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Working Group on Waste Prevention and Recycling

HOW TO APPLY ENVIRONMENTALLY SOUND MANAGEMENT TO SMALL AND MEDIUM SIZE ENTERPRISES

Case Study: Pre-treatment and Recovery of Waste Electric and Electronic Equipments (WEEE)

3rd Workshop on Environmentally Sound Management (ESM) of Wastes
Washington D.C., 20-22 March 2002

This paper was submitted to the Delegates of the Working Group on Waste Prevention and Recycling and participants to the third workshop on Environmentally Sound Management of Wastes for consideration in March 2002.

Henrik Harjula, Tel: +33 (0)1 45 24 98 18, Fax: +33 (0)1 44 30 61 79, Email: henrik.harjula@oecd.org

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FOREWORD

At the second Workshop on Environmentally Sound Management of Wastes (ESM) in September 2000 considerable interest was expressed in an OECD framework that would enhance industry progress toward sustainable practices by emphasising the use of existing Environmental Management Systems (EMS), such as ISO 14 000 series and the European Eco-management and Audit Scheme (EMAS). It was recognised that EMS could play a role in promoting the application in practice of ESM guidance. However, it was emphasized that any ESM system making use of such EMS would also have to provide approaches that small and medium size enterprises (SMEs) could implement.

At the October 2001 meeting of the Working Group on Waste Prevention and Recycling an extended outline was provided concerning a study on "How to Apply ESM to small and medium size enterprises [ENV/EPOC/WGWPR/RD(2001)2]. The study is composed of three case studies and a synthesis report. Case studies look at car dismantling in the Netherlands, pre-treatment and recovery of electronics in Austria and dismantling of ships in Canada.

This case study on pre-treatment and recovery of waste electric and electronic equipments in Austria has been prepared mainly by Mr. Kees Wielenga, Fact Management Consultants, Braine l'Alleud, Belgium. It provides an in-depth analysis on the possibilities of the electronics recovery facilities to implement the ESM guidance developed for the OECD purposes. This version incorporates the comments from the Members of the ESM Steering Group.

Member countries recommended the declassification of this paper in December 2002. It is released on the responsibility of the Secretary General of the OECD.

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1. INTRODUCTION

The Organization for Economic Co-operation and Development (OECD) has made considerable efforts over the last 30 years in development and promulgation of international policies to promote Environmentally Sound Management (ESM) of wastes. In the OECD context ESM could be defined as: 'a concept for ensuring that wastes, and used and scrap materials are managed in a manner which will save natural resources and protect human health and the environment against adverse effects which may result from the management of such wastes and materials'.

Recently its Working Group on Waste Management Policy (WGWMP) has organized two workshops to discuss the scope and future promotion of ESM in particular for recoverable wastes. These workshops, held in October 1999 in Cancun, Mexico and in September 2000 in Vienna, Austria, focused on the different aspects related to ESM and in particular it was recognised that an important goal of an ESM program would be to:

1. develop high level guidelines/standards in order to foster sustainable development (in particular encouraging waste minimisation, including recovery) and
2. achieve a more level playing field for the environmentally sound management of wastes and used and scrap materials within the OECD countries.

Certainly, numerous questions regarding the scope and content of ESM still remain, however, progress was made in identifying a possible framework:

1. The principal focus of an OECD ESM programme should be on recovery. However, to maximise resource efficiency, recovery should not be addressed in isolation and there may be a need to touch upon some upstream or downstream issues because of their link to enhancing environmentally sound recovery.
2. An OECD ESM programme should be designed to be useful for both domestic and transboundary applications and it should address both the hazardous and non-hazardous wastes and used and scrap materials.
3. An OECD ESM framework should have at least two basic components.
 - One component would focus on enhancing industry progress toward sustainable practices by emphasising the use of existing Environmental Management Systems (EMS), such as ISO 14000 series and EMAS. However, any ESM system making use of such EMS would also have to provide approaches that small and medium enterprises could implement.
 - Another component would consist of ESM guidelines, including "core performance elements," to be used in conjunction with EMS, specifically relating to treatment and recovery activities. The core performance elements may be quite general in nature, pertaining to the management of many types of hazardous and non-hazardous wastes and materials, covering collection, re-use, recovery and disposal of residues. More specific guidelines may be necessary for certain problematic waste and material streams.

The concept of ESM should focus on treatment and recovery installations as a priority and on application of core performance elements by these installations to assure ESM of recoverable waste and materials.

Until now relatively little emphasis has been placed on the practical application of ESM by the treatment and recovery facilities. In this context it is important to bear in mind that most of these activities are performed by small and medium sized enterprises (SMEs), which would require specific support in relation to the knowledge of environmental requirements, training, investments in innovative technology and implementation of Environmental Management Systems. To shed more light into these questions a study will be carried out by a consultant to examine the applicability of ESM to SMEs.

On the basis of three case studies the mechanisms underlying the implementation of environmental requirements will be illustrated. These case studies cover the dismantling of end-of-life vehicles (ELVs) in the Netherlands, the pre-treatment and recycling of electrical and electronic equipment in Austria and dismantling of ships in Canada. This report describes the pre-treatment and recycling of electrical and electronic equipment in Austria.

The conclusions from the case studies will feed in to a synthesis report, which will give a more general overview of the factors that influence ESM implementation by the SMEs.

2. SCOPE AND OBJECTIVES

The case study will identify the factors that influence the possibilities of SMEs to implement ESM. There is no worldwide harmonised definition of SMEs. In a recommendation from the Commission from 1996 the EU includes a definition based on number of employees, annual turnover or total balance sheet and independence. For these the following criteria are included.

Table 1: Definition of SMEs (recommended by the EU)

Definition of a small and medium-sized enterprise (SME)			
Criteria	Micro-enterprise	Small	Medium
Number of employees	< 10	<50	<250
Annual turnover or total balance sheet	---	< €7M < €5M	< €40M < €27M
		No more than 25% of the capital or voting rights are held by one or more enterprises which are not themselves SMEs	

As far as possible these definitions will be used in the report. However, this is not the only definition of SMEs. Others may use thresholds of companies with less than 100 or 500 employees to define SMEs.

The case study will give answers on the following questions.

1. What mechanisms make that SMEs implement measures to comply with requirements of environmentally sound management?
2. What is the role of Environmental Management Systems in this context?
3. What are the most difficult elements to implement?

4. How can these difficulties be overcome?

Information will be gathered to describe how this Sector managed to implement the environmental requirements and which activities from the sector itself as well as of other actors (authorities, professional organisations, market players) influenced this. To that end information will be gathered on aspects such as:

- Structure of the sector (number of enterprises, size, volume of the activities, economical key figures);
- Rate of organization and role of professional organisations;
- General information on the technologies used;
- Environmental requirements and standards;
- Legal and policy framework;
- Enforcement activities;
- Dissemination of information and training activities;
- Financial instruments (taxes, levies and subsidies); and
- The use of Environmental Management Systems.
- Requirements for market players.
- Costs involved in the implementation of Environmental Management Systems

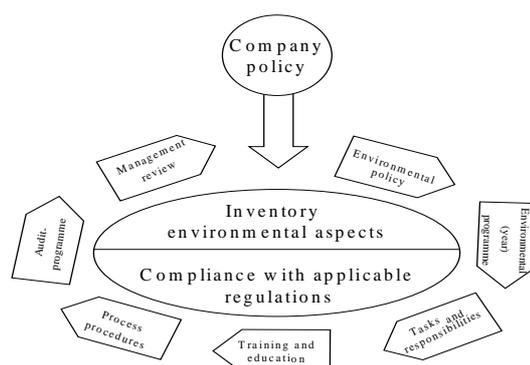
This information will be assessed in view of meeting the proposed ESM core performance elements according to the status per October 2001. These include the following:

1. an adequate regulatory infrastructure and enforcement should exist to ensure compliance with applicable Regulations
2. the facility should be appropriately authorised/permited/licensed on adverse environmental effects
3. the facility should have taken appropriate measures to ensure that requirements for occupational health and safety are met
4. the facility should be appropriately certified under an applicable environmental management system (EMS)
5. the facility should have an operative monitoring and reporting programme
6. the facility should have an operative inspection and recording programme for all input and output materials
7. the facility should have appropriate house and record keeping
8. the facility should have an appropriate and verified emergency plan
9. the facility should have an appropriate and operative training programme for the personnel
10. the facility should have an adequate financial guarantee for emergency situations and closure
11. the facility should have a system in place for the exchange of information on quality requirements with waste producers.

Since October 2001 some modifications to these elements have been proposed. In the context of the case studies these modifications could not be included anymore. However, the abovementioned list contains the essential elements and these have been assessed.

For the analysis the following model will be used.

Figure 1: Analysis model



This model is derived from the implementation cycle of environmental management systems and contains the steps companies undertake to analyse their environmental performance and implement actions to ensure compliance with applicable regulations and improve their environmental performance.

The conclusions of this case study will feed into a synthesis report, together with the conclusions of the other case studies. This should provide the OECD with information on the practical implications of implementation of ESM by SMEs.

3. KEY ECONOMIC DATA

3.1 Economic Activities

Austria has a little over 8 million inhabitants. The national GDP is 217 billion € in 2000 which places it as 22nd most important economy of the world (Worldbank). Nearly 70% of the GDP is generated by the services sector. The total number of enterprises in 2000 in Austria is a little over 300.000 (ÖSTAT). ÖSTAT uses definitions on size of the enterprises, which differ slightly from the EU definitions. The definition of company in this context is a local unit, which may underestimate the number of big companies to a certain extent. However, it is clear that the SMEs are the major part of the number of companies, in particular since the EU definition of SMEs uses 250 workers as maximum for medium-sized companies.

Table 2: Number of enterprises in Austria according to size

Category	Number of employees	Number of enterprises	Percentage of enterprises
Small	< 10	266.843	85%
Medium	10 – 100	43.967	14%
Large	> 100	3.676	1%
Total		314.486	

3.2 Waste Management Sector

Waste management activities include collection, pre-treatment and preparation for recycling as well as composting, incineration and landfilling. According to the waste management plan 2001 (Federal Ministry for the Environment) 28.6 Mton of waste was generated in 2000. This includes all household and industrial waste but excludes excavated soil. Of this waste, 63% was treated or recovered, 10% incinerated and 27% went to other treatment (including landfill). Table 3 and 4 provide for some key data on the number and size of the waste management sector in Austria. The turnover of this sector represents approximately 1.3% of the national GDP.

Table 3: Waste management sector in Austria in 1999

Waste management sector	
Number of companies	1.114
Number of employees	20.000
Amount treated (Mton)	30
Turnover related to waste management (M€)	29.000

Source VÖEB, 1999

Table 4 : Waste management companies according to size.

Company size (number of employees)	Companies (%)	Employees (%)	Waste amounts (%)	Turnover (%)
> 50	9	65	34	53
10 – 49	21	25	27	28
2-9	40	9	33	13
1	30	1	6	7
Absolute fig.	1.100	20.000	30 Mton	29.000 M€

Source VÖEB, 1999

No detailed figures on the different sub sectors of waste management are available. Also figures on profitability are not available.

Table 4 shows that waste management is mainly an activity of SMEs. However, these data do not take into account that an enterprise may have more than 25% of their capital or voting rights held by a company, which is not an SME.

A more detailed description of the sector of pre-treatment and recovery of WEEE is given in the next chapter.

4. MAIN CHARACTERISTICS OF THE WEEE SECTOR

The activities of pre-treatment and recovery of WEEE in Austria include a wide variety of techniques and waste streams. This includes:

- Pre-sorting at collection points
- Repair and sales of certain equipment
- Dismantling and de-pollution of certain types of equipment (e.g. refrigerators, televisions, PCs, fluorescent tubes)
- Recovery of dismantled parts (e.g. cathode ray tubes, printed circuit board).
- Recovery of metals via shredding and subsequent sorting techniques, including recovery of metals from cables.

The first three types of activities could be considered as pre-treatment activities. The pre-sorting activities are however not analysed in detail in this report. The last two types of activity are considered to be the recovery activities. Only those shredding activities that specifically aim at recovery of metals from WEEE are analysed in more detail in this report. The general shredding process, where WEEE is often shredded alongside ELVs and the recovery of cables were not analysed in detail.

Traditionally some of the bigger household appliances were collected in a separate system and treated by shredders to recover metals. The other activities in the sector developed mainly since the beginning of the 1990s. Germany had announced the development of legislation requiring take-back and dismantling of WEEE. Several companies saw this as an opportunity for business development. Companies that developed technologies for WEEE included the shredder companies, waste collection and treatment companies. Also some of the producers of electrical and electronic equipment developed new technologies.

4.1 Number and Size of the Enterprises and Turnover

There are very little key figures available for the sector. This is mainly due to the fact that it is a relatively new activity and that the companies involved are not distinguished as a separate sector in the general statistics.

There are no data on OECD or EU level. Also the key data on Austria are relatively scarce. The Austrian waste management plan gives the following overview.

Table 5: Installations for pre-treatment and recovery of WEEE in 2000

Waste type	Generation (t/yr)	Number of treatment installations	Total treatment capacity (t/yr)
Electrical and electronic equipment	85.000	16	28.000
Refrigerators	5.600	7	5.600
Fluorescent tubes	1.000	3	1.300
Total	91.600	26	34.900

It should be noted that the treatment capacity does not include the capacity of shredders. Those companies may either treat the metal-rich fraction from dismantling or may treat big household appliances without pre-treatment. In Austria 6 shredding installations recover metal from WEEE and other metal-containing wastes such as ELVs.

Most of the sites where the activities take place involve a relatively small number of employees (between 10 – 50). This does not mean that all of these companies should be regarded as SMEs. Some of them are owned by large companies such as RWE or Saubermacher, which are not SMEs.

The situation in Austria differs from the situation in the Netherlands. In the Netherlands a system of take back is implemented by an organisation that takes over these obligation from producers and importers. This organisation has contracts with a limited number of dismantlers (4) that manage the whole flow of WEEE for the Netherlands. These companies all have more than 250 employees or are owned by companies that are themselves no SMEs.

Data on the turnover and profitability of the sector are not available.

There are several initiatives for the repair and sales of WEEE, in particular for PCs. Often these initiatives have a social background, where these activities are promoted to secure jobs for weak social groups and to provide PCs to organisations that normally would not be in a position to buy new equipment. Very little data on the number and size of these companies are available. Data on the turnover of this sector are also not available.

4.2 Rate of Organisation

There is no professional organisation that specifically addresses the enterprises in this sector. Most of the companies are members of other professional organisations for waste management organisations or metal recovery.

4.3 Key Environmental Figures

In 1998, 6 million tons of WEEE were generated in the EU (4% of the municipal waste stream). The volume of WEEE is expected to increase by at least 3-5% per annum. This means that in five years 16-28% more WEEE will be generated and in 12 years the amount will have doubled. The growth of WEEE is about three times higher than the growth of the average municipal waste (AEA Technology).

At the beginning of the 90's nearly all WEEE was collected as residual waste. It was either landfilled or incinerated and some appliances were collected to recover metal without any pre-treatment via shredders. In the pilot study Bregrenz it was estimated that 95% of WEEE was managed in this way. This is considered to be the typical situation in countries where no specific take back schemes are in place.

The main environmental concerns related to management of WEEE are uncontrolled release of hazardous substances into the environment and sub optimal use of recyclable materials.

WEEE may contain several hazardous substances such as CFCs, heavy metals, oil, brominated flame retardants and PCBs. If not removed these will enter into the environment.

The metal content of WEEE might be recovered even without pre-treatment via a shredder. However, if materials such as plastics or glass should be recovered, separation of these materials from the metals and hazardous components is required.

Austria developed several standards for the pre-treatment of WEEE. According to the Austrian definition of environmentally sound treatment of WEEE metals should not be recovered via a shredder without pre-treatment. Otherwise pollutants would be spread to shredder fractions and cause higher emissions of the shredder unit and of the metal works, where the subsequent recovery of the metal takes place.

Pursuant to the Austrian guidelines on ESM of WEEE the direct input of WEEE fractions into a smelter without removal of hazardous components as specified in the Austrian Standard Önorm S2106 is not admissible. Details of this norm are provided in chapter 5.

Other OECD countries may apply other definitions of ESM.

There are no precise data on the percentages of equipment that is collected and dismantled according to the standards in 2000. It is estimated that approximately 50% of the WEEE is collected separately. The rest is still collected with the residual waste or is shredded without pre-treatment (personal communication Mr. Ferth BMU).

For refrigerators and fluorescent lighting the separate collection and treatment is estimated to be 80 – 90% (personal communication Mr Ferth, BMU).

4.4 Use of Environmental Management Systems

A large number of the enterprises active in the sector have ISO 14000 certification or EMAS registration. Some of them even have both. Moreover, the professional organisation of waste management companies (VÖEB) has developed a certification scheme for the sector called 'Entsorgungsfachbetrieb'. A number of the enterprises in the sector have the certificate for this scheme as well. This last scheme is however more a quality management system than a pure environmental management system.

The waste management sector is amongst the leading sectors in the implementation of environmental management systems in Austria.

5. DEVELOPMENTS IN THE SECTOR IMPLEMENTING ENVIRONMENTAL REQUIREMENTS

In Austria there are several pieces of legislation in place that regulate the management of WEEE. The management of refrigerators and fluorescent tubes is regulated via two Ordinances. In these Ordinances the requirements for take back and treatment are given. This implies that for these two streams mandatory systems are in place. These will be described in . First a description will be given of the management of WEEE in general.

5.1 Requirements and Developments of the Management of WEEE in Austria

To date there is no general obligation for the take back and management of all WEEE. Such a system is under preparation. Its implementation is awaiting the EU Directives on this issue. Austria has done considerable research into systems for collection and management of WEEE, anticipating on these European developments. Over the last years several pilot projects for the collection and treatment of specific parts of the WEEE waste stream were conducted. The knowledge gathered in this way will be used to set up a scheme after the adoption of the EU Directive. It is also fed into the legislative process on European level.

5.1.1 *General Description of the Waste Stream and Management of WEEE*

Improvement of treatment of WEEE requires several activities. The WEEE has to be collected separately. This is typically a combination of drop-off points operated by the local authorities and systems for take-back in shops, upon purchase of a new piece of WEEE.

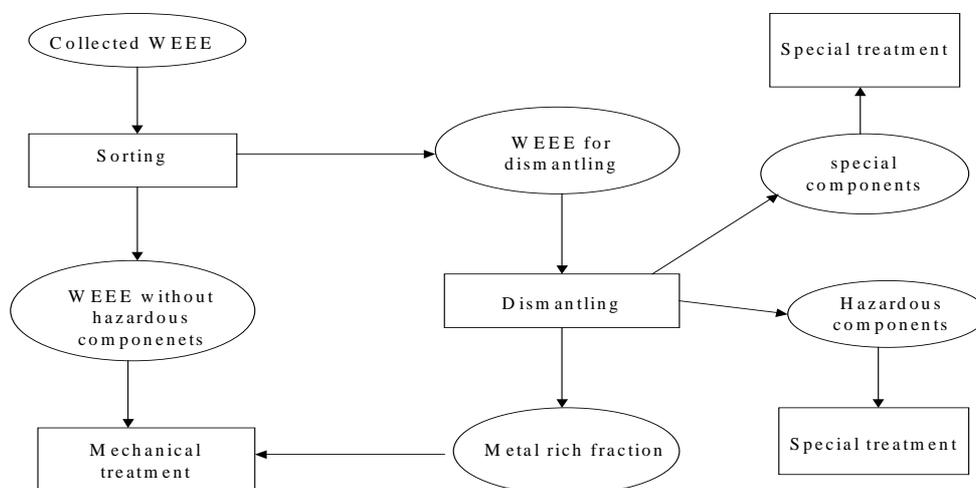
The collected material is then sorted. This may involve in certain cases the repair or refurbishment of equipment in view of re-use of the equipment or parts. Equipment that is not suitable for re-use is sorted into a fraction that require dismantling and a fraction that may directly be processed mechanically (e.g. via shredding).

Dismantling aims at removing hazardous components (e.g. capacitors containing PCB, mercury switches, CFC, asbestos and batteries) and certain special components and materials to improve recycling (e.g. printed circuit boards, CRTs, cables, certain plastics and wood). These sorting and dismantling activities are referred to as 'pre-treatment' of WEEE.

The different material streams from the pre-treatment will undergo a suitable further treatment or may be disposed of. These further treatments include different techniques for fragmentising and separation of different materials. These fragmentising and separation operations are referred to as recovery activities of WEEE.

Recovery activities aim at optimising yield of materials suitable for use as secondary raw materials. They may be used in secondary metal smelters, glass production, production of plastic products or other production processes. These last activities are not included in this case study, since they are not specific for WEEE. The use of materials as fuel and the treatment of residues via physico-chemical treatment, incineration or landfilling were not included for the same reason.

The different steps in the process of are illustrated in figure 2.

Figure 2: Steps in the processing of WEEE.

The WEEE waste stream typically is divided into different types of appliances according to their dismantling characteristics. The most commonly used categories are big household appliances, small household appliances and appliances containing cathode-ray-tubes (CRTs).

The big appliances such as dishwashers and washing machines etc. are traditionally collected via a separated system organised by the local authorities or via a system of drop off points. Also scrap dealers may be involved in the collection. These appliances consist for 95-98% of metals these are traditionally recycled without pre-treatment in shredders.

To improve the management of these appliances the main objective is to remove hazardous components prior to shredding. This includes removal of PCB-containing capacitors, mercury switches, batteries and accumulators and LCD-screens. Certain types of big appliances may contain asbestos or oil (in particular heating devices).

Small household appliances consist of a large variety of appliances such as vacuum cleaners, ironers, cd-players, boring machines and microwave ovens. The composition of these small appliances differs from the big appliances, because the amount of materials other than metals is much more important. Traditionally these appliances were collected together with the residual municipal waste and would end up in a landfill or a municipal solid waste incinerator.

To improve the management of these appliances both removal of hazardous components as well as selective removal of certain materials in view of their subsequent recycling is required.

For TVs and monitors the fact that these contain a cathode ray tube is the most relevant difference with the other types of WEEE. Glass makes up a little over 50% of the weight of this type of equipment. Traditionally this equipment ended up in a landfill or in an incinerator for municipal solid waste.

The removal of the CRTs and hazardous components are the main activities to improve the management of this equipment. The CRTs are subsequently treated to separate the different types of glass and the fluorescent powder can be removed. The glass is then suitable for recycling.

In Austria also a category of ‘special’ appliances is used. These appliances include e.g. oil containing electrical heaters, asbestos containing heating systems, big appliances from businesses and appliances from hospitals. This type of appliances may require specific treatment due to size or specific hazardous components (e.g. radioactive components from medical devices). Also refrigerators and fluorescent lighting could be considered as ‘special’ appliances but they are not included in the following overview.

5.1.2 Composition of WEEE and Collection Rates

The amounts of different materials of different types of appliances as found in the Pilot project Bregrenz (1996) is indicated in table 7.

Table 6: Composition different types of WEEE (in % of weight).

Type of equipment	Metal-containing fraction	Printed circuit boards	Hazardous components	Other ¹
Big household appliances	98.7	0.04	0.3	1
Special big appliances ²	91.6	0	8.3	0.1
TV's and monitors	17.8	2.8	1	78.4
Computers	76.1	4.2	1.6	18.1
Film/photo	78.7	3.3	0.7	17.3
Leisure electronics	60.7	4.1	3.1	32.1
Small household appliances A ³	76.4	0.4	0.3	22.9
Small household appliances B ⁴	86.5	0.6	1.5	11.4
Special small appliances	60.5	17.1	11	11.4

This composition mainly determines the potential for recycling. It also determines the amount of hazardous components that should be expected to be present. Management of these components are one of the main elements determining the costs of the management of WEEE. Moreover, small appliances are typically more expensive to dismantle than big appliances. This is mainly due to the fact that dismantling time depends upon the number of appliances whereas the revenues are generated per ton of material.

The share of the different fractions of WEEE may differ. The results from three pilot projects in Austria indicate the following distribution (in kg collected per inhabitant) (Pilot project Flachau, 1998 and Salhofer et al, 1999):

¹ Mainly plastic, glass and wood.

² Including heating devices, boilers etc.

³ Category A was considered to be dismantled easily, e.g. coffee machines, ironers, vacuum cleaners.

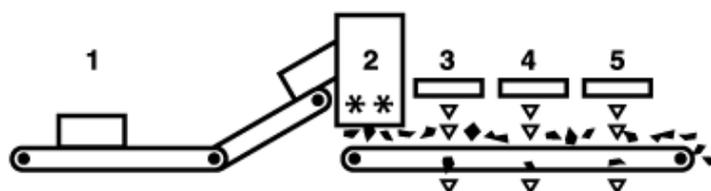
⁴ Category B was considered to be dismantled with more difficulty, e.g. boring machines,

Table 7: Composition of WEEE in different parts of Austria

Group	Bregrenz I	Bregrenz II	Weiz	Flachau	Average
TVs and monitors	1.08	1.11	0.35	0.51	0.76
Small appliances	0.92	1.03	0.44	0.6	0.75
Big appliances	1.81	1.88	1.76	1.59	1.76
Special appliances	0.75	1.04	0.49	0.8	0.77
Total	4.56	5.06	3.04	3.5	4.04

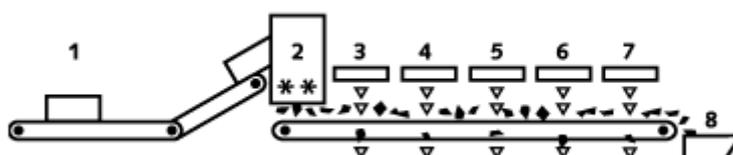
5.1.3. Process Steps for Different Types of WEEE

The different types of equipment may require different steps in the treatment. For a big appliance such as a washing machine the following steps are taken:

Figure 3: Dismantling Scheme of Big Appliances

1. dismantling (of hazardous components and of components for reuse)
2. shredding
3. removal of ferrous metal
4. eddy-current (separation of aluminium)
5. stoner (separation of heavy and light fraction; both of which have to be disposed of).

For a small household appliance such as a coffee machine the following steps are taken:

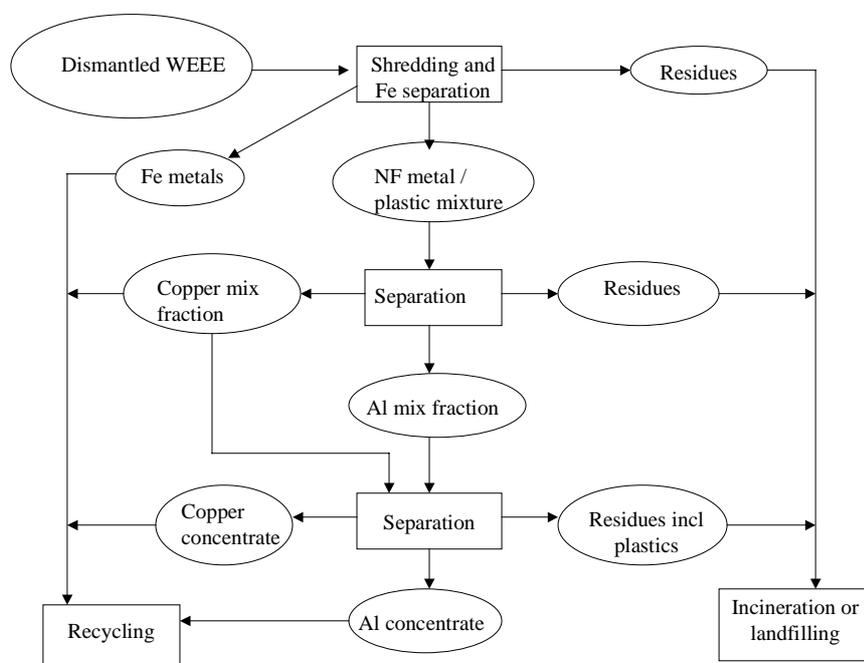
Figure 4: Dismantling Scheme of Small Household Appliances

1. control and dismantling (of hazardous components and of components for reuse)
2. shredding
3. removal of ferrous metals (magnet)
4. wind sifter (removal of light fraction)
5. eddy current (separation of non-ferrous metals)
6. separation of stainless steel
7. separation of copper
8. residue.

The metal-containing fraction from dismantling is subsequently treated mechanically. This treatment may consist of different steps, including cutting, shredding and grinding, separation of ferrous

and non-ferrous metals using techniques such as sieving, magnetic, eddy-current, corona separation, sink-float technologies, jigging etc. The typical scheme for the mechanical treatment of WEEE may consist of the elements illustrated in figure 5

Figure 5: Scheme of treatment of dismantled WEEE



In several projects the shredding and subsequent separation of a non-ferrous rich fraction was monitored. The following results concern the shredding of the metal fraction of big appliances after removal of hazardous components and printed circuit boards (Salhofer, 1999).

The output of the shredder consists of ferrous metal (66-77%), non-ferrous metals (including a heavy residual fraction, 15-16%) and a shredder light-fraction (6-15%).

The fraction containing the non-ferrous metals can be separated further to recover additional metals. Of this fraction that consists of 15-16% of the original input to the shredder, an additional 6-9% of non-ferrous metal can be recovered. The total amount of metals that could be recovered from the shredding and subsequent separation of non-ferrous fractions is therefore approximately 80% and 20% are residual fractions that must be landfilled or incinerated.

For the metal-containing fraction after dismantling of small appliances the recoverable metal content was estimated to be 33% ferrous metal and 14% non-ferrous metals (mainly copper and some aluminium).

The recoverable metals from shredding of printed circuit boards were estimated to be 35% ferrous metal, 25% copper, 2% aluminium and 1% precious metal.

5.1.4 *Legislation*

Currently there is no legislation requiring take-back of all WEEE in Austria. The EU is preparing legislation to that end which will be transposed into national legislation. Several activities have been undertaken to anticipate the implementation of this legislation. The pro-s and con-s of different types of take-back schemes have been investigated and several parties are considering setting up systems for financing and organisation of the take-back and subsequent treatment of WEEE in Austria. Austria also indicated what the requirements should be for the dismantling and subsequent treatment of WEEE. These have been described in the waste management plan of 1998.

A number of types of WEEE have been identified as hazardous waste under Austrian legislation. This includes not dry-laid oil radiators, asbestos-containing thermal storage heating stoves and CFC-containing refrigerating equipment. For these streams the separate take-back and removal of hazardous components is a legal requirement.

5.1.5 *Requirements for Dismantling of WEEE*

Austrian waste management plan contains recommendations for the dismantling of WEEE and the subsequent treatment of the different components of WEEE. These recommendations are laid down in a standard: Önorm S2106, which uses the following principles.

- A separation of appliances that are considered to be hazardous waste as such and other appliances.

For all the appliances, (even the non-hazardous ones) dismantling should be performed in such a way that the hazardous components are separated from the appliance. Further dismantling to increase recycling or recovery is left to the operator who will make a choice on the basis of the costs and benefits of additional dismantling.

- Special care should be taken that the hazardous components do not cause environmental damage.

Also particular attention should be paid to the possibility of formation of brominated dioxins and furans from flame-retardants in certain plastics and the dispersion of beryllium oxide from semiconductors during shredding of WEEE. When appliances contain operating agents such as oil, acid or toner, these should be duly removed before or during dismantling.

For cables stripping is required and burning is prohibited.

- Printed circuit boards should be free of the certain components or these have to be removed during dismantling.

These components include: mercury-containing components, larger electrolyse capacitors, PCB-containing components, batteries and accumulators and LCDs.

- CRTs must be treated in such a way that the metal and glass are separated.

The removal of phosphors is required, but there is no final solution yet for their management. They are currently exported to storage facilities in salt mines. Some pilot applications for the use of CRT-glass as vitrifying agent for residues from incineration are undertaken. To some extent purified CRT-glass is used for the production of new CRTs.

According to the new European Waste List that entered into force on 1 January 2002, CRT-glass fines (without coating), CRTs and coated CRT-glass is classified as hazardous waste. Landfilling of hazardous waste (without a proof of declassification for the purpose of landfilling) is prohibited in Austria since July 2001.

The waste management plan prescribes the treatment and disposal methods for a large number of fractions from dismantling of WEEE according to Önorm 2106 (table 8).

Table 8: Recommended treatment and disposal methods for components of WEEE as prescribed in Önorm 2106.

Treatment and disposal methods			
Fraction	Recovery	Thermal treatment	Other treatment
	<i>Metal, metal casings</i>		
Contaminated iron and steel	✓		
Non-ferrous metals	✓		
<i>Non-metallic casing and parts</i>			
Plastics	✓	✓	
Wood, chipboard	✓	✓	
<i>Cables and lines</i>			Mechanical separation
Metal, e.g. copper	✓		
Residual fractions, e.g. plastics, rubber	✓	✓	
<i>Cathode ray tubes</i>			Separation into metal parts, glass parts with or without coating etc.
Contaminated iron and steel waste	✓		
Non-ferrous metals	✓		
Cathode-ray tubes and screen coatings			Special treatment
<i>Ceramics, glass</i>	✓		
Printed circuit boards, with components			Dismantling, followed by recovery
Printed circuit boards, dismantled or without components			Separation into metal and residual fractions
Contaminated iron and steel waste	✓		
Non-ferrous metals	✓		
Residual fractions		✓	
<i>PCB-containing capacitors</i>		✓	
Electrolyte capacitors	✓	✓	
Batteries, unsorted			Special treatment
Lead accumulators	✓		
Nickel cadmium accumulators	✓		
Lithium cells			Special treatment
LCDs			Special treatment
Mercury containing components	✓		
Electrical operating material containing PCB and PCT		✓	Special treatment
Asbestos waste			Special treatment
CFCs and other cooling agents		✓	Special treatment

The recommendations in Önorm S2106 are used by the competent authorities for the issuing of licenses as well as for the evaluation of ESM in the context of transboundary movement. The recommendations constitute state of the art treatment. When issuing a license the competent authority may however derogate from these recommendations.

5.1.6. *Developments in the Management of WEEE*

Since the system of separate collection of WEEE is not mandatory, not all WEEE will be collected and treated in the type of facilities working under the conditions as described in the Önorm. There are no precise data on the percentages of equipment that is collected and dismantled according to the standards in 2000. It is estimated that approximately 50% of the WEEE is collected separately. The rest is still collected with the residual waste or is shredded without pre-treatment (personal communication Mr. Ferth BMU).

The development of the system started in 1994 when the Ministry published a draft Ordinance on the collection and treatment of WEEE, similar to the German draft from 1991. In this Ordinance a system of separate collection and treatment as well as a system of financing involving shared responsibility of consumers and producers was proposed. This draft was heavily criticised by both the local authorities and the industry. Local authorities wanted to assure that the costs of separate collection would be paid for by the industry. The industry was concerned by the costs of treatment.

The Ministry decided to wait with the implementation, because on EU level work on a European directive had started. In stead the Ministry started a program of pilot-projects to gain practical experience with the collection and treatment. The program also provided information on the amounts that could be collected via different collection schemes, the possibilities to dismantle and treat the different types of equipment and data on costs and efficiency of the different systems. The Federal government financially supported these pilot-projects.

In the period between 1995 and 2000 nearly all states in Austria have started pilot-projects for the collection of WEEE. Most of these projects have been finalised and the results have been published. Although the financial support from the Ministry has stopped, most of these pilot-schemes have continued their activities. This is mainly due to the fact that it is very difficult for a public authority to explain to the citizens that the collection should stop after being successful for a number of years. Moreover, due to the extensive pr-activities during the pilot period citizens know that the treatment of WEEE has considerable environmental advantages. The facilities for the treatment are available and the costs are only marginally higher than the traditional treatment. This implies that the extra costs only represent a small percentage of the total costs for waste management.

5.1.7. *Why Companies Invested in New Technologies*

A number of firms were already for a long time involved in the treatment of certain types of equipment of certain components. These were mainly the firms involved in metal recycling. Shredders traditionally had a certain percentage of their input material that consisted of big household appliances. These were however shredded without pre-treatment. Also certain components contain relevant amounts of precious metals. Several firms had specialised in collection of these components, such as circuit boards and big telecommunication equipment. Also the recovery of metal from cables was an activity related to WEEE. It was mainly this type of firms that started the development of dismantling and specialised treatment technology for WEEE. Also some secondary metal smelters did invest in these technologies, mainly to safeguard their supply of high quality input material. Also some of the leading manufacturers of

equipment were involved in these developments. Their main objectives were image and to assure that costs of end-of-life management would remain within reasonable costs.

In the beginning of the 90's the first drafts of legislation on take back and treatment of WEEE were published in Germany. A number of the firms that already were handling WEEE saw this as an opportunity to develop new markets. Since it was expected that legislation would make treatment obligatory large investments were made in the development of technology and the building of facilities.

A number of these firms however, disappeared around 1995 because the legal developments were slower than expected. Also the technical difficulties of dismantling a large number of different types of equipment were underestimated. Only those firms that had developed efficient dismantling technologies and procedure, high quality treatment and enough other activities to support the losses on treatment of WEEE from households could survive. E.g. the dismantling of CRTs from industrial clients was one of the activities that did survive this period.

At the end of the '90 the investments in the sector did increase again. This was due to the increased confidence that a system of legally binding take back will emerge in the coming years. Also the fact that the different pilot-projects did not stop after the pilot phase gave new confidence to the industry to continue the preparations for a full-scale system capable of serving the whole of the Austrian territory.

5.1.8. *Costs of Dismantling*

The pilot projects in Austria also looked into the costs for dismantling. These may vary considerably, depending on the time needed for the dismantling and the yield of material. Also the possible revenues of the materials should be taken into account. The main costs however are related to personal costs, since dismantling is to a large extend done manually, using small dismantling equipment such as hand-tools.

The following data on cost are found in Salhofer, 1999 where an overview of the different data from pilot projects is given. As far as can be assessed these data include only costs, not revenues of sales of materials.

The cost of pre-sorting and removal of hazardous components for small electrical appliances was estimated to be between 145 and 180 €/per ton.

The costs of treatment of small appliances (after removal of hazardous components) is approximately 250 – 300 €/per ton.

The costs of shredding and separation of ferrous metals from big appliances may cost 60 – 70 € per ton. The subsequent separation of non-ferrous metals may cost 80 – 145 €/per ton, depending on the technology used and the required degree of purity of the separated metals.

Treatment of cables costs 175 – 300 €/per ton.

5.2 Refrigerators

For refrigerators a separate system of take back and recovery is in place. The details of this system are described in this section.

The total amount of end-of-life refrigerators in Austria is estimated to be 5.600 ton per year (Austrian waste management plan 2001). The collection and management of this equipment is regulated via an Ordinance on the take back and by requirements on the handling of end-of-life refrigerators. In this system also other cooling equipment is included as well as equipment for air-conditioning. The main aim of the system is to assure that ozone-depleting substances are removed effectively and are disposed of in a controlled manner. The main obligations for the take back and treatment are laid down in the Ordinance on take back of refrigerators (BGBL, 1992/408). The implementation of these obligations is organised by the company Umweltforum Haushalt (UFH).

5.2.1. *Ordinance on the Take Back of Refrigerators*

The aim of this Ordinance is to assure that refrigerators are collected separately in view of the subsequent treatment for removal of hazardous substances and recovery of other materials.

The Ordinance foresees two possibilities of financing and take-back.

1. the distributor of a refrigerator requires the payment of a refund of 70 € upon purchase of the refrigerator or
2. provides upon purchase a 'recovery-voucher' of at least 7 € This recovery premium serves to cover (a part of) the collection and treatment costs of end-of-life refrigerators.

The refund system has the following characteristics. A distributor that applies the refund system will ask upon purchase payment of the refund. When somebody brings back a refrigerator for which a refund has been paid he has to accept taking it over and return the refund. The distributor assures the correct management of the equipment by a recycler.

Distributors may only use the recovery-voucher if they have a take back system covering the whole of Austria or if they take part in such a system. Any system needs approval by the Federal Ministry of the Environment.

The system must guarantee sufficient capacity of take back, a transparent system of financing and adequate documentation of the material flows.

In this system the distributor has to accept upon request of the client the take back end-of-life refrigerators upon purchase of new refrigerators based upon the principle of 'one old for one new'. The recovery-voucher does not necessarily cover all costs. The end-user may have to pay for the additional costs of take-back and treatment.

5.2.2. *Umweltforum Haushalt (UFH): The Approved Waste Management System for Refrigerators*

UFH organises the take-back and treatment of refrigerators in Austria. They have approximately 750 points where refrigerators and other big household appliances can be handed over (distributors, local authorities and waste management companies).

In 1996 150.000 pieces of equipment were collected and treated. In 2000 this was nearly 200.000 pieces. The last owners can give back the end-of-life equipment upon purchase of a new refrigerator. If they have an old voucher from a system put into place at the beginning of the 90's they can put it on the end-of-life equipment and it will be taken over without additional costs. This voucher was obtained in a period when this was supposed to cover all costs, unlike the current system that only covers part of the costs of take-back.

The equipment can be handed over with the new voucher of 7 €. In that case an additional payment of 31 € is required. If the equipment is handed over without any voucher a payment of 38 € is required. These 38 € are used to cover the costs of collection, dismantling and treatment of the different materials of the refrigerator.

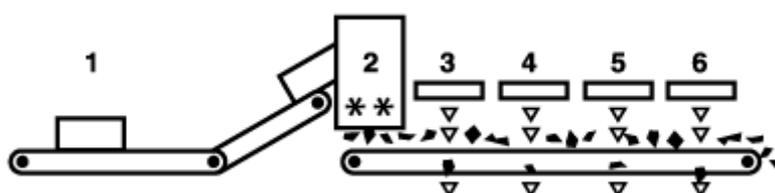
The end-of-life equipment that is not handed over upon purchase of a new refrigerator can be handed over to a take-back centre of UFH. The financial arrangements are the same as indicated above.

UFH assures the dismantling according to the requirements set in the Austrian legislation as described in the next section. UFH is the only system for refrigerators from households operating in Austria. Only for large cooling equipment from shops an alternative system is available.

5.2.3. *Requirements for the Management of Refrigerators.*

The dismantling of refrigerators includes the following stages.

Figure 6: Dismantling Scheme for Refrigerators



1. dismantling: removal of residual waste, cables, glass, draining of the cooling liquid and oil and removal of the compressor
2. shredding
3. removal of ferrous metal
4. wind sifter: removal of PUR foam for subsequent degassing
5. eddy-current: removal of aluminium
6. separation of plastics and residual metals

One of the important aims of the management of refrigerators is the prevention of release of ozone depleting substances (CFCs and HCFCs). These substances are contained in the cooling circuit (1/3 of the CFCs) as well as in isolation foam (2/3 of the CFCs).

The following requirements have to be met by the companies handling refrigerators. The 7 companies working under contract with UFH meet these requirements.

1. General
 - Storage, handling and transport should be done in such a way that the devices are not damaged and release CFCs in an uncontrolled manner.
2. Management of the cooling circuit
 - Removal of CFCs should be done on liquid proof and solvent proof surfaces. Also mobile stations should be operated on such surfaces only.
 - Coolant liquid and compressor oil are to be removed together; the removal should be complete. From each refrigerator at least 115 gram of CFC should be removed.
 - The coolant liquid and compressor oil are to be separated afterwards or to handed over to a facility that will separate them. After separation the residual CFC in the compressor oil shall not exceed 0.1% of weight.
 - The compressor shall be removed.
3. Removal of other materials
 - Glass and mercury switches shall be removed.
4. Management of the isolation foam
 - Either the foam is shredded in view of capturing the enclosed CFC or the device is incinerated after removal of the cooling circuit. Prior to incineration the device may be shredded.
5. Removal of CFC from the foam
 - Shredding of the foam should be performed in lowered pressure atmosphere, the gasses should be filtered with an active coal filter. Air emissions of CFC shall not exceed 150 mg/m³.
 - Depending on the type of equipment the following amounts of CFC should be removed from the shredded foam:
 - Household fridges: 240 gram;
 - Household fridges-freezer combinations: 320 gram.
 - Household freezers and deep-freezers: 400 gram.
 - Residual CFC in the foam should not exceed 0,2% in weight.
6. Incineration of the device
 - Copper containing elements are to be removed to a large extend
 - The device may be shredded before incineration. This should be done in such a manner that emissions of CFCs are prevented. The air filters used for this prevention should be treated in such a way that the CFCs contained in them are destroyed.
 - The incineration of the shredded material should be done in such a manner that the CFCs are destroyed.

An additional requirement is that all material flows shall be documented.

There are no exact data on the share of refrigerators in Austria that are handled following this scheme but it is estimated to cover 80 – 90% of all refrigerators from households (personal communication Mr Ferth, BMU).). Taking into consideration that the voucher only covers part of the costs and that end-

users still have to pay a considerable amount when handing over the end-of-life refrigerator, this high percentage is an indication of the broad acceptance of the system by the general public.

5.3. Fluorescent Lighting Equipment

Also for fluorescent lighting equipment and other lighting equipment containing mercury a separate system is in place.

Lighting equipment using fluorescence contain certain hazardous substances, in particular mercury. This is mainly contained in the gas inside these lamps. When the lamp breaks it is released into the environment. Also the powders used as inner coating of the glass contains hazardous substances and should be removed prior to further treatment. To allow specific treatment of these lamps and to prevent the release of hazardous substances into the environment a system of separate collection was set up in Austria in the beginning of the '90s. The legal provisions for take back were given in the so-called 'Lampenverordnung' that entered into force in the beginning of 1992.

The system includes an obligatory refund of 0.70 € per lamp to be paid upon procurement of a new lamp. Lamps for which the refund is paid have to be labelled with the word 'Pfand' (deposit). This refund is not required if on the time of procurement the same number of lamps is brought back. Also retailers that are member of a nationwide system of collection and treatment of lamps are exempted from the obligation of issuing the refund. Big consumers (more than 50 lamps per delivery) may be exempted from this obligation if they can prove that the collection and treatment of their lamps is covered by adequate contracts with waste management firms.

Those distributors that issue the refund have to accept till a maximum of three lamps for which a refund was paid if these are brought back but no new lamps are bought. The holder gets back the refund at that moment.

The last estimate of the rate of bring back is from 1996. At that time it was assessed that 60% of all lamps were brought back. This percentage has increased over time, although no exact figures are available. It is estimated to be 80 – 90% in 2000 (personal communication Mr Ferth, BMU)

The lamps are stored and transported in such a way that breaking is reduced to the minimum. The treatment consists of the removal of the mercury containing gasses in view of the recycling of mercury, the removal of the fluorescent powder and the separation of metals (mainly aluminium) and glass. All these materials are recycled to the extent possible.

6. FACTORS INFLUENCING SUCCESS

In a period of approximately 5 years the Austrian facilities for pre-treatment and recovery of WEEE implemented the detailed requirements for the environmentally sound management of different types of WEEE. This success was influenced by the following factors.

- *The requirements for dismantling were developed in pilot projects and subsequently laid down in legal requirements.*

The development of the sector was mainly based upon the fact that in absence of legislation requiring the take back of WEEE, several pilot projects were started to collect and treat WEEE. The companies involved could develop their technologies during these projects and the results of the projects were disseminated.

- *The results of the pilot projects were used to develop the requirements in legislation.*

Based upon the results of the projects, the Önorm 2106 was developed. This is the guideline used for issuing licenses for installations for pre-treatment and recovery of WEEE. The use of this norm by the authorities issuing licenses is not obligatory but to a very large extent it is used. The application of the norm guarantees a level playing field for operators in Austria.

- The standards in Austria are used to determine if export of WEEE is allowed.

Export of WEEE for pre-treatment abroad is only allowed if this treatment provides the same or a better level of environmental protection than in Austria. This provides protection of the Austrian firms against unfair competition abroad.

- Dissemination of information policy

There was a deliberate policy from the government to promote the development of technologies for the treatment of WEEE. The pilot projects contributed largely to this. The results from these projects are well documented and widely distributed. Amongst others a manual for the identification of hazardous components was developed.

The installation of a centre of excellence on recycling of WEEE at the Scientific Academy of Lower-Austria is another example of this. The centre was set up as an initiative with support of the Ministry of Economic Affairs. The tasks of this centre were to inform SMEs about legal and technological developments and to provide assistance or the development of new technologies for treatment of WEEE.

The centre was set up too late to be of big importance in the phase of the pilot projects for but may play an important role when the EU directive has to be implemented. Also its orientation is mainly focussed on the manufacturing of equipment design for recycling. However, it did play a role in the development of certain technologies and in the exchange of information.

- A large number of companies took up the challenge and invested in new technology

7. HOW TO APPLY THE PROPOSED ESM GUIDELINES TO SMEs

The core performance elements are the main building blocks of the system proposed by the OECD of safeguarding ESM for waste recovery. On the basis of the information gathered on the sector of the case study the applicability of these elements will be assessed in chapter 7.1. The elements are those as formulated in October 2001.

For PCs a separate document is under preparation with guidelines for the environmentally sound management of used and scrap PCs. Since this guideline is also relevant the version as presented in October 2001 has been assessed in chapter 7.2 in a general way.

7.1 Core Performance Elements

The following core performance elements have been formulated:

1. **An adequate regulatory infrastructure and enforcement should exist to ensure compliance with applicable Regulations**

This element is very important for promoting the creation of a 'level playing field' among recovery facilities. It is also very important to ensure the effective implementation of some of the other core performance elements and for the implementation of measures to protect the environment. It is therefore essential for successful implementation of ESM.

The Austrian case study indicates that the different pieces of legislation for WEEE, refrigerators and lighting equipment are the main driver for the ESM of WEEE in Austria. Since these requirements are applicable for the whole sector and since these have been developed in close co-operation between the authorities and the companies during the different pilot projects the companies do not have particular problems meeting these requirements. A precondition is however, that the authorities provide for a 'level playing field' and that enforcement activities prevent free-riders from entering into the system.

2. **The facility should be appropriately authorised/permited/licensed on adverse environmental effects**

In OECD countries recovery facilities must apply for government authorisation. One of the main objectives of this authorisation is to assure that impacts on the environment and issues related to health and safety are adequately addressed. In combination with the regulatory framework and enforcement the authorisation and the requirements linked to this authorisation promote the implementation of ESM. It is therefore an important element to ensure the effective implementation of a number of the other core performance elements.

The application of this element is mainly the responsibility of the authorities.

There are no particular problems for the sector of treatment and recovery of WEEE to meet this requirement if the authorities put sufficient emphasis on issuing such authorisation and puts sufficient emphasis on enforcement activities.

For collection, treatment and recovery of WEEE which contains hazardous components in amounts that would classify these as hazardous waste (e.g. refrigerators, oil-radiators, appliances whose main component is a battery or accumulator, printed-circuit boards containing hazardous components) a specific permit based on the Federal Waste Management Act is required.

3. **The facility should have taken appropriate measures to ensure that requirements for occupational health and safety are met**

These type of measures are important for the health and safety of the workers at the facility. They are also important for the people living and/or working near the facility. Typically these issues are covered by existing regulatory measures if a recovery activity involves specific health and safety risks (e.g. in the case where the facility handles asbestos or flammable substances). If there are no specific risks this may not be the case (e.g. for certain recovery activities with non-hazardous waste). Also the EMS normally would address concerns regarding occupational health and safety.

Requirements on occupational health and safety are not included in full in the norms on the management of WEEE in Austria. Additional legislation may be applicable and most companies pay attention to this aspect. Additional guidance might improve the implementation of health and safety measures in the sector. The implementation of these requirements would not pose particular problems.

4. **The facility should be appropriately certified under an applicable environmental management system (EMS)**

An EMS helps companies to systematically address environmental issues in the day to day work as well as in the policy of the company. A number of the core performance elements are typically addressed in an EMS, such as the regulatory requirements and provisions of the licence and compliance, monitoring, recording and reporting and training and awareness raising. Having an EMS in place therefore reinforces the compliance with some of the other the core performance elements. If the implementation of the EMS is audited and certified by an accredited third party the implementation becomes verifiable.

The use of environmental management systems is relatively widespread in the sector. A relatively high number of the facilities has obtained ISO 14000 or EMAS registration. Some even have both. This is mainly due to impact on the image of the company and the improved relation to the customers. There are also some advantages in the relation with the authorities such as less burdensome procedures. If the presence of such a system is required for all facilities, its implementation does not pose particular problems. Some guidance on specific measures to be taken by the sector may help easing implementation.

5. **The facility should have an operative monitoring and reporting programme**

Monitoring and reporting gives the management insight in the environmental performance of its facility. It also provides for information to the licensing and enforcement authorities and to the public. The license of the facility often includes certain requirements for monitoring and reporting. Also the EMS provides for this type of measures.

The environmental impacts are mainly related to storage of hazardous materials and handling of CFCs. This implies that the monitoring and reporting programme for environmental impacts is mainly related to reporting on the flows of materials handled. Setting up a separate system, with the possible exception of a system to monitor handling of CFC may be superfluous in this sector, provided a good system for monitoring inputs and outputs of materials is available.

6. **The facility should have an operative inspection and recording programme for all input and output materials**

Also this requirement is a tool to provide information for the management of the facility and for the authorities and the public.

The requirements in the licence for the facilities for treatment of WEEE require registration of the materials. This requirement therefore does not pose particular problems.

7. **The facility should have appropriate house and record keeping**

Good housekeeping and record keeping are also measures the management uses to get insight in the environmental performance of the facility. Both the license and the EMS typically address these issues.

These requirements are not too difficult to implement since these are part of any system of a well-managed facility and record keeping is typically addressed in the license.

8. **The facility should have an appropriate and verified emergency plan**

Facilities with clearly identified risk of accidents or accidental release of pollutants should address these risks appropriately. An up-to-date emergency plan is required in these cases and for certain

specific facilities this may be addressed in the license. For other recovery facilities these risks are less apparent and the license will not address these issues.

The risk of accidents in the case of treatment and recovery of WEEE is rather limited in particular as regards risks that would influence the environment outside the facility. There is little risk for explosions, fire risks can be managed and if the hazardous materials and possible flammable materials such as plastics are stored in an appropriate way. The possible impact of failure of the storage on the environment is limited.

If a facility has implemented measures regarding occupational health and safety in an appropriate manner and if the requirements in the licence related to storage of hazardous materials and operational conditions are well implemented and enforced the requirement of a having an emergency plan may be too burdensome in relation to the possible risk.

Only in very specific cases an emergency plan may be required. This may be the case for installations handling large quantities of hazardous substances or radioactive components.

9. **The facility should have an appropriate and operative training programme for the personnel**

Training of personnel of recovery facilities is of high importance. The environmental performance of the facility depends directly on the correct handling of the waste and scrap materials. Also knowledge of issues related to occupational health and safety require that the personnel is adequately instructed.

Training of personnel in treatment and recovery facilities of WEEE is mainly done on the job. The main task of the training is to make sure that the personnel is familiar with the possible hazardous components included in WEEE and knows how to recognise the and to manipulate these. Also specific skills for the dismantling of specialised equipment and handling of part of the treatment installation may require training.

Supervision of the personnel is relatively direct in the small and medium sized enterprises. Without such continuous training on the job and up to date information on the components, the personnel of pre-treatment facilities cannot do its job properly. Training programmes requiring more then this type of on the job training would be burdensome, in particular for small enterprises. Medium-sized enterprises will have less problems implementing this requirement.

10. **The facility should have an adequate financial guarantee for emergency situations and closure**

In case of accidents the facility may be liable to provide for compensation of damage. Also there may be a need for clean-up of the site after closure of the facility. A financial guarantee will ensure that adequate financial means are in place for these situations.

The requirement for financial guarantee is closely linked to the way environmental liability is regulated in Austria. Currently only civil liability is regulated. The requirement for an adequate guarantee for emergency situations and closure is therefore not implemented in the sector at present. Without such a regulatory framework implementation of this measure would be burdensome for this sector.

11. **The facility should have a system in place for the exchange of information on quality requirements with waste producers.**

Information about the quality requirements for the waste to improve the performance of the recovery facility is important. The waste producers should be adequately instructed about presence of materials that would have a negative influence on the recovery process.

The pre-treatment and recovery facility has only limited influence on the way the waste producer delivers the waste. WEEE often reaches the facility via a collector or via a collection point. It is therefore more important to have an exchange of information on quality requirements with the collector. They will have to assure that the materials they collect are not contaminated. In particular for CRTs and fluorescent tubes the conditions of storage and transport may influence the quality of the recovery process because these items are fragile and may break thus releasing hazardous substances. To a lesser extent this also applies to refrigerators.

7.2 Specific Guidance on Environmentally Sound Management of PCs

The guidance paper identified the environmental issues related to the management of PCs. In particular the substances of concern are identified and also the ways these substances may lead to exposure are identified. This is important in relation to possible measures for occupational health and safety as well as measures to address the potential adverse environmental effects of the pre-treatment or recovery operation. For the different types of activities the relevant issues as regards measures to be taken at facility level are identified.

The information on the specific situation in Austria confirms that these are the issues to be taken into account. Implementation of such measures does not pose particular problems to the sector provided that adequate guidance on the measures to be taken is given.

On the basis of this guidance sets specific measures to be taken at specific types of installations may be developed.

8. CONCLUSIONS AND RECOMMENDATIONS

The development of pre-treatment and recovery of WEEE in the second half of the 90's in Austria was mainly driven by the conviction that legislation on take back of WEEE would be implemented in the near future. A number of companies saw this as an opportunity for business development and invested in new technologies.

The Austrian government supported a series of pilot projects, which were used to gain experience with the collection and treatment. It also allowed the companies involved to develop their technologies and provided the government with information to prepare the technical requirements to be laid down in standards.

The success of the program was therefore due to the following factors:

- A strong believe within industry that legislation was eminent which triggered them to invest in development of new technologies.
- Support by the government in the form of pilot projects
- Continuation of the pilot schemes by the local authorities after the finalisation of the scheme
- Development and enforcement of legal standards on the technical requirements for treatment of WEEE

- Effective measures to provide a level playing field for companies in Austria and protection against unfair competition from companies abroad.

This shows also however, that the system in Austria was successful mainly due to factors that are not market driven. This makes the system vulnerable. It may collapse if the system of take back and financing is not implemented timely.

The role of environmental management systems is mainly to provide the companies with an image of environmental reliability. It is not seen as essential to the functioning of the companies.

The most difficult requirements in the proposed core performance elements are those regarding the emergency plan, training program and financial guarantee for emergency situations and closure. The other requirements may be met without too many difficulties if the appropriate legislative framework for take back and financing is implemented.

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