TEXTE
22/2010

Transboundary shipment of waste electrical and electronic equipment / electronic scrap

Optimization of material flows and control

Summary

Umwelt Bundesamt

| TEXTE | 22/2010

ENVIRONMENTAL RESEARCH OF THE
FEDERAL MINISTRY OF THE ENVIRONMENT,
NATURE CONSERVATION AND NUCLEAR SAFETY

Project No. (FKZ) 3708 93 300
Report No. (UBA-FB) 001331/E

Transboundary shipment of waste electrical and electronic equipment / electronic scrap – Optimization of material flows and control

Summary

by

Knut Sander

Stephanie Schilling

Ökopol GmbH, Hamburg

On behalf of the Federal Environment Agency (Germany)

UMWELTBUNDESAMT

This publication is only available online. It can be downloaded from
http://www.umweltbundesamt.de/uba-info-medien/mysql_medien.php?anfrage=Kennummer&Suchwort=3933
along with the complete version and a German-language version.

Publisher: Federal Environment Agency (Umweltbundesamt)
P.O.B. 14 06
06813 Dessau-Roßlau
Germany
Phone: +49-340-2103-0
Fax: +49-340-2103 2285
Email: info@umweltbundesamt.de
Internet: http://www.umweltbundesamt.de

Edited by: Section III 1.5 Municipal Waste Management,
Hazardous Wastes, Focal Point to the Basel Convention
Dr. Ulrich Smeddinck

Dessau-Roßlau, March 2010

Background and Objective

Currently, significant quantities of used electrical/electronic equipment (UEEE) are being exported from Germany. Notified exports (that is with consent by authorities) of waste electrical and electronic equipment (WEEE) into countries outside the European Union (EU) in past years have not taken place to an appreciable extent. Condition and quality of the exported UEEE, however, suggest that a significant proportion of the equipment can be expected to be non- or not completely functional, can be used solely as a source of spare parts in the country of destination or only has a short service life.

In the countries of destination the equipment encounters waste management structures which lie far below the standards which the European Community considers to be necessary as the minimum protective level in their own territory. Through this, the treatment of the UEEE in the countries of destination leads to risks for human health and the environment. In addition, there are losses of valuable resources if an incomplete collection of the WEEE takes place in the destination countries and treatment technologies are applied for the collected WEEE, which ensure no optimum recovery/recycling rate.

The tangible knowledge regarding amounts and precise paths of the export flows as well as the protagonists and the protagonist chains involved are very limited.

Against this background, and with emphasis in this research project on the example of exports via the Port of Hamburg[1], the export of WEEE and UEEE has been quantified as far as possible on an empirical basis and, taking into account the qualities of the exported goods, approaches, measures and regulation structures have been developed which are suitable to optimise the protection of the environment, human health and resources.

Legal Framework for the Transboundary Shipment of Waste

A series of international and national regulation instruments, recommendations, enforcement guidance and instructions for action monitors and supervises the transboundary shipment of wastes. Here, primarily, the following are important:

[1] In addition, the situation at the ports of Bremen, Antwerp and Amsterdam has been considered.

1. Basel Convention of 22 March1989 on the Control of Transboundary Movement of Hazardous Wastes and their Disposal [Basel Convention],

2. OECD Council Decision C(2001)107/Final of the OECD Council concerning the revision of Decision C(92)39/Final on the Control of Transboundary Movement of Wastes Destined for Recovery Operations [OECD Council Decision],

3. Regulation (EC) No. 1013/2006 on shipments of wastes [EC Waste Shipment Regulation],

3a. Commission Regulation (EC) No. 1418/2007 concerning the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No. 1013/2006 of the European Parliament and of the Council to certain countries to which the OECD Decision on the control of transboundary movements of wastes does not apply [Commission Regulation (EC) No. 1418/2007],

4. German Waste Shipment Law [Abfallverbringungsgesetz],

5. Instruction for the cooperation of (German) customs offices and (German) environment authorities within the framework of the shipment of wastes [Customs Instruction],

6. Revised correspondents' guidelines No 1 - Shipments of Waste Electrical and Electronic Equipment (WEEE) [Correspondents' Guidelines No 1],

7. Correspondents' Guidelines No 4 - Classification of waste electrical and electronic equipment according to Annex IV part I note (c) of Regulation (EC) No 1013/2006 on shipments of waste [Correspondents' Guidelines No 4]

8. Enforcement guidance for the shipment of waste of the Working Group of the German Federal States and the Federal Government on Waste [Enforcement guidance LAGA],

9. Directive 2002/96/EC on Waste Electrical and Electronic Equipment [WEEE Directive],

10. Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment [RoHS Directive],

11. German Electrical and Electronic Equipment Law [ElektroG],

12. Recommendation providing for minimum criteria for environmental inspections in the Member States 2001/331/EC [Recommendation 2001/331/EC].

A simplified summary of the Basel Convention, the OECD Council Decision and the EC Waste Shipment Regulation can be found in Figure 1.

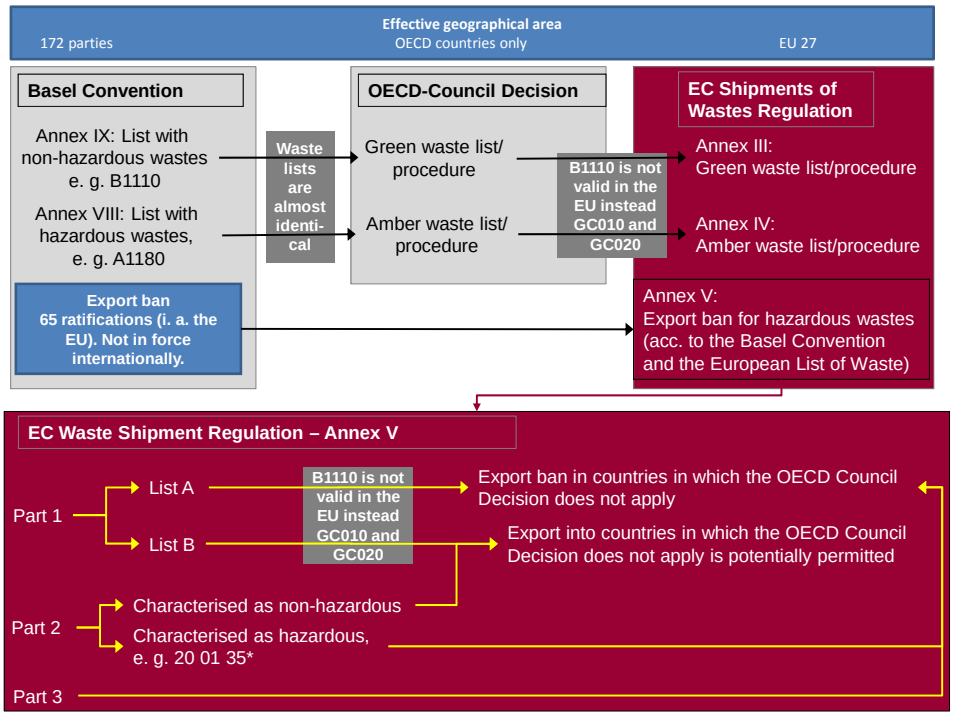

Figure1: Overall diagram on the regulation of the shipment of waste

Exported Quantities

Data on the export of goods from Germany into third countries[2] are reported via the customs own IT system ATLAS, as paper document, on data media and via the internet from the exporters to the customs. From January to September 2008 some 48 % of the reports took place via paper documents, 33 % via online systems or data media and 19 % directly via ATLAS [DESTATIS 2009]. Due to the reorganisation of the data flows (see below) the proportion of the direct reports via ATLAS has increased continuously. In October 2008 the value already lay at ca. 35 %. Bigger exporters are more often represented in the reports via electronic systems, while smaller exporters make up the greater part of the reports in paper form.

The goods were accounted for according to the worldwide applied six-digit “harmonised system for the designation and coding of goods” (HS) and supplemented by two further digits by the customs tariff and statistic nomenclature of the European Union (“Combined nomenclature” or also CN) [Hoeppner 2005]. The goods codes with electrical and electronic equipment do not differentiate between used and new goods.

Figure 2 below shows the information flow between customs and the German Federal Statistical Office for the year 2008.

[2] Under this are understood to be countries outside the European Union [DESTATIS 2008].

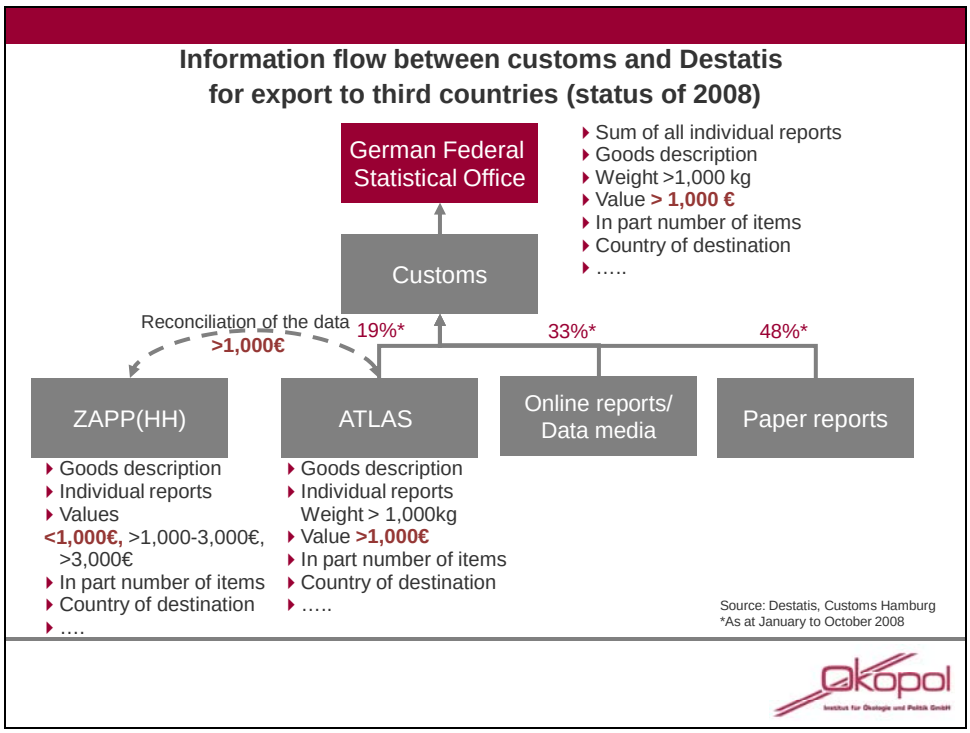

Figure 2: Information flow between (German) customs and DESTATIS (status of 2008)

From 01.07.2009, exports are almost exclusively communicated via the ATLAS system only to the German Federal Statistical Office. The low-value goods[3], which in Hamburg had previously been registered in the ZAPP system, could then also be recorded in the ATLAS system. The ZAPP system is also still employed.

Estimates of the exports from Germany were elaborated on the basis of available statistics for selected good groups (see following table 1) which, within the context of the study, turned out to be particularly quantity-relevant.

[3] Exports with a value below 1,000 €.

Table 1: Goods groups investigated [4]

Goods number	Clear text
WA8415	Air conditioners
WA8418	Refrigerators, freezers, heat pumps
WA8443	Printing units and aids for printing units
WA8450	Machines for washing or drying of washing
WA8469	Typewriters, word processing machines
WA8471	Automatic data processing machines
WA8510	Electric razors, shearing machines with electric motor
WA8516	Electric water heaters and immersion heaters
WA8517	Telephone apparatus, telecommunication equipment
WA8521	Video equipment for the recording of pictures and sound
WA8525	Transmitters for broadcasting, i.a. TV cameras
WA8527	Receiving equipment for telephone traffic or broadcasting
WA8528	Television receiving equipment, video monitors

Total quantity

In the reporting year 2008, in addition to using ZAPP and ATLAS, 33 % of the customs declarations have been done via data media and onlinereports and 48% via paper documents. Taking into account the amount documented in ZAPP (8,951 t) and the amounts which are assumed to be exported as payload of used vehicles (20 % of the total amount in the reporting year) the resulting maximum export volume is **216,000 t** (2008). Based on the assumption, in a minimum variant, that a higher percentage of the export volume is documented in ATLAS, the resulting total exported amount is **93,000 t** (2008) (average of variants: **155,000 t**).

The value and goods analysis revealed that the exported equipment can hardly be new equipment. The very low value as well as the outcome of several export controls made clear that a relevant portion of the equipment have been in a very bad state. An indeterminable amount has been exported illegally as used equipment in spite of its status as waste electric and electronic equipment (WEEE). It is assumed that a large share of the exported WEEE out of the 155,000 t did not pass through the system according to the German ElektroG.

For comparison: In 2006[5] 1.8 million tonnes of new equipment have been put on the market in Germany. The amount of WEEE collected in the system according to the ElektroG added up to 754,000 t [BMU 2008].

[4] For details on goods codes see the commodity index of the Foreign Trade Statistics, 2009 Issue, or http//:www.destatis.de

[5] Monitoring-Data according to the German ElektroG for the year 2008 are not yet available.

Value of exported equipment: The detailed analysis of the statistics of the Port of Hamburg regarding the values of the export reports allow the presumption that the quantity-relevant exports of the good codes investigated were made up primarily of used equipment with small value. Even in case of a "best-case-estimate"[6] low prices appeared such as, for example, 3 € per video monitor, 4 € per TV set or 20-30 € per refrigerator and freezer. The actual value, however, certainly does not correspond to the best-case consideration and lies considerably lower.

Exported mix of equipment: With the differentiation according to equipment types there results a larger uncertainty about the data than with the aggregated quantity details. It is to be presumed that the customs reports are not differentiated in this way in every case as is to be expected from the contents of export containers. Thus the results of container checks show, for example, that an accurate differentiation between television sets and video monitors did not always take place in the customs documents. Primarily, there is a tendency to under-estimate, through undifferentiated reporting, small appliances (e.g. entertainment electronics) and equipment which is exported in small quantities per report (e.g. PCs). With this, the high total quantity of the relevant customs reports is also to be taken into account (e.g. ca. 600,000 in 2008). Smaller items of equipment are also underestimated in quantity since they are essentially more often vehicle payloads in used vehicles than are large items of equipment.

For calculation purposes, two variants have been developed which differ regarding the mix of equipment exported. In distinction to the information from customs declarations variant 2 comprises a higher percentage of small equipment (see also figure 3).

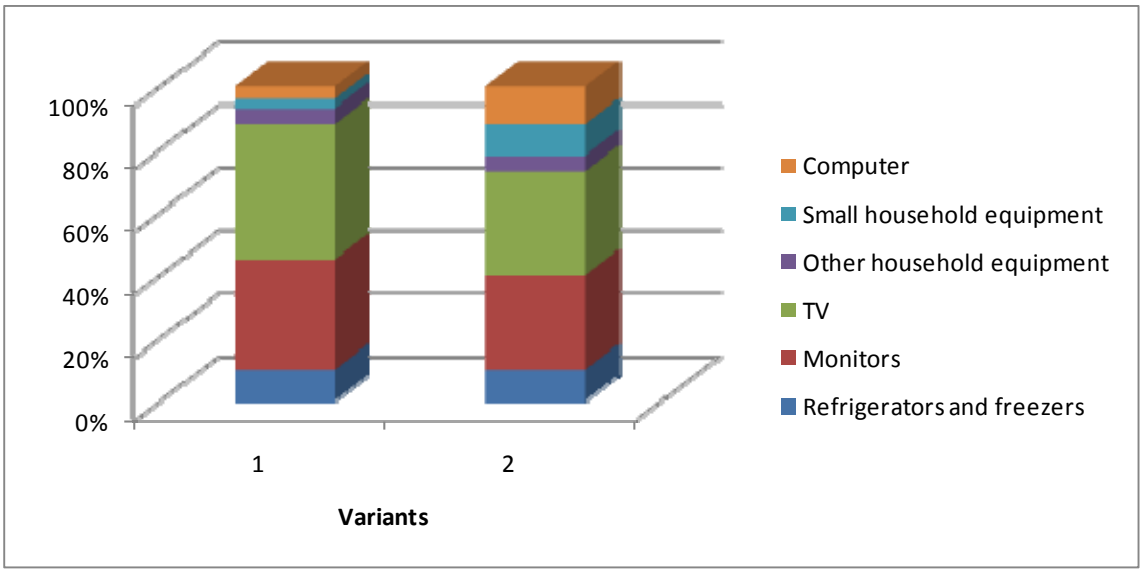

Figure 3: Export fractions according to equipment type

[6] There are essential data uncertainties with regard to the actual details on the values as, in the transmitted ZAPP data, no details have been made about these but rather only value ranges per report have been given (e.g. <3.000 €/report). Therefore only a best-case estimate was possible in the sense that the highest possible value was assumed.

The quantity of refrigerators and freezers exported into countries of destination, taking into account the quantities not represented in the export statistics, is probably of the order of 15,000 t per year. Various sources estimate the fraction of old refrigerators yielded today, which are free of CFCs, to be 10 % to 30 % of the total quantity occurring [Becker RAL pers.com., UBA pers.com., Weigelt pers.com]. It is suspected that the quantity of CFC-free refrigerators yielded in Germany in 2008 to be below 10,000 t/a. On the basis of these assumptions it can be presumed, that significant numbers of refrigerators containing CFCs have been exported.

The quantity of exported monitors is of the order of 50.000 t (weighted average; range from 28,000 t to 76,000 t). This corresponds to ca. 2 million appliances. Also for this type of equipment the investigations revealed that they can hardly be new equipment but a relevant portion is assumed to be in a very bad state. **For comparison**: In the year 2006 315,000 t of new equipment of collection group 3 (IT and telecommunication equipment) have been put on the market in Germany and 102,000 t have been collected separately in the system according to the ElektroG.

Remark: With regard to the total quantity estimate it is to be noted that the exported quantities as well as the equipment mix were probably essentially influenced by the innovation cycles in the countries of dispatch. In 2008 CRT screens (monitors, televisions) made up the most significant export equipment type, which has been influenced essentially by the replacement of CRT screens by flat-screens. In this respect, the view of 2008 can be understood to be only a spotlight.

Treatment Situation in the Countries of Destination

The analysis of the treatment situation in the countries of destination has shown that, in most cases, no treatment infrastructure is available which is even only roughly comparable to that which the European Member States consider for themselves as minimum level of protection for the environment and health[7].

In some countries of destination (e.g. South Africa, India) there are available treatment and recycling facilities for some types of equipment as well as for fractions from the treatment of equipment. However, control and monitoring mechanisms do not appear to have been established with an effectiveness which ensures that equipment, which has been exported from Germany, actually reaches these facilities.

Via the very heavily manually characterised dismantling of the equipment often a very good separation of material is achieved in the first stage of the recycling chain. This, however, concerns only fractions for which sufficient revenues can be achieved on the respective regional market. The dismantling takes place essentially through the informal sector. Above all, in Afri-

[7] Relevant legislation in this context are the Waste Framework Directive (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, OJ L 312, 22.11.2008, p. 3) and the WEEE Directive.

can countries, the degree of organisation of the informal sector is marginal. Through this, the market access for the sale of fractions is very heavily dependent on parochial conditions. Therefore prices, which are achieved on the world market for fractions from the dismantling of WEEE, are often not simply transferable. The discussions and research have shown that the question of market access for such fractions with the further development of the waste management in these countries is accorded an important significance.

Above all, under resource aspects, equipment is important, which contains relatively large quantities of raw materials which, with the treatment infrastructures in the destination countries, cannot be recycled or be marketed, or with which the environmental consequences of recycling are problematic. Here, one is concerned above all with equipment which contains printed circuit boards and non-ferrous metal, which are present in components in low concentrations (e.g. gold in circuit board elements).

The recycling rates for precious metals or noble earths with the recycling processes applied in the important countries of destination are as a rule lower than with state-of-the-art processes according to European standards. The recycling of ferrous metals is classified as less problematic.

Against the background of the treatment structures in the countries of destination, risks for human health and the environment can be differentiated into four areas:

- Treatment steps in which a mechanical disassembling involves destruction of the material structures (e.g. the smashing of cathode ray tubes);
- Hazardous substances which are contained in the products and which might be emitted e. g. by thermal processes. The quantity and number of these substances are reduced through the ecological optimisation of the products within the scope of manufacturers' activities and the limitation through the RoHS-Directive from 2007. The use of such equipment as used equipment in the destination countries takes place, however, time-delayed (commensurate with the service life in Germany);
- Auxiliary products from separation and/or recycling processes (e.g. liquids and sludge from leaching);
- Substances which result from the handling or recycling (e. g. PCDD/F with thermal processes).

With the last two points a modification of the processes in the countries of destination is necessary if a level of protection comparable with Europe is to be achieved.

The reduction of hazardous substances in newly produced electrical and electronic equipment taking place currently is an important step in reducing the environmental and health risks from disposal, also in the countries of destination. In addition, it is however, necessary also to incorporate in the overall consideration the risks from the use of auxiliary products from the handling (e. g. leaching agents, cyanide), as well as the emissions from handling and recycling processes (e. g. PCDD/F emissions from thermal processes, wastewater, secondary wastes such as, for example, sludge).

Against the background of the treatment situation in the countries of destination, an extensive differentiation of equipment types, components and fractions with the estimation of the environmental and health risks appears to be sensible. For this, Appendix II of the WEEE Directive can be used.

Environmental and health problems, which arise through a lack of or insufficient waste management structures, also from own stock equipment, are also significantly increased through imported equipment which, following import, has no utilitarian use (and is to be treated immediately as waste). But even equipment with curtailed service life[8] leads to treatment problems arising more quickly. Through the shortened usage period there is often no acceptable balance between usefulness and environmental loading from treatment.

Against the background of the presented relationships it appears to be sensible to undertake a differentiation of the exported equipment using their characteristic and/or usage profiles which covers seven groups (see Table 2):

Table 2: Summary of the characteristic profiles of electrical and electronic equipment for export

Equipment category	Characteristic	Condition according to Correspondents' Guidelines No. 1, para. …	Usage
A	As new, fully functional	/	Equipment utilisation
B	Used, fully functional	8a	
C	Used, limited functioning		
D1	Used, non-functional, not-waste status	8b	Equipment does not remain in-country, but is returned
D2	Used, non-functional, no used equipment status	9	Partial utilisation
E	Utilisation as source of spare parts		
F	Utilisation as source of raw material (removal of useful fractions)		Material utilisation
G	Direct landfilling	/	No utilisation

Equipment of Groups D2 to G is, with the following work steps, treated as problematic groups for export. Equipment of Group D1 primarily covers equipment which is shipped collectively for repair by the manufacturer or their repair centres within the scope of warranty. Groups A to D1 are treated below as less problematic groups of exported equipment.

[8] Compared with new equipment.

Collection points and Protagonists/Players

Collection points are important centres of the export business between collection of equipment in Germany and export to countries of destination (see figure 4 and figure 5). Various types of collection points can be differentiated within the context of this project:

Figure 4: Collection points (commercial)

Locations where equipment can be traded (purchase and sale on site) and where equipment suitable for export is packed into sea containers and vehicles either on site or at another site (here site operators and exporters do not have to be identical. It is also possible that, for example, the collection point acts as a business at which exporters make purchases).

- Locations, providing containers into which the equipment is collected over a longer period. The equipment is then packed into sea containers, which for a limited period, are set up on the site (e. g. collection in collection containers over several weeks or even months; packing into sea containers in three days).

Figure 5: Collection points (exclusively storing of equipment)

The number of such collection points in Germany can, on the basis of expert opinions, be estimated as several hundreds to over a thousand.

Research has shown, that few large and numerous small exporters are active. With the exporters, who export only a few equipments, one is often concerned with so-called “waste tourists” who come to Germany, buy material for one or more containers, load this/these, take possession again of the container or containers in the destination country (primarily in Africa) and remarket the contents.

In the export chain there continues to be a series of further protagonists/players who, however, hardly have any influence on the question of what is actually exported.

- Agents often form the connection between those who export and the shipping lines. If required, agents also organise sea containers and the stowage of the equipment into the containers. With the agents often a great personnel or spatial proximity to those exporting can be determined.

- According to information from the Hamburg police, exports to West Africa are, as a rule, processed via forwarding agents. It has been estimated that here, related to quantity, one is concerned with ca. 10 forwarding agencies. Exports to Southeast Asia on the other hand are more often processed via the shipping companies without resorting to a forwarding agent.

- For the transport of UEEE primarily the shipping line operations (different to traffic as required) are pertinent. For the West Africa route ca. 10 lines are mass-significant. Exports to Asia are currently primarily processed via nearly 10 further shipping lines. According to statements by exporters, exports on both routes take place above all via completely loaded containers. The packing firm with whom an exporter with the forwarding agent or in the port also stows goods in containers of other exports is less quantity-significant. The stowage of equipment into containers takes place in the overwhelming majority of cases at collection points.

- The shipping lines on their routes sail into several ports in Africa or Asia, such as, for example, the line Poland, Hamburg, Antwerp, Nigeria and Côte d’Ivoire.

An organisational or personal closeness between those exporting and shipping lines or a specialisation on a certain product such as, for example, with the export of used vehicles, cannot be determined as existing with the shipment of UEEE. In the container business there is less engagement of the shipping line with the products (even if the shipping line receives information on the freight via the cargo documents).

The shipping line has more engagement with exported UEEE where the equipment is stowed in used vehicles. These vehicles are often welded for transportation in order to avoid pilferage during the transport. The ownership of the equipment in used vehicles as a rule lies with the owner of the vehicle.

With regard to developing measures (see below), even if the carrier barely has influence on the type of exported goods, it is to be noted that carriers of illegal waste exports have possibly to bear the costs of take back if the exporter himself cannot be held responsible.

Origin

The analysis of the sources of exported equipment with more than 4,000 identified intervention points pointed out the multitude of possible sources. The following table 3 summarises the results with regard to areas of origin, quantification and qualification.

Table 3: Areas of origin of exported electrical/electronic equipment

Area of origin	Main equipment groups	Quantifying quantity class[1]	Qualification[2]	Price[3]	Outlay for acquisition[4]	Number of intervention points[5]
Pilferage of bulk waste collection	White goods, brown goods, small domestic appliances, Information Technolgy (IT), consumer electronics (CE)	II (highly erratic, depending on the level of the metal prices)	3	3	2	IV II (Information for the public)
Scrap collection	White goods, brown goods	II to III (highly erratic, depending on the level of the metal prices)	3	3	2	IV II (Information to public)
Classified ads in print media	All	I	2	2	1	II (Information to public)
Flea markets	Small domestic appliances, IT, telecommunication (TC), CE	I	2-3	2-3	1	IV II (Information to public)
Value cascades	Small domestic appliances, IT, TC, CE	I to II	2 - 3	3	3	III
Recycling centres, First treatment company	White goods, brown goods, small domestic appliances, IT, CE	No details	2 - 3	3	2	IV
Re-use-organisations	White goods, brown goods, small domestic appliances, IT, CE	I	2[6]	3	3	II
Waste transporter	No details	No details	No details	No details	2	IV
Online advertisements/ auction houses	All	II	2 – 3[7]	1 - 3	3	II (Information to public)
Re-marketing-firms[9]	White goods, brown goods, IT, CE	III	2 – 3[8]	2-3	3	III
Handing over to trade – private area	Primarily white goods, less CE and IT	III (already taken into account with re-marketing firms)	2 – 3	2 – 3	3	II

[1] 3-stage scaling; quantity classes I: <10,000 t/a, II: 10,000 t/a to 50,000 t/a, III: >50,000 t/a to 100,000 t/a; the estimate of quantity relates to the total quantity from the respective area of origin. The actual amounts exported into countries in Africa and Asia are a subset therefrom.

[2] 3-stage scaling; 1 = high value product profiles A and B, 2 = medium quality product profiles C and D1, 3 = low quality product profiles D2 to G

[3] 3-stage scaling; 1 = high price, 2 = medium price, 3 = low price to free of charge

[4] 3-stage scaling; 1 = high, 2 = medium outlay, 3 = low

[5] 4-stage scaling; I = 1 to 10 intervention points, II = 11 to 100 intervention points, III = 101 to 1000 intervention points, IV = >1000 intervention points.

[6] Although non-functioning equipment is exported from re-use organisations, the quantities are, however, smaller than the quantities of equipment which are processed or repaired by the re-use organisations.

[7] This takes into account that non-functioning equipment is also offered (often as equipment "for hobbyists").

[8] The commercial resellers take over a large part of the equipment from take back of used equipment from private customers through retailer, for example when the retailer supplies new equipment.

The financing of exports is determined through a series of factors. In the destination countries functional equipment and components are traded at higher prices than would be the case in Germany. The transport itself is relatively inexpensive. Often a mixed financing takes place via functional equipment, equipment which is used as source of spare parts and via equipment which will no longer be employed and used either for production of raw materials or treated immediately. A financing of exports exclusively on the basis for raw material appears improbable. For a CRT monitor, in countries such as Nigeria, less than € 1 is realised, the transport, however, costs significantly more than € 1. Equipment with a high recyclable fraction (e.g. washing machines and also PCs) with an exclusively resource-based financing of the export, the difference from the revenues in Germany and in the country of destination must act as economic driver of the export. This, however, is probably not the case. Continuing to be effective are costs saved for the disposal of non-recyclable fractions and the lower costs of the separation of the fractions in the countries of destination.

Furthermore, it is to be noted that a cross-financing with some types of equipment via treatment costs saved probably takes place (e.g. CRT screens). The costs are saved if the equipment was to be collected in accordance with the ElektroG and the waste management company does not pass lower costs to the (financially responsible) producer who already paid for treatment. Herein the types of equipment with treatment costs (e.g. CRT screens) differentiate themselves from the equipment types with revenues from treatment (e.g. washing machines). The latter do probably not arrive frequently in the collection system in accordance with the ElektroG but rather are captured for export.

Raw Materials

Because of data uncertainties different variants regading the exported volumes have been calculated. With this, data uncertainties on two different aspects have been taken into account:

- Total amount exported: A minimum mass flow of 93,000 t, a maximum mass flow of 216,000 t and a (weighted) average of 155.000 t have been considered.
- Exported mix of equipment: As already discussed above it is to be presumed that small equipment is underestimated. Thus, in addition to the equipment mix as described in the customs documents, a variant with higher portions of small equipment has been included in the calculations.

Table 4 summarises the variants.

Tabelle 4: Variants of mass flow calculations

Variant	Sub-variant	Overall export volume	Mix of appliance types	
			Portion CRT	Portion small appliances and PC
1	1	High	High	Small
	2		Slightly less	Increased
2	1	Low	High	Small
	2		Slightly less	Increased
3	1	Average	Average	Average

Based on the described variants total export volumes (weighted averages) for steel of 37,000 t (range from 18,000 t to 61,000 t), of 65.000 t CRT-Glas (range from 35,000 t to 81,000 t) and 23,000 t of plastics (range from 13,000 t to 33,000 t) have been calculated (see also figure 6).

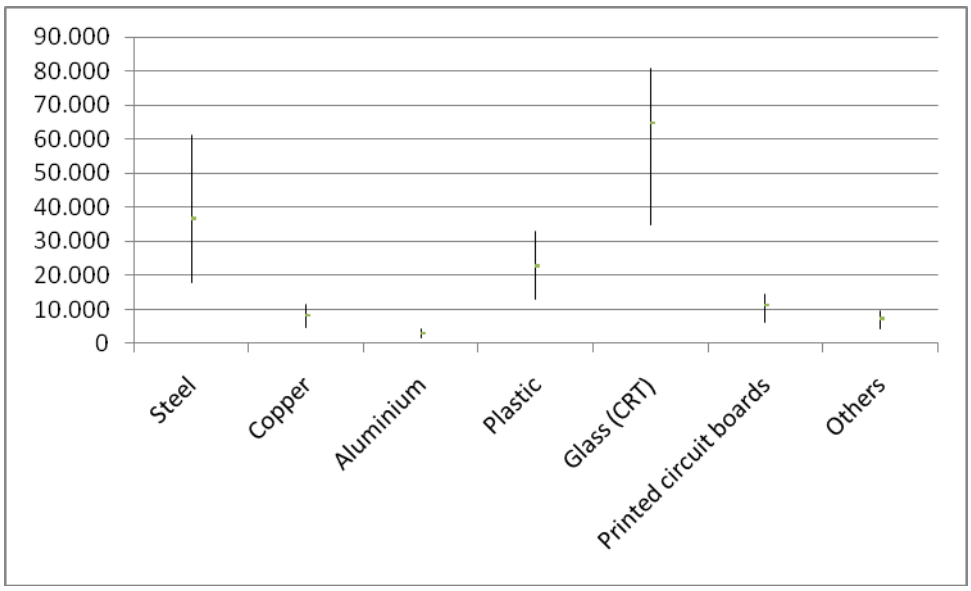

Figure 6: Ranges of exported mass flows (in t for 2008)

Due to the limited availability of data on the precious metal contents the portrayal is limited to gold, silver and palladium. The exported quantity of silver has been calculated at ca. 1.6 t (ranges from 0.5 t to 3.3 t), 300 kg of gold (ranges from 0.1 t to 0.6 t) and 120 kg of palladium (ranges from 0.05 t to 0.2 t) (see also figure 7 below).

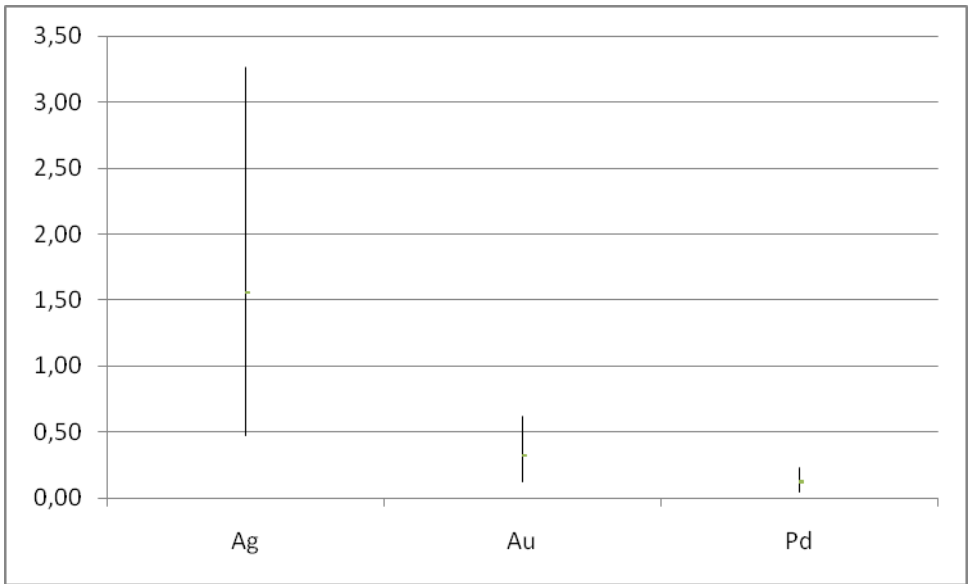

Figure 7: Ranges of exported mass flows of precious metals (in t for 2008)

Based on precious metal values as of the first quarter of 2008 the value of the exported precious metals is at ca. 9 million € (ranges from 3 million € to 17 million €).

Of substances with particularly high environmental relevance (other than the already given CRT glass) there resulted quantities of 22 t of batteries/accumulators (ranges from 7 t to 47 t) and 90 kg of mercury (ranges from 20 kg to 190 kg).

Under ideal market conditions, i. e. with the effects of market forces in the areas in which the electrical/electronic equipment is handled in the countries of destination, it can be assumed that mass-relevant raw materials with relatively good purity can be recovered/recycled for reuse. This applies, for example, for steel and copper and, to a limited extent, aluminium (the recycling of the latter is dependent on whether it is identified and whether sufficient quantities are yielded in order to carry out separation).

For ca. three quarters of the exported quantities it can be assumed that the lacking waste management infrastructure leads to the final disposal of materials (often on unsuitable areas). The inadequate possibilities for final disposal, primarily with batteries and accumulators, mercury switches, capacitors and oils, lead to direct environmental effects.

No analysis is available regarding the reclamation rates for precious metals and rare earths in the countries of destination. Based on analysis in Bangalore and treatment processes applied in Asia it can be assumed according to [Hagelüken 2009] that reclamation rates for gold of 25 % are achieved when printed circuit boards are treated in simple processes. Palladium, rare metals, lead and nickel will be lost. According to this basis it can be estimated that ca. 240 kg gold (ranges from 90 kg to 458 kg) and 120 kg palladium (ranges from 50 kg to 230 kg) are lost in the countries of destination. If similar reclamation rates are applied for silver as done for gold it can be estimated that 1.2 t of silver would be lost (ranges from 353 kg to 2,445 kg).

It has to be noted that this calculation model assumes that the equipment is actually collected in the countries of destination and that market forces in the regions ensure that (limited) reclamation possibilities are applied. To what extent this is actually the case is not known exactly and would require investigations in those countries.

Measures

Measures have been elaborated which can contribute to the optimisation of control and monitoring of transboundary flows of electrical equipment. Those measures are presented in following table 5.

Table 5: Summary of the proposed measures

Measure		Addressee	Implementation level
Statistics			
1a	Evaluation routines for the export databases should be developed and implemented in order to simplify or enable monitoring.	BMF (German Federal Ministry of Finance) supporting work by enforcement authorities	Short-term
1b	A simple access to the export data should be provided for the waste surveillance authorities (if necessary also of those German Federal States other than Hamburg), in order to enable a monitoring of the development of quantities.	BMF	Short-term
1c	It should be permanently ensured that the police forces have access to the exports databases.	BMF	Short-term
1d	European statistics for important exported types of equipment such as, for example, monitors, television sets, refrigerators should be differentiated between new/used equipment in that appropriate codes are introduced into the combined nomenclature (a world-wide harmonisation is recommended as long-term perspective).	BMF	Medium-term
Sources of exported equipment			
2a	The collection of bulky waste should take place in such a form that protection against pilferage of waste electrical and electronic equipment is provided.	Federal states / municipalities	Short-term
2b	The public should be more intensely informed about its own role in relationship to the export of waste electrical and electronic equipment and its negative effects.	UBA (German Federal Environment Agency)/ VKS/VKU (German Association of Municipal Waste Management and City Cleaning in VKU), all protagonists	Short-term
2c	Manufacturers should elaborate and implement explicit corporate policies for the export of used electrical/electronic equipment and waste electrical/electronic equipment.	Manufacturers / BMU (German Ministry for the Environment, Nature Conservation and Nuclear Safety)	Short-term
2d	Quality label and voluntary self binding agreement for resellers should be elaborated and implemented (Objective: non-export of non-functional equipment in non-EU States). The integration of the label development in the UBA promoted project “Second Life” is recommended.	BMU / UBA	Short-term
2e	A voluntary self binding agreement of manufacturers and exporters for the non-export of non-functional used equipment should be presented at the CeBIT Trade Fair in 2011.	BMU / UBA	Short-term
2f	Corporate policies for the export of non-functional equipment should be taken up by company ranking.	Ranking organisations	Medium-term

Table 5: Summary of the proposed measures (continued)

Measure		Addressee	Implementation level
Legal regulations and controls			
3a	The distinction between waste and non-waste for EEE/WEEE should take place via the amendment of the WEEE Directive. The existing draft should be refined in detail on this point.	BMU/UBA	Short- to medium-term
3b	A systematic survey of the collection points for equipment for export in the German Federal States should take place and criteria for the identification and checking of such points should be elaborated.	Federal states, municipalities	Short-term
3c	Risk profiles for the export of WEEE and UEEE should be developed further and exchange between the responsible authorities should be intensified.	BMF/UBA, Environmental authorities in NL and BE; focal points for the Basel Convention	Short-term
3d	Investigations using police means in certain potential areas of origin for exported WEEE/UEEE should be initiated (equipment which has already been in the waste regime and is to be exported as used equipment).	Environmental authorities, department of public prosecution	Short-term
Cooperation with countries of destination			
4a	Investigations should take place into how a re-export of fractions from the manual and mechanical disassembly of WEEE from the countries of destination into industrial states can take place.	EU, BMZ (German Ministry for Economic Cooperation and Development)	Short-term
4b	European countries and manufacturers should provide support with the build up of suitable waste treatment facilities and infrastructure in countries of destination.	Manufacturers, EU, BMZ	Medium-term

The analysis and the discussions with experts clearly showed that the improvement of the situation cannot be achieved via a singular measure. The proposed measures combine mid- and long-term activities and target numerous protagonists/players. An intensive monitoring of potential sources of equipment destined for export everywhere will not be possible due to restricted human resources and a desired high controlling efficiency. Control measures should therefore be focused on those spots which concentrate equipment destined for export (collection and loading points, ports).

Due to the transnational character of this problem with exports pure legislative approaches cannot solve the accompanying difficulties completely. Therefore voluntary measures on the level of manufacturers (but also of the re-marketing and waste treatment companies) have been developed.

It can be expected that the combination of these measures will mitigate the problem for Germany. In order to improve the situation in the countries of destination structurally, further activities on an international level are necessary.

The inclusion of further export rules into the recast of the WEEE-Directive is being welcomed in particular by the controlling authorities. Nevertheless with regard to the current export wave of CRT-monitors the implementation of the Directive within the Member States will come too late. With regard to the current large scale exports of old CRT-Monitors and -TV short term solutions should be found.

References

1. .[DESTATIS 2008] German Statistical Agency – Export statistic; Wiesbaden 2008
2. [BAN 2005] Puckett, J., Westervelt, S.,Gutierrez, R., Takamiya, Y., The Basel Action Network. The Digital Dump-Exporting Re-use and Abuse to Africa, 24.10.2005.[Basel 2006-1]
3. [Commission Regulation (EC) No. 1418/2007] Commission Regulation (EC) No. 1418/2007 of 29 November 2007 concerning the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No. 1013/2006 of the European Parliament and of the Council to certain countries to which the OECD Decision on the control of transboundary movements of wastes does not apply, dated OJ L 316, 4.12.2007, p. 6, in the valid version
4. [Correspondents' guidelines No 1] Revised correspondents' guidelines No 1 - Shipments of Waste Electrical and Electronic Equipment (WEEE), http://ec.europa.eu/environment/waste/shipments/pdf/correspondents_guidelines_en.pdf
5. [Correspondents' Guidelines No 4] Correspondents' Guidelines No 4 - Classification of waste electrical and electronic equipment according to Annex IV part I note (c) of Regulation (EC) No 1013/2006 on shipments of waste, http://ec.europa.eu/environment/waste/shipments/pdf/correspondents_guidelines4_en.pdf
6. [Customs Instruction] Instruction for the cooperation of (German) customs offices and (German) environment authorities within the framework of the shipment of wastes, http://laga-online.de/laganeu/images/stories/pdfdoc/veroeffentlichungen/Handlungsanleitung%20Zoll_02_2008.pdf
7. [EC Waste Shipment Regulation] Regulation (EC) No. 1013/2006 of 14 June 2006 on shipments of wastes, OJ L 190, 12.7.2006, p.1, in the valid version
8. [ElektroG] German Electrical and Electronic Equipment Law, dated 16. March 2005, BGBl. I p. 762
9. [Enforcement guidance LAGA] Enforcement guidance for the shipment of waste of the Working Group of the German Federal States and the Federal Government on Waste, http://laga-online.de/laganeu/index.php?option=com_content&task=view&id=22&Itemid=35
10. [Hoeppner 2005] Hoeppner, D. Änderungen in Internationalen Warenverzeichnis für den Außenhandel (SITC), Statistisches Bundesamt-Wirtschaft und statistik 12/2005, http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Querschnittsveroeffentlichungen/WirtschaftStatistik/Klassifikationen/AenderungenwarenverzeichnisProperty=file.pdf
11. [Oboro pers.com.] Oboro, John, Assistant General Secretary, Computer and Allied Products Dealers Association of Nigeria (CAPDAN), Lagos, Nigeria, phone conversation December 2008
12. [OECD Council Decision] Decision C(2001)107/Final of the OECD Council concerning the revision of Decision C(92)39/Final on the Control of Transboundary Movement of Wastes Destined for Recovery Operations, last amended on 26 October 2005 with Decision C(2005)141
13. [Osibanjo pers.com] Osibanjo, Oladele, Professor of Chemistry and Director of the Basel Convention Regional Coordinating Centre, University of Ibadan, Centre for Africa for Training and Technology, Ibadan, Nigeria, phone conversation December 2008
14. [Recommendation 2001/331/EC] Recommendation providing for minimum criteria for environmental inspections in the Member States 2001/331/EC, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:118:0041:0046:EN:PDF
15. [RoHS Directive] 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, OJ L 37, 13.2.2003, p. 19, in the valid version
16. [WEEE Directive] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on Waste Electrical and Electronic Equipment, OJ L 37, 13.2.2003, p. 24, in the valid version,
17. [Basel Convention] Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, http://www.basel.int/
18. [Becker RAL pers.com.] Technical discussion May 2009.
19. [UBA pers.com.], Technical discussion May 2009
20. [Weigelt pers.com.], Technical discussion May 2009
21. [Abfallverbringungsgesetz] German Waste Shipment Law, dated 19. July 2007, BGBl. I p. 1462, in the valid version
22. [DESTATIS 2009], Email of the German Statistical Agency, 08.01.2009