycling process is relatively sophisticated, it is not able to extract or separate some materials. Shredded plastics that may still include some metals, such as copper, are sent to China, where hand-sorting allows for a finer extraction of re-usable materials. PC boards, when they are extracted, are sent to Rotterdam. (ibid.)

African Sky – an initiative which musician Johnny Clegg is involved in – exports e-waste to Citiraya in Singapore, after some elementary recycling (Lombard, 2005 Int). Citiraya is considered one of the world's biggest processors of corporate e-waste, and deals with multinationals such as Intel, Nokia and HP (www.e-strategy.co.za). However, some waste practitioners feel that the recycling process at African Sky is too elementary, and that much of the value to be had from the process is lost by exporting e-waste in a raw form.

14. LANDFILL

There is some disagreement about the potential health threat or negative environmental impact e-waste dumped on landfills might pose. Although accurate figures have not been made widely available, one landfill in Gauteng reports that 2.2 tons of e-waste are disposed at its site each month.¹¹ (Lombard, 2004)

According to Lombard, unrefined e-waste dumped on landfills does not pose much of a health risk. He says registered landfills are reasonably protected to prevent leaching. At the same time, informal salvaging from landfill sites is either restricted or closely monitored.

However, this seems to contradict the attention a hazardous waste site like Holfontein gives to nickel-cadmium batteries – if it receives them, they must be in a properly sealed drum, and are encapsulated (buried in concrete) (Site visit, 2005). Similarly, van Rensburg points out that simply crushing CRT tubes is a potential problem, and that municipal dumps could be particularly vulnerable: “Most people don’t know what they dump. They don’t check what you’ve got on the back of your truck. They put it in a hole, and drive over it with a big compactor. That is more dangerous than anything” (van Rensburg, 2005. Int)

All stockpiled fraction that is sent to landfills (such as plastic or glass, but excluding nickel-cadmium batteries, which are simply stockpiled) is regularly tested for toxicity levels at Universal Recycling. Although toxic substances such as arsenic and mercury are contained in e-waste, no special provision is made for these. “We were a bit worried about the end product – if we were contaminating our waste [by accepting e-waste]. Then we started testing. So far the toxicity has been at acceptable levels.” CRT tubes are also crushed in the recycling process, but there has been no evidence of adverse toxicity. (van Rensburg, 2005. Int)

15. STORAGE AND DISPOSAL OF HAZARDOUS MATERIALS

Nickel-cadmium batteries, CRTs and plastics used in electronic products all pose major challenges for recyclers in South Africa – potentially

¹¹ This can be compared to the 16-tons of medical waste produced in the entire province each month by one of the country’s main testing laboratories (Lancet, 2005. informal discussion).

highlighting a major gap in the country’s current capacity to handle e-waste.

Although Universal Recycling prefers that nickel-cadmium batteries are removed from e-waste it receives, this does not always happen:

We don’t pull out the nickel-cadmium battery. It goes through the shredder. We’ve got big drums of those batteries, so we do in the end separate them. We hold the drums. We’re hoping that someone will recycle them one day. We don’t know how to recycle them. If we can’t find anything else they will have to go to Holfontein. (ibid.)

A key challenge it faces is that it may only dispose of the batteries at a hazardous waste site, which will cost it money.

Of equal concern is what happens to the batteries that are removed from e-waste it receives: “When they are removed, we don’t know where they go” (van Rensburg, 2005. Int). This concern is supported by the Holfontein site visit, which says it “does not receive a lot” of e-waste (Site visit, 2005).

In 2004 Desco had 25 tons of CRTs stockpiled (Lombard, 2004). The problem is further exacerbated by the fact that although refurbishment can extend the useful life of a PC, monitors are not easily refurbished, and are one of the most likely components to simply be swapped out (Open Research, 2004). This, together with the relatively low cost of new monitors, means that with refurbishment, a monitor to PC ratio of roughly 2:1 is likely to enter the e-waste stream.

Flame-retardant plastics from electronic goods are also a challenge. Universal Recycling says it can find no local market to accept stockpiled fraction. Some of the plastic fraction is used for lunging rings for horses. The rest is sent to landfills.¹² (van Rensburg, 2005. Int)

¹² This can be compared to Computer Aid International’s experience in the United Kingdom, where the re-use of recycled materials appears to be higher: “We recycle everything we get. Our recyclers may landfill small amounts of plastics or glass but this is rare and only when there is no re-use for the material. One of the challenges is finding a use for everything - a lot of plastics ends up in road building - still technically landfill if you’re worried about chemicals leaching into the environment.” (Sinanan, 2005. Int)

According to van Rensburg, if the cost of disposal means that it becomes financially unsustainable to continue receiving e-waste, it will no longer accept electronic products for recycling. The same applies if the toxicity levels rise in stockpiled fraction destined for landfill: "If something slips through, then we have to look at a whole different model. It's not viable if we have to dump our waste in Holfontein landfill."¹³ (van Rensburg, 2005. Int).

16. CURRENT E-WASTE ACTIVITIES IN SOUTH AFRICA

16.1. Projects and initiatives

The BCRC is tasked with influencing role-players across 22 countries in Africa (including businesses, NGOs, governments and industry bodies).¹⁴ It is one of four set up in Africa. Others centres have been established in Egypt and Senegal. A co-ordinating centre has been set up in Nigeria. (www.baselpretoria.org.za)

The role of these centres is to "promote capacity building in Hazardous waste management through mainly training and technology transfer activities." (ibid.)

An African Institute for Environmentally Sound Management of Hazardous and Other Wastes is currently being set up. This is the result of a joint agreement between 13 African countries, including South Africa.¹⁵ The institute, which will be a separate legal entity, will then host the BCRC. (ibid.) According to Ecoignard, BCRC is currently looking for funds to implement an e-waste programme so that the issue of e-waste can be highlighted regionally. (Ecoignard, 2005. Int)

13 Again, the economic model is different in the United Kingdom: "We rarely pay cash to get rid of waste but it does take up a lot of our time. We make money back on monitors and from Metallo Chimique for metals reclaimed." (Sinanan, 2005. Int)

14 The countries are Botswana, Ethiopia, Gambia, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Nigeria, Seychelles, South Africa, Rwanda, Tanzania, Uganda, Ghana, Eritrea, Sierra Leone, Liberia, Swaziland, Zambia and Zimbabwe (www.baselpretoria.org.za).

15 Others are Ghana, Kenya, Mozambique, Nigeria, Rwanda, Swaziland, Tanzania, Gambia, Namibia, Botswana, Uganda and Zambia.

In South Africa, an e-waste Working Group, which consists of multi-stakeholder players, has also been set up. Waste experts, hazardous waste recyclers, the government (DEAT and Department of Trade and Industry), IT distributors as well as the BCRC are all represented in the Working Group. However, Ecoignard says the Working Group has had difficulty operating effectively because of a shortage of funds. Despite this, its activities – and those of its participants – have raised the profile of e-waste significantly. (Lombard, 2005. Int).

South Africa also has an Environmental Enforcement Unit (or 'Green Scorpions') which is engaged in regulating and monitoring waste sites. It has closed down sites in the past, and its activities include training magistrates about environmental issues and legislation. (Ecoignard, 2005. Int)

For the NGO sector, the issue of e-waste is relatively new. Most NGOs active in the area of ICTs have discussed the issue, but in the main little is known about the actual status and implications of e-waste on the ground in South Africa and the rest of Africa.

By implication, NGOs that have been refurbishing PCs for educational or other developmental purposes have been taking part in the recycling continuum. Some grassroots recycling projects, such as the Gauteng Zero Waste Communities Forum, do not currently have the capacity to give serious attention to e-waste. (O'Hagan, 2005. Int)

16.2. Legislation or self-regulation?

According to Ecoignard, the core aim of the BCRC is to develop legislation that is based on the Swiss recycling model. This is seen to be practical, straightforward, and easy to follow, and closest to what the Basel Convention wants. The task of the Working Group is to suggest legislation that is "workable" and "not too difficult to follow".¹⁶ (Ecoignard, 2005. Int)

Switzerland (as well as other OECD countries), has developed a recycling system that consists of a "high rate of recycling in an environmentally sound manner" (EMPA & seco, 2004). These recycling processes, which are certified and monitored, are financed by an Advanced Recycling Fee (ARF) on new electronic products.

16 She suggests that in contrast, legislation in, for example, California, is complicated.

Consumers return end-of-life products to retail outlets or collection points, which are then delivered to the recyclers. (EMPA & seco, 2004)

The BCRC says that while an ARF in South Africa could be useful, one of the main challenges is developing capacity for the collection and delivery of e-waste to recyclers, with 'ease of use' being the emphasis. "A fee would help, but because recycling is viable for recyclers at the moment, it might not be necessary. Setting up a system where it's easy to take-back old technology is more important. Big recyclers are unwilling to go out and pick up only two machines". (Ecroignard, 2005. Int)

The BCRC's current emphasis is South Africa, where it hopes to show that the e-waste challenge can be dealt with in a practical way. This will then be used as a model for other African countries.

For some, legislation is not necessarily seen as the best way forward. What is preferred is an industry solution to an industry problem, with self-regulation being the key. The refurbishment of PCs for development purposes is one of the potential industry solutions being emphasized.

However, a key challenge in South Africa is getting the ICT industry on board and involved in the current processes ("tentative links" are described as being forged (ibid.)). Both Axiz, a distributor of computers and peripherals, and Mustek, a supplier of IT products, are said to be enthusiastic. HP, which is already recycling through its i-Community refurbishment project in Mokopane, Limpopo province, is also interested. However, according to the Working Group, many other ICT vendors are showing a distinct disinterest.

Cell phone companies in particular are proving problematic. A key irony is that many of the multi-national vendors operating in South Africa have already implemented take-back systems in Europe. Similarly, the UN and Basel Convention are attempting to develop a Mobile Phone Partnership, which deals with the environmentally sound management of used and end-of-life phones. According to Ecroignard, some mobile phone multinationals, who are represented locally, are involved in the initiative. "They're not bringing what they do over there here. In our experience, they are reluctant. There's concern across the board that they need to comply with EU legislation, but not in South Africa." (ibid.)

HP, which has participated in the Working Group through its i-Community programme, produces some e-waste at its refurbishment programme in Mokopane. While only about 200 PCs have been refurbished through the programme, scrap metal is given to local scrap metal dealers, and it has spoken to Desco about taking its discarded CPU boards. However, it currently doesn't have sufficient volume of these stockpiled. Monitors are posing a problem. Although there are operations overseas which can recycle them, it's currently not financially viable for HP to export what it has. (Rose, 2005. Int)

It is expected that HP's international e-waste practices – which are described as seeking an 'holistic' solution to e-waste – will be implemented locally, regardless of legislation. However, no ARF surcharge is currently envisaged locally. As Rose points out, take-back systems are already effectively in place for its major clients in government and big business. Old machines are swapped out for new. However, these clients trade in PC volumes of anywhere between 4000 - 30 000 PCs. The fate of technology purchased by small businesses, NGOs or the public is less certain.

It is, nevertheless, a good sign that distributors like Axiz – one of HP's two local distributors – is already engaged with the e-waste Working Group. The Department of Trade and Industry is also currently considering ways of developing incentives to encourage the participation of business (Visage, 2005. e-mail correspondence).

17. TO WHAT EXTENT IS E-WASTE A PROBLEM IN SOUTH AFRICA?

"On a scale of 1-10 we're at a three. We're getting somewhere, but slowly". (Ecroignard, 2005. Int)

The extent to which e-waste is seen as a problem in South Africa, depends to some measure on who you talk to.

E-waste is receiving a relatively high priority in South Africa at the moment, and there are reported to be good management and monitoring systems in place that govern waste streams. A recent visit by a Swiss monitoring team concluded that the key area of intervention in the country was to "support and expand existing business initiatives to

accept e-waste and improve the re-use loop” - South Africa was described as having “sophisticated e-waste recycling facilities”. (EMPA & seco, 2004)

Some waste practitioners, such as Lombard, see e-waste as an opportunity – a chance to significantly scale up local refurbishment processes (using technology discarded locally), and a way of developing a small, yet effective recycling industry. Both offer the opportunity for socio-economic development, and skills transferal.

However, refurbishment is only likely to result in part of the solution. Studies have suggested¹⁷ that it’s not simply the case that any old PC is worthy of refurbishment or is a good technology solution for development. As one NGO put it, “They’re not going to be able to do much with my old PCs. 43c/kg [for electronic bulk offered by the likes of Universal Recycling] doesn’t make it seem worth the petrol to deliver old technology to recyclers.” Similarly, the big recyclers don’t see it worth their while to collect from individuals or small organisations.

While recyclers like African Sky and Desco do bother to collect e-waste en masse from government and large corporations, there is clearly a need for more awareness to be raised amongst the public, and micro-collection processes to be established. However, for a grassroots project like the Gauteng Zero Waste Communities Forum, it is difficult enough streamlining the collection of ‘traditional’ waste like cans, paper and bottles. The economics of e-waste collection at a micro level are also, at this stage, unclear.

The financial viability of the recycling industry is sometimes tenuous. Exporting waste means that it is vulnerable to the vagaries of the rand, which can have a knock-on effect for collection projects. At the same time, competitive strategies by big recycling companies - that, for instance, are designed to manipulate the price of recycled goods - have in the past had a negative impact on smaller recyclers (Lombard, 2005. Int). As Universal Recycling points out, the viability of continuing to accept e-waste is unproven if, in the end, it needs to dispose of its stockpiled nickel-cadmium batteries at a hazardous waste site or the toxicity in its landfilled fraction rises.

There are differences of opinion of the extent to which dumping e-waste at registered land-

fills is a problem. Waste scientists such as Lombard feel these sites are sufficiently protected to prevent leaching into underground water. By implication, Holfontein, which encapsulates nickel-cadmium batteries, disagrees. The BCRC also finds this problematic.

According to HP, international practices in dealing with e-waste are likely to trickle down to regional outfits. One of the key motivators is brand protection: “If a whole lot of HP PCs end up on a dump, we don’t want to be seen to be responsible.” (Rose, 2005. Int). At the same time, HP seems sincere about looking for an holistic solution to the problem, and is already recycling by-products of its refurbishment process in Limpopo. However, in the absence of legislation, the key motivator for ICT vendors to follow suit is not predictable. As Rose suggests, some will, some won’t.

While the high level of storage of end-of-life technology distorts the current picture, most agree that e-waste will become a major challenge in a few years time. The capacity of current e-waste recyclers to handle a major inflow of e-waste is questionable.

Both the disposal of nickel-cadmium batteries and CRTs are currently a problem. There is equally a potential threat of unregistered or backyard electrochemical processes developing.

In many other countries in Africa, the challenges are described as more basic. Although there has been an improvement in waste legislation over the past few years, e-waste has not received significant attention. However, the BCRC says it has received some enquires from countries such as Botswana and the Central African Republic. At the same time, many African countries are signatories for to the Basel Convention, by implication making e-waste one of their policy priorities. Given the funding, the BCRC is also looking to raise the profile of e-waste in the region.

¹⁷ See, for instance, Open Research, 2004.

18. LIST OF INFORMANTS

Ecroignard, Lene

BCRC, Information & Marketing Co-ordinator. Member of e-waste Working Group.

O'Hagan, Thandi

Gauteng Zero Waste Communities Forum

Lombard, Ray

Waste scientist. Member of e-waste Working Group.

Rose, Hayward

HP i-Community

Sinanan, Sonia

Computer Aid International, Operations Director

Visagie, Marba

Department of Trade and Industry. Also member of e-waste Working Group.

Van Rensburg, Debbie

Universal Recycling, Environmental Manager

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Websites

Basel Convention Regional Centre – Pretoria. www.baselpretoria.org.za

Desco Electronic Recyclers. www.desco.co.za

Wikipedia. [For useful summarized definitions of the Basel Convention and the Ban Amendment, amongst others] <http://en.wikipedia.org>

Icando. www.icando.co.za

20. APPENDICES

20.1. Signatories to Basel Convention in BCRC region

	BASEL CONVENTION		
	Convention	Ban amendment	Protocol on liability
Botswana	Accession	Acceptance	Accession
Eritrea			
Ethiopia	Accession	Ratification	Accession
Ghana	Accession		
The Gambia	Accession	Ratification	
Kenya	Accession		
Lesotho	Accession		
Liberia	Accession		
Malawi	Accession		
Mauritius	Accession	Ratification	
Mozambique	Accession		
Namibia	Accession		
Nigeria	Ratification	Ratification	
Seychelles	Accession		
Sierra Leone	Accession		
South Africa	Accession		
Swaziland			
Rwanda	Accession		
Tanzania	Accession	Ratification	
Uganda	Accession		
Zambia	Accession		
Zimbabwe			

.Source: www.baselpretoria.org.za

20.2. Perspective of practitioner in the United Kingdom

By *Sonia Sinanan*,
Computer Aid International

Computer Aid International (CAI) is a registered charity in the United Kingdom (UK) whose mission is to solicit donations of the highest quality computer equipment from donors in the UK for the productive reuse in non-profit organisations in developing countries.

In order to achieve our mission, CAI have established an operation in the UK for donations of computers and related equipment to be collected, processed and shipped. It has been essential for CAI to put in place the logistics necessary to ensure that we are able deal effectively with everything that is donated to us.

To encourage organisations and companies to donate equipment, we have developed a service which enables donors to give us all their equipment safe in the knowledge that they are complying with current legislation regarding e-waste.

The current framework for legislation on the disposal of e-waste in the UK is the European Union (EU) Waste Electronic and Electrical Equipment (WEEE) Directive. The (WEEE) Directive was agreed on in February, 2003, along with the related Directive on Restrictions of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS). It is due to become law at the end of the summer of 2005.

WEEE aims to minimise the impacts of electrical and electronic equipment on the environment during its lifespan, and when it is discarded. It encourages and sets criteria for the collection, treatment, recycling and recovery of waste electrical and electronic equipment.

WEEE makes producers responsible for financing most of these activities, which means that the producer (or manufacturer) must ensure that it has in place suitable logistics to recycle equipment at the end of its life. It is expected that this financing will come from a levy on goods at the point of sale to cover the costs of eventual disposal (i.e. consumers will pay for this disposal). It is also expected that retailers will manage the take-back of old equipment at the point of purchase of new equipment.

Private householders are to be able to return old technology without charge. This process is to be managed by local authorities in the UK who, in principle, should already have in place local drop-off facilities for e-waste for consumers.

Businesses and organisations must demonstrate how they have disposed of equipment that they have deemed waste by showing volumes and waste transfer notes for all their WEEE. The emphasis is currently on showing that equipment has been properly disposed of rather than re-used; but designating equipment for re-use means that it is not classified as waste and organisations can reduce their waste output by reselling, or giving equipment away for re-use.

CAI is committed to re-using as much of the equipment donated to us as we can. We refurbish this equipment and prepare it for shipping to our beneficiaries in developing countries. We also cannibalise equipment that we are not going to use to harvest spare parts for our shipments.

What we are left with is equipment that we cannot re-use. This is e-waste generated by CAI in the course of our work and we must comply with the WEEE directive in our disposal of this waste.

We have a number of routes for this equipment. Waste base units, printers and peripherals are collected by a licensed waste management company which is also licensed to carry hazardous waste (e.g. monitors) on the road. This waste is transported to a sorting depot (in the UK) and the equipment is manually taken apart to separate its component parts and raw materials. There is a market for many of the raw materials, particularly in volume, such as iron, aluminium, copper, gold and silver. Where possible, but not exclusively, material is separated without the use of chemicals or incineration.

For larger amounts of waste, pallets are transported to an incinerator in Belgium. This is run by Metallo Chimique (www.metallo.com) and here waste is incinerated in a state-of-the-art furnace. This produces optimum levels of returned raw materials and creates zero waste – materials are shredded and incinerated. Anything not recovered is used or destroyed in the process. For example, reclaimed glass is used as ballast for the furnace.

Monitors are sent to an organisation in Germany which repairs them, where possible, for re-sale. Monitors that do not work are separated into their components. The glass and plastics, as well as printed circuit boards and other components are recycled. They reclaim cathode ray tubes for re-use. This activity is currently subsidised by the German government and it is the only plant of its kind in the EU.

We also have recycling routes for paper and cardboard used by the organisation and wherever possible we re-use before throwing away. We are assisted in this by our refuse collector which also undertakes to recycle as much waste as possible before land filling. Our local authority who makes recycling bins and collections available at no cost.

20.3. e-Waste in Asia Pacific

By Mylene Soto, WomensHub

20.3.1. Overview: the e-waste 'horror story'

The Basel Action Network noted three reasons why e-waste is increasingly flooding Asian countries: very cheap labour cost (in China, \$1.50 per day); lax environmental and occupational hazard regulations; and, since the United States (US) is not a signatory to any international law banning the export of e-waste, it

can always opt to dump its e-waste elsewhere at minimal cost.¹⁸

E-waste is routinely exported by developed countries to developing ones, often in violation of the international law. Inspections of 18 European seaports in 2005 found as much as 47% of waste destined for export, including e-waste, was illegal. In the United Kingdom alone, at least 23 000 metric tons of undeclared or 'grey' market electronic waste was illegally shipped in 2003 to the Far East, India, Africa and China. In the US, it is estimated that 50-80% of the waste collected for recycling is being exported in this way.¹⁹

The e-waste trade is also fueled by the economics of solid waste disposal. In the US, it is cheaper to ship waste abroad than throw it in landfills. Waste is separated before it is shipped and transferred through a difficult-to-trace series of buyers, sellers and brokers. Ultimately, it arrives in impoverished cities in China, Pakistan and India, where cheap labour means every last screw can be salvaged and sold back to manufacturers.²⁰

Famous global brand names in electronics have been found dismantled and stockpiled in the large-scale junkyards in Guiyu and Taizhou in China. This e-waste is from: Sony, Nokia, Samsung, Sony Ericsson and LG, Hewlett-Packard, Compaq, Dell, Motorola, Apple, IBM, Toshiba, Panasonic and Acer.²¹

Most of the e-waste exports end up in the highly toxic electronics junkyards in China. Significant quantities of highly-pollutant electronic waste like cell phone chargers, laptop computers, air-conditioners, printers, cameras and other electronic refuse are entering China illegally from Japan and South Korea.²²

18 The Basel Action Network (BAN) and Silicon Valley Toxics Coalition (SVTC). February 25, 2002. Exporting Harm: The High-Tech Trashing of Asia. See Annex A for a complete listing.

19 Greenpeace. May 2005. *op cit*

20 Aleks Krotoski. February 24, 2005. Made in Taiwan. Buried in China. Technology Review http://ban.org/ban_news/050224_taiwan_china.html

21 <http://www.greenpeace.org/international/campaigns/toxics/electronics/how-the-companies-line-up/e-waste-hall-of-shame>. Accessed: 30 August 2005.

22 Chen Liang. 29 April 2004. Taizhou Chosen as Electronic Waste Dump. China Daily http://www.ban.org/ban_news/040429_taizhou_chosen.html

Hong Kong has become a dumping ground for electronic waste from the US, Europe and Japan and soil tests have uncovered excessive lead levels. Nearly 100 large, open fields in the city's New Territories are covered in a sea of old computers, televisions, printers and printed circuit boards. The semi-rural New Territories, near the border with mainland China, have become a receiving and sorting station for the waste before disassembled parts are sent across the border for recycling.²³

The Hsinchu Science-Based Industrial Park (HSIP) in Taiwan is host to multinational IT high tech production infrastructure. However, it lacked adequate waste management facilities. In July 2000, one of its waste handlers, the Shengli Chemical Company, was caught dumping toxic waste into the Kaoping River. This severely polluted the Kaoping and left the people of Hsinchu without water for two days.²⁴

Thousands of Chinese workers have been dismantling electronic trash with chisels and cutting torches since the 1980s, and the presence of Canadian waste in Chinese dump sites has been documented since 2001.²⁵

However, other countries in the region are equally affected by the toxic dumping. For instance, there is a growing e-waste trade problem in India. 25 000 workers are employed at scrap yards in Delhi alone, where 10-20 000 tons of e-waste is handled each year, 25% of this being computers. Other e-waste scrap yards have been found in Meerut, Ferozabad, Chennai, Bangalore and Mumbai.²⁶

In 2003, the Basel Action Network accused New Zealand of exporting lead-acid batteries to a smelter in the Philippines. Since it knowingly violates the Basel Convention, there is high

23 Planet Ark. May 31, 2005. Tiny Hong Kong Falling Foul of Electronic Waste – Greenpeace. http://ban.org/ban_news/050531_tiny_hong_kong.html

24 California Global Corporate Accountability Project. May 2002. Dodging Dilemmas? Environmental and Social Accountability in the Global Operations of California-Based High Tech Companies. http://www.ban.org/Library/dodging_dilemmas.pdf

25 Geoffrey York. June 20, 2005. Canada's E-trash Plagues China. The Globe and Mail http://www.ban.org/ban_news/050620_canada_ewaste.html

26 *Ibid*

probability that New Zealand is shipping circuit boards and CRTs to the Philippines as well.²⁷

Asian countries also discard an estimated 12-million tons each year.²⁸ In Hong Kong for example, it is estimated that 10-20% of discarded computers go to landfill.²⁹

Thailand generated a lot of outdated mobile phone equipment and batteries because Thai consumers frequently replaced their mobile phones. It is still not known where the junk cell phones and batteries are dumped. There are potential risks if these are improperly disposed.³⁰

20.3.2. Guiyu case overview

Guiyu is the most studied showcase of e-waste trade in China. Since 1995, it has been transformed from a poor, rural, rice-growing community to a booming e-waste processing center. While rice is still grown in the fields, virtually all of the available building space has given way to many hundreds of small and often specialized e-waste recycling shelters and yards. Chinese press accounts say the total employed in the e-waste sector in Guiyu is 100 000; but it would be a very difficult number to estimate, due to a fluctuating migrant workforce.³¹

The workers retrieve from the e-waste pile whatever they can resell: copper, steel, plastic, aluminum, gold, printer toner, solder (lead/tin-based), circuit boards and reusable processors and chips. They earn as little as \$5 (US) a day for their dangerous work of dismantling the electronic waste in unregulated conditions, without any safety equipment, such as masks or goggles.³²

Below are some of the processes employed by the workers to extract whatever they can from the e-waste.³³

27 Anita Matthews. 4 April 2003. How E-junk Poses a Global Hazard. New Zealand Herald http://ban.org/ban_news/e-junk-nz.html

28 Greenpeace. May 2005. *op cit*

29 Ibid

30 Kultida Samabuddhi. 3 June 2003. Call for Tighter Electronic Waste Controls. The Bangkok Post http://ban.org/ban_news/thai_call_tighter.html

31 The Basel Action Network (BAN) and Silicon Valley Toxics Coalition (SVTC). February 25, 2002 *op cit*

32 Geoffrey York. June 20, 2005. *op cit*.

33 The Basel Action Network (BAN) and Silicon Valley Toxics Coalition (SVTC). February 25, 2002. *op cit*

1. Toner Sweeping

Residual toner, such as black, cyan, magenta and yellow from colour copiers and printers, is collected; but its final use is uncertain. Workers without any protective respiratory equipment or special clothing of any kind open cartridges with screw drivers and then use paint brushes and their bare hands to wipe the toner into a bucket. Constant clouds of toner that billowed around the workers was routinely inhaled. In the course of the day, the worker's skin and clothing was blackened.

2. CRT Cracking and Dumping

Copper-laden yokes from the end of the tube of CRTs are broken off to be sold to copper recovery operations. Then the CRTs are cracked and discarded in the river. Lead-laden monitor glass, which qualifies as a hazardous waste in the Basel Convention and fails US EPA's leachate tests (TCLP), was regularly dumped on open land or pushed into the rivers.

3. Open Burning

It is extremely likely that due to the presence of PVC or brominated flame retardants in wire insulation, the emissions and ashes from such burning will contain high levels of both brominated and chlorinated dioxins and furans - two of the most deadly persistent organic pollutants (POPs). It is also highly likely that cancer-causing polycyclic aromatic hydrocarbons (PAHs) are also present in the emissions and ash.

Workers place the circuit boards on shallow wok-like grills that are heated underneath by a can filled with ignited coal. In the wok-grill is a pool of molten lead-tin solder. The circuit boards are placed in the pooled molten solder and heated until the chips are removable. These are then plucked out with pliers and placed quickly in buckets.

4. Circuit Board Recycling

The most environmentally destructive recycling overall involves the recovery of the various components and materials found on electronic circuit boards. Hundreds of women and girls perform this task every day. The de-soldering process starts when the solder is collected by slapping the boards hard against something such as a rock - where the solder collects and is later melted off and sold. While there are sometimes

fans placed to blow the toxic lead-tin solder fumes away, the exposure on a daily basis is likely to be very damaging to the laborers' health. The removed chips are then separated between those with re-sale value and those to be sent to the acid chemical strippers for gold recovery. Often the pins on chips will be straightened and later dipped in fresh solder to make them look new for use in the computer refabrication business, said to be prominent in Guangzhou.

After the de-soldering process, the stripped circuit boards might go to another less skilled laborer who then removes small capacitors and other less valuable components for separation with wire clippers. After most of the board is picked over, it goes to large scale burning or acid recovery operations outside of town (situated along the river) where the last remaining metals are recovered. Whole riverbanks were seen full of charred circuit boards reduced to blackened fiber-glass. This final burning process is bound to emit substantial quantities of harmful heavy metals, dioxins, beryllium and PAH's. Some of the severely contaminated areas sampled are adjacent to areas where circuit boards were burned.

5. Acid Stripping of Chips

Much of the work to remove chips from circuit boards is done for the ultimate purpose of removing precious metals. This is most often done by a very primitive acid bath process using the chemical aqua regia (a mixture of 25% pure nitric acid and 75% pure hydrochloric acid.) This mixture and process was invariably set up on the banks of the river. Huge clouds of steamy acid gases were emitted. Routine dumping of aqua regia process sludges blackened the river banks with the resinous material from computer chips. The men worked at this process day and night protected only by rubber boots and gloves. They had nothing to protect them from inhaling and enduring the acrid and often toxic fumes. The aqua regia process is known to emit toxic chlorine and sulphur-dioxide gases.

6. Materials Dumped

A substantial amount of imported e-waste and process residues are not recycled but simply dumped in open fields, along riverbanks, ponds, wetlands, and in rivers.

7. Plastic Chipping and Melting

The plastic parts of e-waste, and in particular the housings of computers, monitors, and plastic keyboard parts, etc. were all sent to one of the Guiyu villages that were processing plastics. The melting of the computer plastics is done in rooms with little ventilation and with no respiratory protection.

Studies of sediment samples taken above a river showed lead 212 times higher than what would be treated as hazardous waste had been dredged from the Rhine River in the Netherlands. Likewise other heavy metals found in circuit boards and in CRTs were found in very high quantities. Barium was found at levels almost 10 times higher than an EPA threshold for environmental risk in soil. Tin was found at levels 152 times the EPA threshold. Chromium in one sample was at levels 1 338 times the EPA threshold level. Copper in another sample (which in fact appeared to be a dumped residue from some recycling process found on the banks of a river) was an astounding 13.6% of the total.³⁴

An investigative team took one water sample, one sediment sample, three soil samples in one area along the Lianjiang River, where circuit boards had been treated with acid and fire, and then were dumped charred along the banks. The test results revealed alarming levels of heavy metals that correspond very directly with metals most commonly found in computers. The single water sample taken by a reporter in 2000, adjacent to a location where circuit boards had been processed and burned in the past, revealed lead levels that were 2400 times higher than World Health Organization (WHO) Drinking Water Guidelines.³⁵

Already Guiyu has become so polluted that well water is undrinkable and water has to be trucked in for the entire population, the report said.³⁶

20.3.3. Surveillance and fact-finding on a suspected e-waste disposal plant

On September 2, 2005, together with five other volunteers for an environment organization, I travelled to an idyllic village, in the province

³⁴ *Ibid.*

³⁵ *Ibid.*

³⁶ John Vidal. 21 September 2004.op cit.

of Laguna, 60 kilometers south of Manila. Our objective was to confirm a lead that e-waste is being incinerated in a Korean-owned waste disposal company there.

Near the plant, we divided ourselves into two teams made up with three people each. Our team was to enter the compound and the other team to check on the periphery of the compound.

We said that we were employees of a media and survey company, and were conducting interviews to get the opinions of the residents on the then ongoing move to lodge an impeachment case against the Philippine president for election fraud.

Armed with fake media outfit company IDs, clipboards, survey sheets, pens, cameras, and alibis, our team was able to enter the gates of the plant which does not bear the company signage. Since it was almost lunch time, the employees were already relaxing and getting ready to go out to lunch. Two of us administered the interviews, while the others took pictures on the pretext that we have to show our office where we held the survey. We were able to interview the plant manager, machine operator, assistant supervisor and administrative assistant in the compound. The interview questions focused on the impeachment issue interspersed with queries about plant operations and the work that they do there.

We learned from the employees that they burn industrial waste such as paint, garments, and furniture from the Export Processing Zone Authority (an industrial park). Honda is one of their clients. The plant operations are irregular with no definite volume of waste processed. Sometimes they operate for 24-hours and at times there are no operations.

Twice a week the plant comes to a standstill (like the day we were there) for maintenance and cleaning of the machines. The ash from the machine is mixed with the sand in the sand filtration area and recycled as substandard cement. Hundreds of drums are stocked in the compound containing materials that are yet to be burned. When asked, the manager and supervisor denied burning TVs and computers there. But the administrative assistant said that they, indeed, buy and process computer waste. Burning of e-waste in a thermal processing plant is analogous to incineration.

That afternoon, we moved our 'survey' to the adjacent residential area which is about 100 meters from the perimeter fence of the waste

processing plant. The residents told us that waste such as paint, swatches of cloth and dismantled TVs are burned by the plant. When the plant is burning its waste, a thick, cloud of foul-smelling (like poison) smoke is released through the chimney at 10-minute intervals.

The plant had now been in operation for three years. On its first year, the residents already complained about the plant's foul smell and black smoke. They approached the head of the village officers. In response to the complaint, the waste disposal plant management removed the company sign, built a higher fence, stripped their container vans of labels and names. The daytime operations stopped, only to be shifted to the evenings.

Now in its third year of operations, the residents are still complaining about the smell and smoke. Chronic respiratory illnesses such as coughs and colds among their children are common. They said they cannot go back to the village officials to complain because he is closely connected, and friends with waste disposal plant management.

20.4. e-Waste in India

By Frederick Noronha, Bytes 4 All

At present in India there is no e-waste policy. E-waste is considered as a hazardous waste and is mentioned in hazardous waste legislation.

There are also no statistics available on e-waste in India. The Central Pollution Control Board (CPCB), a federal government organisation, is trying to document the data, and the process is on-going through a rapid assessment study. Some data on the national capital of Delhi and the South Indian city of Chennai (formerly Madras) was compiled by Toxics Link in their reports 'Scrapping the Hi-Tech Myth' and 'Time is Running Out'. These can be accessed at this non-governmental organisation's website www.toxicslink.org.

Campaigners feel that India, which projects itself as a rising IT superpower, could push for better disposal techniques of e-waste, restriction of hazardous substances in the manufacturing of electronics and the transboundary movement of e-waste and Extended Producer Responsibility (EPR) guidelines for big IT companies and the like.

But campaigners point out that rather than going in for a new institutional arrangement

for e-waste, what is needed is the proper implementation of the existing hazardous waste rules. The main challenge is seen to be the need to stop the illegal import of e-waste into India and the proper recycling of (locally generated) e-waste within India.

Civil society organisations, such as Toxic Link, believe their chance of making 'some' dent is to push Indian government agencies "to act fast on the problem through more data and media reports".

Problems linked to e-waste in India surfaced after India's economic liberalisation began in 1990. Infrastructure reform and e-governance lead to the application of information technology in a bigger way.

India's supreme court issued a 1997 directive which bans import of hazardous waste into India, reflecting the Basel Ban. But affluent nations find it easier and cheaper to export e-waste to countries like India. "Primary investigations" undertaken for the Basel Action Network showed local and imported computer waste had given birth to a "thriving market of computer waste products and processing units for material recovery in different parts of India". Groups like Toxic Links argue that the trade in e-waste is "camouflaged and is a thriving business in India, conducted under the pretext of obtaining 'reusable' equipment or 'donations' from developed nations."

In mid-August 2005, global campaign group Greenpeace warned that a lack of rules were making Indian (and China) dumping grounds for highly toxic e-waste. Numerous recycling units handling this were releasing toxic chemicals into the workplace and, in many cases, into the environment. Both these countries were getting a "lot of electronic waste from the European Union and the US", Greenpeace said.

Ramapati Kumar from Greenpeace stressed the need for an Extended Producer Responsibility (EPR) policy to make producers liable for electronic equipment, such as computers and mobile phones, until their life span is over. He said while recycling electronic equipment costs about \$2 in India, it takes about \$20 in Europe.

In a report entitled *Toxic Tech: Recycling Electronic Wastes in China and India*, Greenpeace said "both wastes and hazardous chemicals used in the processing are handled with little regard for the health and safety of the workforce or surrounding communities and with no regard for the environment".

The report is based on the scientific analysis of waste waters, ashes, indoor dust, groundwater, soils and sediments from e-waste recycling yards in India and China. Seventy samples were collected during March 2005 from sites in the suburbs of New Delhi and Guang Dong province in China.

"Samples from and around recycling units at Salempur, Zafarabad, Shastri Park, Mayapuri, Buradi, Kantinagar and Brijgang establish that heavy metals, including lead, tin, antimony, cadmium, mercury, acids and organic contaminants are released in the environment," Kumar was quoted as saying.³⁷

Sponsors of the report, including the San Jose-based Computer Take-Back Campaign, said the research also found evidence that the United States and other industrialized nations are continuing to export hazardous e-waste to developing countries for recycling and disposal. Emerging news indicated that in the Delhi suburbs of Mayapuri and Buradi, battery-dismantling workshops yielded dust samples that contained 40 000 times more cadmium than typical floor samples.³⁸

37 Source: http://www.indiadaily.com/breaking_news/43042.asp

38 The report, *Recycling of Electronic Wastes in China & India: Workplace & Environmental Contamination*, is available online at http://www.e-takeback.org/press_open/export_waste.htm. It supplements a 2002 study of conditions in recycling workshops titled *Exporting Harm*, which also was based on Greenpeace field work. It is at "<http://www.ban.org/E-waste/technotrashfinalcomp.pdf>" <http://www.ban.org/E-waste/technotrashfinalcomp.pdf>.



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