Electronic Scrap Project Styria

Contractor: Institute for Waste Disposal and Landfill Technology, University of Leoben

Customer: Styrian Provincial Government - Specialised Division 1c

Date of Publication: July 1998

1. Summary

In Austria about 80,000 t of electronic scrap are produced every year. This scrap will, for the most part, still be taken to the landfill although some devices contain components that must be classified as being hazardous waste. On the other hand, this practice is responsible for the loss of numerous valuable raw materials, such as iron, copper and aluminium, which are contained in the used electric and electronic devices in considerable quantities.

Based upon the "Elektronikschrottprojekt Weiz" (Electronic Scrap Project Weiz), the "Großversuch zur Sammlung und Verwertung von Elektro- und Elektronikaltgeräten" ("Large-scale test for collecting and recycling used electric and electronic devices") was made in the Styrian Districts of Feldbach, Fürstenfeld, Graz Environs, Leoben and Weiz from June 01, 1996, to December 31, 1997. Among these Districts 154 communes with altogether 260,000 inhabitants participated.

Like in the Project Weiz, the used electric and electronic devices were collected and subjected to further treatment after being separated according to the groups large devices, (e. g. electric stoves, washing machines), small devices, (e. g. mixers, radios) and screens, (e. g. television sets, monitors). The devices were collected via waste collecting centres, stationary and mobile collections of problematic materials, collections of bulky waste and traders for electric and electronic devices.
Small devices, screens and large devices containing pollutants had to be picked up by an authorised collecting company. Large devices could also be handed over to a scrap dealer along with normal iron scrap if the parts containing pollutants, above all capacitors, had been dismounted in the collecting centres before. However, random samples taken in cooperation with scrap dealers showed that freeing from pollutants did not work optimally yet.

In the course of the large-scale test, 66,189 kg of small devices, 198,007 kg of large devices and 65,000 kg of screens were recorded. As for the large devices, in particular, it is quite probable that the quantity recorded does not correspond to the quantity actually collected. This is due to the fact that large devices were often recycled along with the rest of iron scrap and that the quantity of these devices often was not documented.

Besides collection, the automatised processing of small devices was prioritised in this study. The small devices were freed from pollutants by Rumpold Co. and then processed in the small shredder of SMK Co. Like this 60 weight per cent of the input mass could be put to further use by recycling steel, copper and aluminium. About 20 weight per cent could be used by separating plastics. Putting the plastic fraction from the shredder on the landfill without pretreatment will no longer be admissible from 2004 because the TOC and some total pollutants cannot be kept. Due to the variety of fractions and the flame retardants containing halogen, which are not used yet, the residual materials produced at the mechanical processing of small electric devices should therefore be treated thermally in future. SMK aufgegeben wurde. Hazardous components, such as capacitors, had a share of 1 weight per cent. The other fractions were composed of tailings, cables to be processed separately and a recirculation fraction, which consisted of plastics with a higher metal content and could not be fed into the separating facility of SMK Co. again because its quantity was too low.

The large-scale test showed that the collection and recycling of used electric and electronic devices was quite feasible and useful. The legislator should support the separate collection of used electric and electronic devices until the EU Directive on the separate collection and recycling, which is being revised, enters into force. One option would, e. g., be to declare ÖNORM S2106 and S2107 (ÖNORM - Austrian Standard) as being binding.

2. Starting Position

Every year about 80,000 t of electric and electronic devices produce waste. About half of them comes from households or facilities resembling households. Small devices, in particular, still are put on the landfill along with the tailings and bulky waste. Large devices often are recycled as iron scrap without further treatment. This practice

is not very recommendable, in particular in view of the components in electronic scrap that contain pollutants, such as mercury switches and capacitors containing polychlorinated biphenyls (PCB's). On the other hand, many valuable raw materials, such as copper, aluminium and iron are lost as well.
In order to meet the principles specified by the Waste Management Act and to come closer to a future cyclical process, the Federal and Provincial Governments have, in the last few years, increasingly taken pains to find a legal or different regulation for electronic scrap. The draft of an Electronic Scrap Regulation has existed since August 12, 1993.

Before, however, a binding regulation can enter into force, it is useful to test its effects in practice on a small scale beforehand. For this purpose, two model tests, one in the District of Weiz in Styria and one in the City of Bregenz in Vorarlberg, were made. As the projects were accepted so well by all the participants, the collection and recycling of electronic scrap were continued in these areas.

In Styria the Electronic Scrap Project Weiz was extended to the Districts of Feldbach, Fürstenfeld, Graz Environs and Leoben. Many communes of these districts are extremely interested in a separate collection of electronic scrap for the simple reason that they take their tailings to the Landfill Markt Hartmannsdorf and high fees are charged there for electronic scrap residues in the garbage.

Under the name of "Großversuch zur Sammlung und Verwertung von Elektro- und Elektronikaltgeräten (EAG) in der Steiermark" ("Large-scale test for collecting and recycling used electric and electronic devices in Styria"), the project was made under the leadership of the Styrian Provincial Government, Specialised Division 1c (Waste Management), from July 01, 1996, to December 31, 1997. Furthermore, the project was accompanied and supported by the IED (Institut für Entsorgungs- und Deponietechnik der Montanuniversität Leoben - Institute of Waste Disposal and Landfill Technology of Leoben University).

3. Procedure

Project Area

154 Styrian communes, in which little less than a quarter (260,951 inhabitants) of the Styrian population lives, took part in the project. The Waste Management Associations of Feldbach, Fürstenfeld and Weiz participated with all their communes while only a part of the Districts of Graz Environs and Leoben joined the project (Graz Environs: 21 of 57; Leoben: 9 of 19).

The Specialised Department 1c - Waste Management - of the Styrian Provincial Government headed the large-scale test and was responsible for the basic organisation. Its main task consisted in planning and coordinating the large-scale test in cooperation with all those concerned. The individual tasks of the Specialised Department 1c were as follows:

- elaborating the basic structure of the large-scale test
- making sure all those concerned were ready to participate
- safeguarding the funding
- establishing an experience exchange group as a discussion platform for all those concerned and coordinating regular meetings of this group
- supporting the Waste Management Associations in informing the communes and traders for electric and electronic devices
- preparing information material and supporting the Waste Management Associations in public relations
- determining the collecting quantities in cooperation with the companies executing the collection and treatment

Collection of the used electric and electronic devices

For collecting the used electric and electronic devices, existing facilities like the ASZ (Altstoffsammelzentren - Centres for Collecting Used Materials) and centres for collecting problematic materials were entrusted. Furthermore, used electric and electronic devices were also collected in the course of collections of bulky waste and mobile collections of problematic materials. Some traders for electric and electronic devices also volunteered to take over used electric and electronic devices.

In the ASZ, the used electric and electronic devices were taken over by the employees of the respective communes and immediately sorted according to the three groups of small devices, large devices and screens. As the devices were taken over in a controlled way, it was guaranteed that the individual fractions were only blended with tailings to a minimum extent.
Mobile collections of bulky waste and collections of problematic materials are becoming less and less important. The decentralised collection in several centres in the commune, in particular, is increasingly being given up because no controlled takeover is possible and the collecting centres are ransacked and partly destroyed by

passers-by.

Companies charged with picking up and collecting the used electric and electronic devices:

- A.S.A.
- Kohl
- Kovac
- Kuttin
- Lobbe
- Müllex
- Rumpold
- Saubermacher
- Schauperl

Companies charged with treating and dismounting the used electric and electronic devices:

- Lobbe
- Kuttin
- Müllex
- Rumpold
- Saubermacher

Funding:

The large-scale test was supported and funded by one half by the Styrian Provincial Government and the Federal Ministry for Environment, Youth and the Family respectively. In the Districts of Feldbach, Fürstenfeld, Graz Environs and Leoben, however, the project sponsors also took over part of the collecting and treatment cost.

4. Goals

The essential goals of the large-scale test are:

- increasing the number of data available for designing a future regulation of electronic scrap and for allowing its implementation,
- documenting the acceptability among the population and their readiness to participate,
- Identifying factors influencing the collection by making a comparison between the Districts,
- documenting the further development of the collection in the District of Weiz under the changed basic conditions,
- assessing the recycling and disposal options according to ecological and economic aspects,
- making sure freeing from pollutants works well in the collecting centres,
- reviewing the possibility of a largely automatised processing of small electric and electronic devices.

Based upon the findings gained, proposals for designing and implementing a future Electronic Scrap Regulation were discussed.

5. Result / Benefits

The data on the quantities recorded are based upon information given by the Styrian Provincial Government, Specialised Division Waste Management (1c), the Waste Management Associations and the project communes. The project communes were to report their quantities collected to the FA 1c (FA - Fachabteilung - Specialised Department) in order to check whether the subsidy agreed upon (ATS 3.50 for each small device) had been refunded by the collecting companies.
Nevertheless, the quantities stated by the collecting companies, the Waste Management Associations and the

communes were different. This is mainly due to the fact that the communes mostly failed to document the quantity of the used electric and electronic devices picked up sufficiently.

What was especially difficult was to determine the collected quantities of the large devices, which were, for the large part, taken over by the scrap dealers after being freed from pollutants. Only the project communes of the Waste Management Association Leoben and the communes that handed over their large devices to authorised collectors with components containing pollutants documented the quantities collected sufficiently. For some collecting centres, only low quantities collected are reported because the records were partly missing or were insufficient. This is why the term "quantity recorded" will be used from this point. For the small devices and screens, the records are better than for the large devices. For the latter had to be handed over to authorised collectors, who reported their quantities collected to the FA 1c (FA - Fachabteilung - Specialised Department). The small devices and screens that were handed over to do-it-yourself people or unauthorised collectors were not recorded.

Quantities recorded:

As for these quantities, it should be noted that the quantities recorded in the Districts of Feldbach, Fürstenfeld and Graz Environs come from the period between July 01, 1996, and December 31, 1997 whereas the Districts of Weiz and Leoben have only reported the quantities recorded in 1996 and 1997 resp.

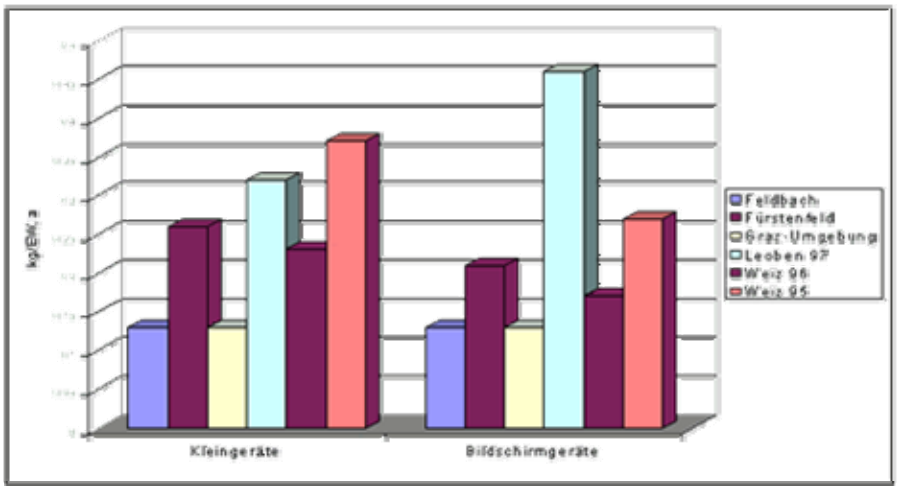
District	**Small devices [kg]**	**Large devices [kg]**	**Screens [kg]**	**Total [kg]**
Feldbach	12,683	29,412	13,050	55,145
Fürstenfeld	8,818	15,083	7,225	31,101
Graz Environs	9,214	17,036	9,425	35,675
Leoben 97	13,817	127,820	19,575	161,212
Weiz 96	18,934	0	13,950	32,884
Summe	**63,466**	**189,351**	**63,200**	**316,017**

Another problematic field was the recording of the weight because only the numbers of pieces were noted at the collection of large devices. The mass, however, was determined by taking the mean values of the Electronic Scrap Project Weiz as a reference.

Districts	Small devices [kg/inh., a]	Screens [kg/inh., a]	Large devices [kg/inh., a]
Feldbach	0.13	0.13	0.30
Fürstenfeld	0.26	0.21	0.45
Graz Environs	0.13	0.13	0.24
Leoben 97	0.32	0.46	2.98
Weiz 96	0.23	0.17	0.00
Weiz 95	0.37	0.27	1.01
Average	0.21	0.22	0.79

In the following Chart, the quantities recorded in the individual Districts were converted to one year and related to the number of inhabitants:

Large devices were not shown in the Chart.



Comparison of the annual inhabitant related quantities recorded in the individual Districts

There are several reasons for the fact that the quantities recorded are quite low in some project communes:

- As for the large devices, the insufficient documentation of the quantities collected obviously is the reason for the low quantities
- A certain influence may be read from the opening hours of the collecting centres
- In the District of Leoben, 3 waste consultants attend to 17 communes whereas 2 waste consultants were responsible for 55 communes in the Waste Management Association of Feldbach
- The fact that waste collecting centres are serviced at the site by the IED has shown that Hungarians and Slovenes come to the waste collecting centres on a regular basis and will, among other things, take along used electric and electronic devices. Even if the employees of the waste collecting centres refuse access to them, they will often wait for people delivering waste in front of the doors of the waste collecting centres and take over usable objects. As a waste disposal fee amounting to appr. ATS 200 has to be paid for screens in many waste collecting centres, the people delivering waste are, of course, glad if they can give their television sets to Hungarians or Slovenes free of charge.

Processing small devices in a small shredder:

Manually disassembling the small devices is difficult and thus cost intensive because there are so many different devices with a complex composition. For minimising cost in recuperating valuable substances while meeting the required environmental standards, a mechanical processing of small devices therefore is of utmost importance. For this reason, the attempt was made to comminute the devices by means of a shredder (coarse and fine shredder) (with the support of SMK Co., who made its shredder available) and to sort them mechanically afterwards (magnetic grader, zigzag sifter, sorting furnace, sorting table and corona separator).

Nevertheless, it was also at mechanical processing that great importance had to be attached to freeing the devices from pollutants. The small devices were subdivided into 4 groups:

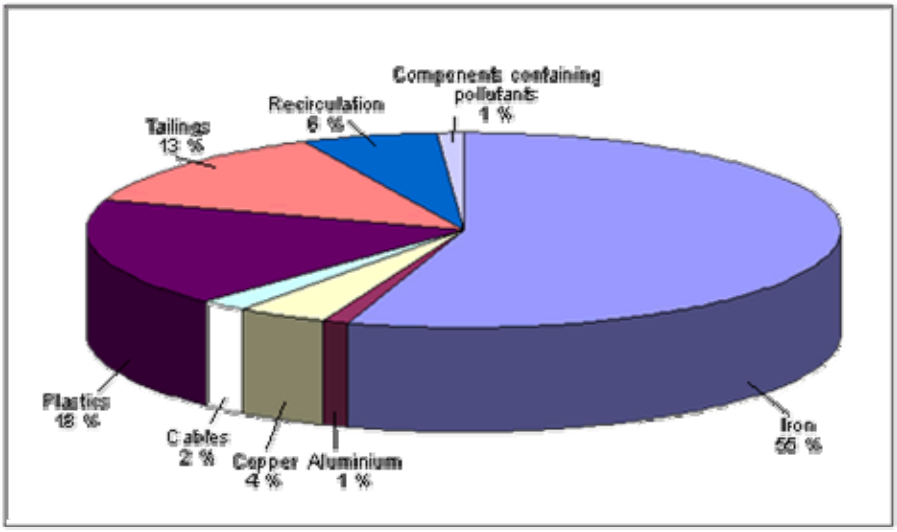
- Devices "without" pollutants, which are suited for the shredder test;
- Devices with components that may contain pollutants;
- Massive devices, which are not suited for the existing shredder and
- sorting fraction; sorting out mainly referred to iron, cables and tailings as well as pollutants, e. g. batteries

After the disposal or recycling of the individual fractions, the cost, incl. personnel expenditure, amounted to ATS 5.6 ATS /kg of used electric and electronic devices.

Volume balance for untreated kg of used electric and electronic devices (the test was made with 7,477 kg)

Fractions	**kg**	**Wt.%**
Iron	4,148	55.5
Copper	284	3.8

Aluminium	57	0.8
Plastics, coarse	1,006	13.5
Plastics, fine	322	4.3
Recirculation	425	5.7
Cables	170	2.3
Tailings	956	12.8
Capacitors	86	1.2
Batteries	12	0.2
Toners and inking ribbons	12	0.2
LCD	0,2	0.002



Analysis of the shredder fraction:

The analysis was made in the laboratory of the IED. The results were as follows:

- The magnetic fraction can be used for steel industry quite easily; the only problem is the high copper content, which amounts to 10 % and is a disturbing factor;
- The copper fraction has a percentage purity of 96 %;
- The fractions aluminium and plastics are so pure that they can be recycled;
- There were problems with humidity because the particulates sticked together, which prevented an optimal separation

Recycling:

Aluminium
35 % of today's aluminium needs are covered by secondary raw materials, (i. e. recycling). Alu will be molten open and the impurities will be removed by means of additives.

Copper
can be cycled as long as desired because recycling in pure fractions is simple. First the copper scrap will be molten down in different serial furnaces (admixture of different secondary raw materials for copper according to the copper content in different processing steps), foreign matter being separated in each section. Then upgrading to 99.9 % will be done by means of electrolysis.

Iron (and steel resp.)
will be admixed for cooling at steel production according to the LD Process. Furthermore, scrap can be used almost completely for electric steel production.

Plastics

will be recycled by using the materials (remelting, granulating), raw materials (transforming the molecules) or for producing energy (incineration).

The large-scale test has shown that the separate collection and a subsequent processing of used electric and electronic devices are absolutely feasible and viable. On the one hand, it allows to prevent parts containing pollutants from being taken to the landfill or from getting into nature. On the other hand, raw materials for metal and plastic industries can be won by the processing in a shredder.
This means that harmful environmental impacts could be prevented, raw material and energy resources could be saved, the consumption of landfill volume could be reduced and only materials that would not leave any potentials for risk for the following generations were left. Thus the projects have succeeded in implementing the requirements placed by the Waste Management Act without disproportionate expenditure.

Recommendations for the Electronic Scrap Regulation:

- Controlled takeover of the used electric and electronic devices in a waste collecting centre; no decentralised collection because the collecting isles are destroyed
- Separating the waste according to the three groups large devices, small devices and screens
- Freeing from pollutants in the waste collecting centres should be continued but needs to be optimised
- Pointing out to scrap dealers they should only accept material freed from pollutants or charge fees for eliminating pollutants from devices containing pollutants
- Incorporating the traders for electric and electronic devices into the collection; taking back used electric and electronic devices might be offered as an additional service
- As many used electric and electronic devices have components containing pollutants, mechanical processing still is quite difficult and cost intensive. If used electric and electronic devices are produced without components containing pollutants and the variety of plastics is reduced tremendously in future, mechanical processing will definitely be a useful way of recuperating raw materials