





# Survey of Special Waste Fractions in the Nordic Countries: Legislation, Logistics, Quantities, Treatment and Disposal

June 2004

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**Nordic Environmental Co-operation**

Environmental co-operation is aimed at contributing to the improvement of the environment and forestall problems in the Nordic countries as well as on the international scene. The co-operation is conducted by the Nordic Committee of Senior Officials for Environmental Affairs. The co-operation endeavours to advance joint aims for Action Plans and joint projects, exchange of information and assistance, e.g. to Eastern Europe, through the Nordic Environmental Finance Corporation (NEFCO).

**Nordic co-operation**

Nordic co-operation, one of the oldest and most wide-ranging regional partnerships in the world, involves Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland. Co-operation reinforces the sense of Nordic community while respecting national differences and similarities, makes it possible to uphold Nordic interests in the world at large and promotes positive relations between neighbouring peoples.

Co-operation was formalised in 1952 when *the Nordic Council* was set up as a forum for parliamentarians and governments. The Helsinki Treaty of 1962 has formed the framework for Nordic partnership ever since. The *Nordic Council of Ministers* was set up in 1971 as the formal forum for co-operation between the governments of the Nordic countries and the political leadership of the autonomous areas, i.e. the Faroe Islands, Greenland and Åland.

# Table of Contents

<i>Forord</i> .....	7
<i>Summary and Conclusion</i> .....	9
Objective and Scope.....	9
Legislation.....	9
Collection Systems .....	10
Treatment and Disposal .....	10
Proposals for New Special Waste Fractions .....	11
<i>1. Introduction</i> .....	13
1.1 Objective .....	13
1.2 Background .....	13
1.3 Organisation .....	14
1.4 Scope and Definitions .....	14
<i>2. Regulation of the Special Waste Fractions</i> .....	17
2.1 EU Regulation .....	17
2.2 Denmark .....	18
2.3 Finland .....	26
2.4 Iceland.....	32
2.5 Norway.....	35
2.6 Sweden .....	44
2.7 Summary of Regulation, Logistics and Financial Mechanisms .....	51
<i>3. Quantities of Special Waste Fractions</i> .....	55
3.1 Denmark .....	55
3.2 Finland .....	62
3.3 Iceland.....	70
3.4 Norway.....	73
3.5 Sweden .....	81

<b>4. Treatment of the Special Waste Fractions.....</b>	<b>89</b>
<b>4.1 Denmark .....</b>	<b>89</b>
<b>4.2 Finland .....</b>	<b>96</b>
<b>4.3 Iceland.....</b>	<b>97</b>
<b>4.4 Norway .....</b>	<b>98</b>
<b>4.5 Sweden .....</b>	<b>100</b>
<b>4.6 Summary on Treatment .....</b>	<b>105</b>
<b>5. Proposals for Selection of New Waste Fractions .....</b>	<b>107</b>
<b>Sammendrag .....</b>	<b>109</b>
<b>Formål og afgrænsning .....</b>	<b>109</b>
<b>Lovgivning .....</b>	<b>109</b>
<b>Indsamlingssystemer .....</b>	<b>110</b>
<b>Behandling og deponering.....</b>	<b>110</b>
<b>Forslag til nye affaldsfraktioner .....</b>	<b>111</b>
<b>Appendix 1: Numbering of Waste Fractions according to EWC.....</b>	<b>113</b>
<b>Appendix 2: Key Data for Nordic Countries .....</b>	<b>115</b>

# Forord

This report includes an overview of the regulation, handling, treatment and quantities of special solid waste fractions in the Nordic countries.

The work is initiated by the PA-group under the Nordic Council of Ministers. The project has been conducted by Rambøll.

Apart from establishing an overview of the present state of special waste fractions the report also proposes new areas of interventions.

June 2004.



# Summary and Conclusion

## Objective and Scope

The objective of this project is to carry out a survey of selected special solid waste fractions that require separate handling and treatment in the Nordic countries. The aim of the survey is to exchange information on the experience gained and to select new areas of intervention for the coming years.

The survey includes descriptions of the current legislation, physical design of the collection systems, financial mechanisms, quantities handled, treatment and disposal of the special waste fractions.

The special waste fractions included in this study are:

- Heavy metal containing batteries
- PVC containing waste
- PCB containing waste
- Asbestos containing waste
- Discarded refrigerators
- Electric and electronic waste
- Used tyres
- Discarded cars
- Impregnated timber waste
- Discarded fluorescent tubes and low energy light bulbs.

## Legislation

EU has implemented regulation that covers some of those categories of special waste fractions that are included in this study. The relevant regulation includes directives for the following fractions:

- PCBs and PCTs
- Used batteries and accumulators
- End-of-life vehicles
- Discarded electrical and electronic.

In addition to this EU has approved the European Waste Catalogue (EWC), which defines the various waste categories and fractions, including those mentioned above.

All the Nordic countries have implemented or are in the process of implementing the various directives, even those Nordic countries that are not members of EU (Iceland and Norway).

With regard to national legislation all the Nordic countries have implemented specific legislation for all the special waste fractions, except PVC, impregnated timber and fluorescent tubes. However, those fractions that are not covered by specific legislation, is covered by a general legislation on hazardous waste.

## Collection Systems

Generally speaking all the Nordic countries have established a dual collection system, including a municipal system covering most special waste fractions and a number of private systems covering the special waste fractions individually.

The municipal system covers most of the special waste fractions, except end-of-life vehicles. Usually the collection stations for special waste fractions also receives recyclable materials, such as paper, cardboard, glass, plastics as well as hazardous chemicals. The municipal collection stations are open for all citizens and small enterprises. In most cases waste materials can be delivered free of charge.

The private collection systems are mostly based on the producers liability principle and are based on specific products or groups of products, and hence also on specific industry sectors. In most of the Nordic countries this is the case for batteries, discarded refrigerators, electric and electronic waste, used tyres and discarded vehicles.

In several cases the industry sectors have established companies that have been given the responsibility for establishing and operating the collection and some processing of the waste materials.

For some of the products – e.g. lead accumulators, tyres and vehicles – refund or deposit systems have been established in order ensure an environmentally sound and efficient collection and treatment of the waste products.

## Treatment and Disposal

For most of the special waste fractions, included in this project, treatment and final disposal facilities are available within the borders of the Nordic countries. However, most of the collected NiCd batteries and some materials from EE waste are sent abroad - outside the Nordic countries - for recycling and treatment. In addition to this some of the materials, e.g. steel scrap from discarded vehicles, are traded on the world market, al-

though there exist Nordic steel works that are able to process the materials.

## Proposals for New Special Waste Fractions

Although collection, recycling and treatment of special waste fractions have taken place in the Nordic countries for more than 25 years, many of the systems are still developing, and new fractions are included. This is among others a consequence of the fact that the waste management systems become more advanced and treatment and disposal more expensive.

Based primarily on environmental concerns the following list presents new fractions that could be considered for segregation and special treatment.

**Table 1: Proposal for new waste fractions to be segregated from the general municipal solid waste stream**

Waste category/material	Environmental aspects	Potential treatment
Surface treated metal objects	E.g. cadmium, nickel and chromium emitted from incineration plants or landfills	Melting/recycling
Impregnated leather	E.g. chromium emitted from incineration plants or landfills	Incineration with flue gas cleaning
Pesticide waste/residuals	Persistent organic compounds emitted via incineration plants or landfills	Incineration with flue gas cleaning
Lead and lead containing objects	Lead and lead compounds emitted from incineration plant or landfills	Melting/recycling
Mercury containing objects	Mercury emitted directly to air or from incineration plants or landfills	Recycling/storing
Copper containing objects	Copper emitted from incineration plants or landfills	Melting/recycling
Mineral wool	Volume at landfill, dust emitted	Segregation/recycling
Photo paper and other photo products	Silver and heavy metals emission from incineration plants or landfills	Incineration and recovery of heavy metals
Hard PVC containing products	Emission of acidic and dioxins containing fume when incinerated	Recycling
Soft PVC containing products	Emission of softening agents when land filled. Emissions from incineration	Environmentally sound destruction

It should be emphasised that some of the above substances and materials – as well as the selected special waste fractions included in this study - already are subject to “cleaner products” initiatives, e.g. by substitution of the hazardous substances, and that more initiatives can be expected, parallel with the recycling, treatment and disposal initiatives.



# 1. Introduction

## 1.1 Objective

The objective of this project is to carry out a survey of a number of special solid waste fractions that require separate handling and treatment in the Nordic countries. The aim of the survey is to compile information on management of the special waste fractions in the different Nordic countries with the purpose of exchanging information and to select new areas of intervention for the coming years.

The survey includes descriptions of the current legislation, financial mechanisms as well as the physical collection system, quantities handled, treatment and disposal of the special waste fractions.

## 1.2 Background

During the last two decades a growing number of solid waste fractions have been segregated from the municipal waste stream in order to treat these fractions separately. The separate handling and treatment is usually required for both environmental, technical and financial reasons.

By segregating the special fractions the treatment can be directed toward the particular needs that these fractions require and hence ensuring a high environmental performance as well as cost-effective handling and treatment. For the treatment of the remaining municipal waste stream the required environmental demands can be reached at a lower cost than otherwise expected.

One of the fractions that firstly was separated from the general municipal waste stream in the Nordic countries was batteries, and in particular mercury containing batteries, mainly due the environmental risk of mercury. Later on separate collection and treatment systems have been established for other fractions such as refrigerators, car tyres etc.

In the meantime EU legislation is under implementation, covering some the fractions that already have been regulated in the Nordic countries. Although, not all the Nordic countries are members of the EU, all the Nordic countries are harmonising their Regulation to comply with the various EU directives etc.

Many of the systems for collection and treatment of the special fractions differ from country to country and they are still under current development. Hence, there is a need to exchange information on the experience achieved in order to ensure a continued expansion and implementa-

tion of the most feasible techniques, thereby improving the environmental performance and reducing costs.

### 1.3 Organisation

The project has been conducted under the supervision of the PA-group (Produkt- och Avfallgruppen (Product and Waste Management Group)) under the Nordic Council of Ministers. For this project a reference group has been established, including the following representatives of the various Nordic countries:

- Lone Schou, Miljøstyrelsen (Danish EPA), Denmark
- Klaus Pfister and Eevaleena Häkkinen, Miljöministeriet (Finnish Ministry of Environment), Finland
- Cornelis Aart Meyles, Hollustuvernd Rikisins (Icelandic EPA), Island
- Pål Spillum, Statens Forurensningstilsyn (Norwegian EPA), Norway
- Lars Asplund, Naturvårdsverket (Swedish EPA), Sweden.

Lone Schou has acted as chairperson of the reference group. Niels Juul Busch, RAMBOLL, has been consultant of the project.

### 1.4 Scope and Definitions

The special waste fractions include those fractions of the municipal solid waste that create special problems, either environmental or technical problems, whereas they are segregated from the remaining waste stream to receive special treatment.

The special waste fractions included in this study are:

- Heavy metal containing batteries
- PVC containing waste
- PCB containing waste
- Asbestos containing waste
- Discarded refrigerators
- Electric and electronic waste
- Used tyres
- Discarded cars
- Impregnated timber waste
- Discarded fluorescent tubes and low energy light bulbs.

The definition of the waste fractions in relation to the European Waste Catalogue (EWC) is shown in Appendix 1. It should be emphasised that

the waste fractions are following complicated waste streams, and hence are categorised under different EWC-numbers along their paths.

Appendix 2 includes a number key data for the Nordic countries, including population, area, population density and currency exchange rate.

Concerning Regulation, the report is focusing on the national legislation in the individual Nordic countries, and not the corresponding EU Regulation, although the national legislation in most of the countries either represent the implementation of EU directives or represent a gradual harmonisation of existing national legislation to new EU directives.

The descriptions of the collection systems for the various fractions are incorporated in the sections that include descriptions of the regulation, in order to avoid too much repetition of the text. The presentation of information on the quantities of the special waste fractions as well as description of the treatment technologies is dealt with separately.



## 2. Regulation of the Special Waste Fractions

This chapter includes an overview of the regulation, the various countries have implemented or are going to implement in the near future concerning special waste fractions.

The chapter firstly gives a brief introduction to the EU regulation of the special waste fractions; then follows a detailed presentation of the national regulation within each of the Nordic countries. The countries are dealt with in alphabetic order.

As the description of the collection and management system of the special waste fractions are closely linked to the regulation the descriptions of the collection systems are included in this chapter as well.

### 2.1 EU Regulation

EU has implemented regulation that covers some of categories of special waste fractions that are included in this study. The relevant regulation includes the following directives:

- Disposal of PCBs and PCTs (Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT))
- Disposal of used batteries and accumulators (Commission Directive 93/86/EEC of 4 October 1993 adapting to technical progress Council Directive 91/157/EEC on batteries and accumulators containing certain dangerous substances)
- End-of-life vehicles (Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles)
- Waste from discarded electrical and electronic equipment (Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (the WEEE directive) with amendment 2003/108/EF by 8. December 2003 and
- Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (the RoHS directive)
- Council Directive 91/689/EEC of 12 December 1991 on hazardous waste.

In addition to this the EU commission has published a Green Book on the Environmental Aspects of PVC. Asbestos and impregnated timber are regulated according to the Directive on Hazardous waste. Refrigerators as well as low energy light bulbs are included in the directive on discarded electronic and electrical equipment (the WEEE directive).

The Directive on disposal of PCB is mostly dealing with the registration of all equipment containing PCB and PCT, and the responsibility of the authorities to ensure that PCB/PCT containing waste is treated environmentally sound.

The directives on used batteries, end-of-life vehicles as well as electronic and electrical equipment are based on the “producer liability” principle, which means that the manufacturers have the overall responsibility to establish recovery systems and to fulfil targets for recovery of a certain percentage of the products for recycling and environmentally sound treatment. Furthermore, the directives in some cases include possibilities for establishing financial mechanisms that makes it attractive for the users to return the discarded products.

All the Nordic countries have implemented or are in the process of implementing the various directives, even those Nordic countries that are not members of EU (Iceland and Norway).

## 2.2 Denmark

Denmark has implemented legislation or binding agreements for the following special waste fractions:

- Heavy metal containing batteries
- PVC containing waste
- PCB containing waste
- Asbestos containing waste
- Discarded refrigerators
- Electrical and electronic waste
- Used tyres
- Discarded cars.

For some of the fractions relatively strict regulation has been introduced, e.g. legislation that demands that all of the waste has to be delivered to certain treatment operators (e.g. PCB in industrial transformers), while other legislation have a more voluntary character, e.g. legislation that encourage municipalities or industries to establish waste collection systems or taxes that should make it attractive for the waste generators to deliver the waste to certain waste treatment. This is e.g. the case for end-of-life cars.

In addition to this some municipalities have established voluntary waste collection systems for the following special waste fractions:

- Impregnated timber waste
- Fluorescent tubes and low energy light bulbs.

Most of the legislation is based on overall Danish environmental laws, but when EU-legislation is introduced the Danish legislation become more and more harmonized with the EU-legislation.

#### *Heavy Metal containing Batteries*

The collection of discarded batteries is regulated according to the Waste Management Departmental order (Bekendtgørelse om affald, bek. nr. 619 af 27. juni 2000), according to which heavy metal containing batteries are considered as hazardous waste, and has to be collected and treated as such. Waste fractions including batteries without a content of heavy metals are categorised as municipal waste, and these can in principle be collected and treated as such.

In order to ensure appropriate management of the different types of “hazardous” batteries a number of different collection and treatment systems have been established, and a number of financial mechanisms have been introduced to support these systems.

#### *Lead containing Batteries*

For car batteries and similar lead containing industrial batteries an agreement between the industry and Minister of Environment has been signed, resulting in the establishment of a separate company, Returbat A/S, that is responsible for collection and transport of the batteries for recycling.

The collection scheme is supported by two departmental orders, one about the rules for the collection system (Bekendtgørelse om tilskud til indsamling og genanvendelse af blyakkumulatorer, bek. 1060 af 4. april 2000) and one for a financial mechanism (Bekendtgørelse om gebyrer på blyakkumulatorer, bek. nr 1061 af 4. april 2000).

The financial mechanism consists of a fee on 6-12 DKK per battery, paid by the manufacturers and importers to a special fund. The revenue of the fund is used to finance the collection, transport and recycling of the materials as well as disposal of residues. For the time being all lead containing batteries are collected through registered collectors and delivered to Boliden-Bergsöe in Landskrona for recycling.

*Mercury Batteries*

Earlier the most common batteries for small electronics such as cameras were mercury containing bottom cells. Already in the 1980'es a collection system particularly for this kind of batteries was established. In the meantime manufacturing, importing and marketing of these batteries has been prohibited.

However, as it will take long time before these batteries are disposed of there is a need for maintaining a collection system that also includes these. The collection nowadays takes place through the separate collection for small batteries (Hg- and NiCd batteries).

*NiCd Batteries*

For batteries containing nickel and cadmium, mostly rechargeable batteries, the collection of used batteries was based on a voluntary scheme established by the manufacturers and dealers of the NiCd-batteries and device containing the batteries. However, the collection scheme was not efficient, and later on a number of new initiatives have been implemented in order to improve the collection efficiency.

This includes a directive covering public institutions that have to deliver used batteries to certain collectors who then is responsible for delivering the batteries to Kommune Kemi A/S (treatment plant for hazardous waste) (Cirkulære om indsamling af genopladelige NiCd-batterier og apparater fra offentlige institutioner, Cirkulære nr. 2 af 3. januar 1992).

*New Collection System for Batteries*

Due to a continued low collection rate and confusion among consumers of which kinds of batteries that should be collected this scheme has later been replaced by a firmer system, based on two new by laws:

- Law on remunerationremuneration in connection with collection of NiCd batteries (lovbekendtgørelse nr 547 af 30. maj 2000)
- By Law on remunerationremuneration in connection with collection and recycling of NiCd batteries (bek. nr 1062 af 4. December 2000).

According to the above mentioned law the minister of environment would be able to establish a system according to which anybody collecting NiCd batteries for recycling could be paid a remuneration of 150 DDK per kg. The idea behind the remuneration is to encourage people to deliver all NiCd batteries to the collection system, and hence ensuring that they are treated in an environmentally sound way. The departmental order describes in further details the rules for such a collection and recycling system, and under which conditions the remuneration should be paid.

The remuneration is covered by a separate tax on manufacturing, import and sales of NiCd batteries on 6 DDK per battery or 36 DDK battery packages. This tax was implemented through a by law in 1998 (Bekendtgørelse af lov om afgift af hermetisk forseglede NiCd akkumulatorer, lovbekendtgørelse nr. 561 af 3. juni 1998).

In order to simplify the collection procedures it has been agreed upon that all small batteries (NiCd, mercury and alkaline batteries) can be delivered to all collection stations. The mercury containing batteries was earlier sent to Germany for disposal in an old salt mine, but now they are disposed of at a special landfill. The NiCd batteries are sent to France or Sweden for recycling. The alkaline batteries are disposed of at a landfill. However, new recycling technologies are under development where the batteries can be split into different materials and some of be recycled.

#### *PVC containing Waste*

The activities concerning PVC containing waste are regulated according to a agreement between the plastics industry (Plastindustrien i Danmark) and the minister of environment that was signed in 1991.

The overall purpose of the agreement is to reduce the amount of PVC that is brought to the waste incineration plants. The agreement is setting up - among others – goal for:

- Phasing out the use of PVC for packaging
- Recycling of PVC from the building sector
- Reduction of the content of lead, flame retardants and other substances

The phasing out of PVC as packaging material and the reduction of certain substances in PVC has – to a certain extend - taken place through substitution. The recycling of PVC from the building sector is supposed to take place through a company, Wuppi A/S, established by the PVC manufacturing industry.

In addition to this a special law on tax on PVC and ftalater has been implemented (Lov om afgift på polyvinylchlorid og ftalater, lov nr. 954 af 20 december 1999) to strengthen the phasing out of the use of PVC and the softening agents, ftalater.

#### *PCB containing Waste*

PCB containing fluids, products and device have been regulated a number of years ago. All devices containing PCB fluid, e.g. transformers, had to be registered, and after use the fluid containing PCB has to be handled as hazardous waste.

Apart from transformer, e.g. small condensers in fluorescent tubes contain small quantities of PCB.

The Regulation was strengthened in 1986 through a new departmental order in 1986. According to this departmental order most use of PCB was prohibited by 1 January 1995. Waste containing PCB should still be handled as hazardous waste.

In order to collect the PCB containing condensers and the mercury vapour that is contained in fluorescent tubes, some municipalities have established special collection system for this kind of waste.

#### *Asbestos containing Waste*

Waste containing asbestos is classified as hazardous waste and has to follow the special Regulation of hazardous waste. This includes registration of waste generators, the quantities of waste, delivery of the waste to special collection and treatment systems. For the purpose of collection of asbestos containing waste from households and smaller companies, a considerable number of municipalities have installed special containers for collecting asbestos waste, normally at their recycling station.

The handling of asbestos containing waste and products is covered by the Occupational Health and Safety Regulation. The overall objective of the regulation is to protect the employees against inhalation of asbestos fibres.

#### *Discarded Refrigerators*

The Regulation of discarded refrigerators and freezers are based the obligations of the Montreal Protocol. The Regulation consist of the following elements:

- Phasing out the use of ODS
- An agreement concerning collection of discarded refrigerators etc.
- Municipal circular/directive on collection and treatment of ODS and discarded refrigerators.

The phasing out of ODS (Ozone depleting Substances) is based on a number of departmental orders that describe when the ODS are no longer permitted in different products, including refrigerants in refrigerators and freezers.

By the end of 1995 it was no longer allowed to use CFC (CFC-11 for insulation foam and CFC-12 as refrigerant) for the manufacturing of refrigerator and by 2002 it is no longer allowed to use HCFC (used for insulation materials in some refrigerators).

However, as the life of refrigerators is relatively long, in average more than 7 years, refrigerators containing CFCs may still be disposed of. In

order to strengthen the collection of discarded refrigerators the dealers of refrigerators agreed to take back discarded refrigerators. They offered customers to fetch the old refrigerator when new ones were delivered. The collected old refrigerators were then delivered to the municipal collection system or scrap dealers.

A departmental order for municipal Regulation of disposal of CFC containing refrigerators was issued, determining rules for collection of old refrigerators and recovering CFC from them. The departmental order went into force 1 January 1997 (ref.: Cirkulære om kommunale regulativer om bortskaffelse af CFC-holdige kølemøbler, bek. nr. 132 af 13. juni 1996).

The collection, treatment and trade of ODS, from larger cooling systems etc., is organised by a separate company, Kølebranchen Miljøordning (the KMO scheme), established by the refrigeration industry in accordance with an agreement between the major suppliers of ODS, and with support from the Danish EPA.

#### *Electric and Electronic Equipment*

According to a departmental order on handling of waste of electric and electronic equipment (WEEE) (Bekendtgørelse om håndtering af affald af elektriske og elektroniske produkter, bek. nr. 1067 af 22. december 1998) municipalities have to establish collection systems for waste of electric and electronic equipment by 1 June 1999.

The departmental order also includes rules for segregation of the waste and the possibilities of reuse and recovery of the materials from the waste.

Used refrigerators and freezers are not included under this departmental order as this kind of waste has to follow the above mentioned separate collection scheme for discarded refrigerators (refer to section 3.2.5).

The EEE scrap collected by the municipalities is delivered to a number of companies around the country that are equal to handle this kind of waste.

The largest of these companies is H.J. Hansen Elektromiljø A/S in Vejle, which receives growing quantities electronic waste from municipalities as well as private companies.

#### *Used Tyres*

The Regulation of used tyres is based on an agreement between the industry and the minister of environment as well as a departmental order on fees and subsidy for recycling or utilisation of used tyres.

Through the agreement it is ensured that the industry has established a collection system and that the tyres are upgraded for reuse, recycling of materials for new rubber products or incinerated.

According to the departmental order (Bekendtgørelse om gebyr og tilskud til nyttiggørelse af dæk, bek. nr. 111 af 5. februar 2000) it is determined that a fee on 8 DDK for all new tyre has to be paid to the Danish EPA (the fee vary according to the size and type of tyres). The departmental order furthermore determines under which conditions companies can apply for subsidy for collection and recycling of the used tyres.

Hence, the concept of this system is more or less the same as for other of the special waste fractions. A tax or a fee has been put on the selling of the products and the revenue is then used for supporting the collection and treatment of the products when they are discarded.

#### *Discarded Cars*

Traditionally, the disposal of discarded cars has been regulated to prevent cars from being left in the nature and in public places. The Regulation has included municipal directives prohibiting the disposal of waste in other places than those prescribed by the municipality. Furthermore, a considerable number of scrap dealers receiving discarded cars have existed for a long time.

The latest Regulation of the waste fraction consists of Statutory order on management of end of life Vehicles (bekg. Nr. 480 om håndtering af affald i form af motordrevne køretøjer) and a Statutory order concerning a financial mechanism supporting the recycling of the cars (Bekendtgørelse om opkrævning af miljøbidrag og udbetaling af godtgørelse i forbindelse med ophugning og skrotning af biler, bek. nr 782 af 17. September 2002).

This Environmental Scheme for Cars (Miljøordning for biler) has the double purpose of ensuring that more discarded cars are collected for scrapping and that the scrapping is done in an environmentally sound way.

According to the statutory order 480 all scrap dealers handling discarded cars have to implement an environmental management system in their company. On the other hand car owners can get a compensation, if they deliver their ELV to one of the registered dismantlers that have implemented an environmental management system.

The departmental order introduces a premium (on 60 DKK per year) that all car owners have to pay to a central fund. When the car is ready for scrapping the last car owner can receive a compensation on 1 750 DDK from the fund, but only if the owner delivers the car to a registered dismantler.

#### *Impregnated Timber*

According to three departmental orders ("Bekendtgørelse om begrænsning af salg og anvendelse af pentachlorphenol", bek. nr 420 af 21. april

1996, "Bekendtgørelse om begrænsning af salg og anvendelse af creosot", bek. nr. 665 af 4. juli 1996 and "Bekendtgørelse om begrænsning af salg og anvendelse af visse farlige kemiske stoffer og produkter til specielt angivne formål", bek. nr 1042 af 17. December 1997) it is not allowed to import, manufacture or sell timber containing pentachlorophenol (PCP), creosote and arsenic compounds for certain uses.

According to the first mentioned order it is not allowed to use pentachlorophenol for manufacturing impregnation means, and it is not allowed to import, sell or use products containing more than 5 ppm PCP.

The two other orders states that it is allowed to use products containing creosot and arsenic for industrial use but not for civil use. These two orders have been revised in 2003 ("Bekendtgørelse om begrænsning af salg og anvendelse af creosot til træbeskyttelse og creosotbehandlet træ", bek. nr. 534/535 af 18. juni 2003 and "Bekendtgørelse om begrænsning af salg og anvendelse af arsen", bek. nr. 536 af 18. juni 2003). According to these orders it is still allowed to use impregnation timber containing the substances for some purposes, but the list of prohibited use has been expanded.

The above departmental orders only concern the new impregnated timber products. As considerable quantities of timber containing the compounds already have been installed for various purposes, timber waste containing these compounds will for a long period ahead appear in the waste streams.

Impregnated timber waste is defined as timber that fully or partly has been treated with impregnation fluid, meaning fluids containing biological active substances that protect the timber against fungus, and/or vermin. This means that all kinds of impregnated timber is included, whether it contains the above substances or other impregnation fluids, containing e.g. chromium and cobber (Ref.: Handling of impregnated timber waste" Report from Danish EPA, no. 38, 2002 ("Håndtering af imprægneret træ", Arbejdsrapport fra Miljøstyrelsen, Nr. 38 2002)).

Impregnated timber waste is regulated according to the Waste Departmental Order (Bekendtgørelse om affald, bek. nr 619 af 27/06/2000), which says that municipalities have to order companies and institutions to bring impregnated timber waste to landfills for disposal (§ 36). Furthermore, the municipalities must establish a collection system for impregnated timber from household (§ 41). Hence, the overall intention of this regulation is to ensure that impregnated timber waste is segregation from other waste and then landfilled.

However, timber waste containing creosote can be incinerated at plants that are permitted for this particular purpose.

### *Fluorescent Tubes*

Fluorescent tubes and low energy bulbs contain mercury and some fluorescent tubes PCB as well. Hence, they are considered as hazardous waste and as such they have to be delivered to the collection system for hazardous waste. Through this system the tubes and bulbs are brought to companies for recovery of the mercury, PCB and other materials.

Some municipalities have located special containers for fluorescent tubes and low energy bulbs at their recycling stations where private households and smaller companies can get rid of the fluorescent tubes and low energy bulbs.

Some municipalities also collect hazardous waste, including fluorescent tubes and low energy bulbs, by special hazardous waste collection vans that are circulating around the municipality.

In Copenhagen the waste management company R98 is responsible for the collection of fluorescent tubes and low energy bulbs. R98 send the tubes and bulbs to a company, Werc, in Germany for recycling and disposal.

Recently, the company for electronic waste treatment, H.J. Hansen Elektromiljø A/S, has installed a comprehensive plant for recycling of almost all materials from used fluorescent tubes.

## 2.3 Finland

### *General Legislation covering Special Waste Fractions*

All waste management in Finland is based on the general Waste Act (Avfallslag 1072/1993) and the related ordinance (Avfallsförordning 1390/1993). In particular, the paragraphs 6 and 13 of the Waste Act are relevant with regard to special waste fractions. Paragraph 6 is stating that hazardous waste components have to be handled and treated separately, and paragraph 13 describes the obligations of the municipalities to organise systems for collection of municipal hazardous waste components.

Licensing of facilities for treatment of special waste fractions and other kinds of waste is regulated through the Environmental Protection Law (Miljöskyddslag 86/2000) and the related ordinance (Miljöskyddsförordning 196/2000). This law represents the implementation of the EU Integrated Pollution Prevention and Control Directive (the IPPC directive).

The waste fractions are classified according to the Finnish List of Wastes and Hazardous Wastes (Miljöministeriets förordning om en förteckning över de vanligaste typerna av avfall och över problemavfall 1129/2001). As regards the classification of waste as hazardous waste, the list is more or less identical to the EU Waste Catalogue List (the only

diversion: the Finnish list include all medicine waste as hazardous, while the EU list does not include outdated medicine).

The further development of the waste management initiatives in Finland is described in the National Waste Plan, which gives general guidelines for implementing new initiatives within waste management and sets target for work until year 2005.

Among others The National Waste Plan sets the targets for certain special waste fractions as shown in table 2.below.

**Table 2: Targets for special waste fractions according to National Waste Plan for 2005.**

Type of waste	Target for waste prevention, %	Target for re-cycling, %	Recycling method
Electric and electronic waste	-10 <sup>1)</sup>	70	Materials recycling or energy production <sup>3)</sup>
Used tyres	-10 <sup>1)</sup>	100	Materials recycling or energy production
Discarded cars	-	90 <sup>2)</sup>	Materials recycling or energy production
Lead batteries	-	95	Materials recycling

Notes: 1) in relation to the quantities of waste generated in 1992  
 2) in relation to the quantities of waste generated in 1994  
 3) this also includes reused components of the products.

In addition to this the National Waste Plan says that:

- The amount of hazardous waste should, in 2005, be at least 15% less than the calculated amount in 1992 plus the percentage increase in the BNP
- The average recycling of hazardous waste fractions should be at least 30% in 2005
- Hazardous waste fractions should be segregated from the other waste already at the point of generation
- There should be a system for collection of hazardous waste fractions that covers the whole country
- There should be high level/technical advanced and sufficient capacity for collection, recycling and treatment of the hazardous waste fractions.

The National Waste Plan furthermore describes the instruments for the implementation of the above targets.

*Heavy Metals containing Batteries*

Just like the other Nordic countries Finland established the first collection systems for different kinds of batteries for quite some years. The current Regulation of used batteries is based on a decision made by the Finnish Council of State concerning batteries and accumulators containing haz-

ardous substances (Statsrådets beslut om batterier och ackumulatorer som innehåller vissa farliga ämnen 105/1995).

According to the Waste Law all municipalities have an obligation to organize management of household and respective waste from industry, services and other activities, including hazardous waste arising in households and agriculture and forestry, unless the quantity is unreasonable. Costs of waste management must be covered via waste management fees. The charges often support hazardous waste management from households. In fact, it is usually free of charge. Some suppliers of batteries also receive batteries and accumulators, but most of the batteries excluding automotive batteries are collected through the municipal collection system.

The car batteries are brought further to metal scrap dealers (the one handling most batteries is Kuusakoski Oy), who send them for treatment/recycling abroad. Lead batteries are primarily sent to Sweden (at the factory Boliden-Bergsöe AB, Landskrona) for recycling of the lead and treatment of the remaining parts. The NiCd batteries are exported to Sweden or France for recycling and treatment.

The handling of the lead batteries is in itself profitable. The handling of the NiCd batteries of municipal origin is financed over the general municipal waste management fees.

It is under consideration to introduce producer responsibility within this area to strengthen the present system, and in order to bring the system in accordance with the expected EU Regulation in this field.

#### *PVC containing Waste*

There is no particular regulation of the PVC containing waste in Finland. Most of the PVC waste is land-filled just like most other municipal waste. There is only one incinerator plant treating municipal waste. This plant is located in Turku (Åbo). A number of other incinerator plants (e.g. at paper mills) are available for the energy recovery of RDF (refuse derived fuel).

#### *PCB containing Waste*

The Regulation of PCB containing waste is based on two decisions made by the State Council:

- One concerning restrictions on the use of PCB and PCT (Statsråds beslut om begränsning av användningen av PCB och PCT 1071/1989)
- One concerning phasing out PCB and PCB device by 2000 and treatment of PCB waste (Statsråd beslut omtagande ur bruk PCB och PCB-utrustning samt behandling av PCB-avfall 711/1998).

The Regulations prohibit further use of the two substances, PCB and PCT. It furthermore states that everybody having these materials in their possession is obliged to deliver the waste to the waste collection system.

The waste, including PCB contaminated soil is treated at the central treatment plant for hazardous waste, Ekokem Oy, which treats it with high temperature incineration. This plant also treats PCB containing waste from other countries.

#### *Asbestos containing Waste*

The use of asbestos was prohibited according to an occupational health and safety regulation in 1993. However, there still remain considerable quantities of asbestos in products, machinery and buildings. When this asbestos appear as waste, it is categorised as hazardous waste and has to be land-filled according to special rules, which aim at eliminate the dispersion of fibres. The landfills that are allowed to receive asbestos containing require a special permit, and have to follow special procedures for the handling of asbestos containing waste.

Until beginning of 2002 only asbestos waste including “loose fibres” was categorised as hazardous waste, but now asbestos waste containing “fixed fibres” (such as “asbestos cement”) is included as well.

#### *Discarded Refrigerators*

The collection of old refrigerators is regulated according to the rules on hazardous waste. This means that the municipalities have to receive ODS containing appliances from households at the collection stations for hazardous waste. However, there is no particular financial mechanisms have been implemented to encouraging the delivery of old refrigerators to these stations.

These refrigerators are collected and brought to regional stations, where the ODS refrigerant is recovered. This is - together with the remaining refrigerators - sent to Ekokem, where the ODS refrigerant and the ODS containing insulation material is treated (incinerated).

Some manufacturers of refrigerators takes old refrigerators back and bring these appliances into the collection and recovery system.

With regard to ODS refrigerants from commercial facilities the ODS is regulated according to two decisions made by the State Council:

- One concerning handling of ozone depleting substances (Statråds beslut om ämnen som bryter ned ozonskiktet 262/1998)
- One concerning maintenance of devices that contain ozone depleting substances and some fluorohydrocarbon as well as certification of persons that conduct maintenance of and demolition of such device (Statsrådets förordning om underhåll av anläggningar som innehåller

ämene som bryter ned ozonskiktet samt vissa fluorkolväten samt behörighetskrav för personer som utför underhåll på och avfallshandtering för sådana anläggningar 1187/2001).

According to these resolutions as much ODS refrigerant as possible has to be collected during maintenance and demolition of facilities containing the substances.

#### *Electric and Electronic Device*

So far there is no particular regulation of the collection of electric and electronic waste, so by now the EE waste follows the general rules of hazardous waste. The Finnish government has been awaiting the EU Regulation within this field, meaning the EU Directive on EE waste, in particular with regard to financial mechanisms that encourage citizens to deliver the EE waste to the collection and recycling system.

The municipalities have provided stations for separate collection of these appliances. In addition to this, some shops have taken back old appliances and then delivered the appliances to the municipal collection system.

A number of small companies have been established to dismantling and to segregate valuable components from the EE waste. Selected products are sent abroad, e.g. computers to Holland, for treatment. Now when the directive is approved, relevant Finnish regulation is under preparation.

#### *Used Tyres*

Used tyres are regulated according to a decision on recycling and treatment of discarded tyres made by the State Council (Statsrådets beslut om återvinning och behandling av kasserade däck 1246/1995). According to this decision producer liability has been introduced for this kind of special waste, as all companies selling tyres are obliged to take old tyres back. The decision further states that the Finnish Environment Institute shall collect information from the industry to monitor the development.

The collection system is organised by the association of tyre manufacturers, who have established a special company for recycling of the tyres, Rengaskierrätys Oy . This company is collecting the discarded tyres and bringing it for crushing at certain companies. The crushed materials are used for different kinds of products, e.g. noise barriers and covering of landfills.

Earlier a large number of discarded tyres were exported to Russia and Estonia for refurbishing, but this has now been reduced. In 2000-2001, 35 – 40,000 tonnes of tyres were recovered, corresponding to a recovery rate at 90 %.

### *Discarded Cars*

The law on removal of vehicles and scrapping of discarded cars (Lag om flyttning av fordon och nedskrotning av skrotfordon 151/1975) deals with the responsibilities of removal of cars left in public places.

At the moment there is no particular regulation that supports the car owners to deliver discarded cars to scrap dealers. The Finnish government has been preparing the implementation of the EU Directive on End-of-Life Vehicles and expects the directive to be in force in the end of 2003 or early 2004.

In 2000, the number of scrapped end-of-life-vehicles reached 73,000 cars. The cars were primarily scrapped by Kuusakoski Oy. The recovery rate was 80-90 %.

### *Impregnated Timber*

Two State council resolutions are regulating impregnated timber waste:

- A decision made by the Council of State on limitation of the use of and marketing of creosot and timber treated with creosot (Statsråd beslut om begränsning av användning samt utsläppande på marknaaden av kreosot och trä behandlat med kreosot 1045/1995)
- A decision on marketing of specific impregnation agents, as follow up on EU directive 2001/90/EC.

The first decision is only dealing with creosotes and timber impregnated with creosotes. This kind of timber has only occasionally been collected, and it has been disposed of usually by incineration. In 2000 the wood preserving industry association, Kestopuu, established 20 collection stations, mostly located at timber selling companies, where citizen and companies can delivered their impregnated wood waste free of charge. The association plans to establish a special incineration plant for impregnated wood waste, but it is still not in place (Mid 2003).

The second decision is dealing with a broader range of impregnated timber and the handling of it as waste. This decision is not final, and it awaits further discussions. However, some steps have already been taken, as all impregnated timber by the beginning of 2002 has been classified as hazardous waste, and some municipalities are preparing collection facilities for the impregnated timber. In addition to this the central hazardous waste treatment facility has applied for a permit for treatment of this kind of waste.

### *Fluorescent Tubes*

There is no particular regulation of the discarded fluorescent tubes and energy saving light bulbs, but as it is classified as hazardous waste, col-

lection of these particular fractions, are taking place. Fluorescent tubes are handled and materials are recovered. The collected mercury is disposed of by three enterprises according to certain procedures at licensed landfills.

In the future, this category of waste will be covered by the EU Directive on EE waste, and hence, the Finnish collection system may be expanded.

## 2.4 Iceland

Iceland is the smallest of the Nordic countries in terms of population. The country only has 286,000 inhabitants on an area of 166,000 km<sup>2</sup>. 178,000 inhabitants live in the main town of Reykjavik and surrounding towns and suburbs.

### *Heavy Metals containing Batteries*

With regard to batteries a distinction is made between disposable batteries and rechargeable ones (accumulators). Batteries and accumulators are imported as such or as a part of a device.

From March 15, 1997 a special fee ("Spilliefnagjald" or hazardous waste fee) was charged on accumulators and from August 1 1997, also on batteries. This fee is IKR 26/kg for accumulators containing acid and IKR 36.40/kg for accumulators without acid. By September 1, 2000 the fee was lowered to about 20% and again 10% by August 1, 2001. Today the fee is IKR 19/kg for accumulators containing acid and IKR 26.60/kg for accumulators without.

The fee for batteries was set to IKR 186/kg by August 1, 1997, but was raised to IKR 200/kg by September 1, 2000. For of alkaline battery-cells a fee of IKR 9/piece was set. From August 1, 2001 the fee was set for the number of batteries instead of their weight, as this was considered more justifiable. The fee is mainly set on alkaline battery-cells and NiCd batteries.

As it was foreseen, it would be difficult to charge this fee on batteries that are imported as a part of a device. Hence, this has been postponed for the time being.

By January 1, 2000, the Regulation nr 946/1999 on batteries and accumulators with specified hazardous substances went into force. According to this regulation import of batteries containing more than 0,0005% Hg by weight is prohibited. This, however, does not apply to battery-cells and combined batteries, which are allowed to contain up to 2% Hg by weight.

All kinds of used batteries can be returned to dealers and municipal collection stations. At a central collection station the various types are

segregated. The alkaline batteries are land-filled, while the other types are exported to Denmark (Kommunekemi), where it is re-exported to either Sweden (lead batteries) or France/UK (NiCd batteries) for recycling and treatment.

The collection, land-filling, export and treatment is financed by the hazardous waste fee.

#### *PVC containing Waste*

Most PVC waste occurs in demolition waste and health care waste. The demolition waste is land-filled, while the health care waste is incinerated.

PVC containing waste is not regulated in Iceland as such, and hence the waste is not segregated for collection and treatment.

However, the Icelandic EPA has negotiated with the key importers of PVC containing products, to investigate ways of substitution of the PVC.

#### *PCB containing Waste*

Disposal of PCB/PCT containing products and waste is regulated by the Regulation 810/1999, newly revised the by Regulation 184/2002 on list of hazardous waste.

In order to encourage the collection of PCB containing waste the Hazardous Waste Committee of Iceland has introduced a refund system for hazardous waste, including PCB/PCT containing products and waste (e.g. PCB containing oils). When purchasing a product containing certain types of hazardous materials, a fee is included. This fee is (partly) refunded by the Committee, when the product is returned as waste.

The PCB/PCT containing waste is exported to Denmark for treatment at Kommunekemi.

The refund system does not apply to PCB/PCT contaminated soil (around transformers at electrical power plants e.g.), which is usually sent to Denmark for treatment. Usually, it is only minor quantities of contaminated soil that appear, varying from 1-10 cubic metres per year.

#### *Asbestos containing Waste*

In Iceland, the occupational health and safety aspects of asbestos is regulated by Regulation nr 794/1999 on the prevention of pollution from asbestos. This regulation is based on EU Directive 87/217/EC (Council Directive 87/217/EEC of 19 March 1987 on the prevention and reduction of environmental pollution by asbestos).

Furthermore, the Regulation nr 870/2000 on restriction of import, use and treatment of asbestos, is implemented to avoid new installation of asbestos and asbestos containing products.

### *Discarded Refrigerators*

No specific regulation is in force for import, use and disposal of refrigerators. However, the refrigerant used in refrigeration equipment is subject to a regulation implemented by the Hazardous Waste Committee. This regulation includes a fee that is charged to imported refrigerants to ensure an effective return, transport and reuse/disposal of refrigerants. This fee was first introduced on refrigerants November 1, 1999. Most of the refrigerants in Iceland are used in the fish industry.

Some municipalities are making efforts to recover refrigerants from domestic refrigerators before they are disposed of, but this is not yet laid down in regulations. However, it is generally known that considerable quantities of the ozone depleting substances used in small (domestic) refrigerators are left behind in the insulation (up to 50%), when the refrigerant is recovered. It is not yet economically interesting to recover the refrigerant from the insulation foam of the refrigerators.

### *Electric and Electronic Equipment*

No particular regulation is in force for treatment or disposal of electric and electronic equipment in Iceland, others than regulation on waste collection and -treatment in general. There are a few smaller projects going on to repair and reuse of such devices. Iceland is now working on retaining better statistics on this issue, in cooperation with other Nordic countries. Most of the devices are land filled today.

### *Used Tyres*

According to EU Directive 1999/31/EC (Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste), member states are not allowed to landfill whole used tyres after 2003 and shredded used tyres after 2006. However, tyres used as an engineering material are excluded from the directive. The landfill directive has not yet been implemented in Icelandic law, but a new law on a fee on specific waste fractions has been approved recently (December 13, 2002), including used tyres (fee), end of end-of-life vehicles (refund), plastics for heavy-rolls (fee) and drinking cartons (fee).

By this law it would be ensured that the industry establishes a collection system for tyres and that the tyres are upgraded for reuse, recycled for new rubber products or incinerated. It is the intention of the regulation that the fee should be high enough to pay for collection, transport and recycling/energy recovery.

Iceland is working on the incorporation of the EU landfill directive into national law, which is expected to be in force in 2003.

*Discarded Cars*

Iceland has decided to comply with the EU Directive on end-of-life vehicles (Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles), which means that a collection system should be in place by July 2002. No measurements have been taken so far, but recently a new law on refund for end-of-life vehicles has been approved by the parliament.

The refund of IKR 10.000 will be introduced July 1, 2003 and is paid for by means of extra taxes that owners of registered vehicles have to pay together with road taxes 2 times a year (IKR 570/6 months), until the vehicle has reached an age of 15 years.

*Impregnated Timber*

No specific regulations are in force in Iceland concerning impregnated timber other than general regulations on hazardous substances and waste. However, a fee of IKR 2/kg is put on all oil-paints, including impregnation products from July 15, 1997, raised to IKR 6/kg by March 1, 1998, to IKR 10,50/kg by September 1, 2000, to IKR 13,50 by August 1, 2001 and to IKR 16,00/kg by December 15, 2001.

*Fluorescent Tubes*

According to the Regulation nr. 184/2002 on fluorescent tubes containing Hg are to be considered as hazardous waste after use. It is unclear, however, whether/when fluorescent tubes will be included under the hazardous waste fund. A practical problem is that fluorescent tubes contain different quantities of Hg – from 5–30 mg per piece. The process of regaining Hg from the tubes is a costly one (Sweden has a factory that processes Hg from fluorescent tubes) and therefore this is not yet considered economically interesting in Iceland as quantities are not very big.

## 2.5 Norway

In Norway the special waste fractions are regulated according to several regulations, most notably the Regulations on Hazardous Waste (Forskrift om farlig avfall), issued by the Environmental Protection Department, 20 December 2002. This regulation replaces the Regulation on Special Waste of 19 May 1994, latest revised 1 July 1999 (no. 865).

As such the regulations deals with all the waste fractions included in this study and in addition also hazardous waste fractions such as waste oil, paint etc.

The regulations should be seen as an overall regulation of the hazardous waste types, while detailed legislation has been introduced for some

of the special waste fractions such as batteries, discarded cars, used tyres, in order to ensure the environmentally most appropriate collection and treatment, including recycling.

#### *Regulations on Hazardous Waste*

By 22 September 2003 the previous legislation on “special waste” was changed to legislation on “hazardous waste”. The reason for the change of the name was a wish to underline the fact that this kind of waste implies an environmental “hazard”. So, all previous legislation on “special waste” was renamed to the legislation on “hazardous waste”.

The Regulations on Hazardous Waste (RHW) includes directions on storing, delivery and management of hazardous waste, including many types of special waste. The regulations also implement the European Waste List in Norwegian legislation. The RHW is mostly directed toward the hazardous waste from industries, but it also includes direction on how to manage from household and small industries. In this respect the RHW states that the municipalities have the responsibility to ensure that collection schemes for such waste is available for the households and the small industries.

With regard to storing of hazardous waste the RHW states that the waste shall be stored in a safe way and in such a way that it will not create risk of pollution and damage to human beings or animals. Furthermore, it is not allowed to mix hazardous waste with other types of waste.

Transportation and storing of the waste has to comply with special rules for labelling and packaging. All waste has to be packed so that the handling can take place without risk of spillage, and a declaration including information of the composition of the waste has to follow the waste all through its way from the waste generation to the final disposal.

The handling of hazardous waste requires a permit, issued either by the Environmental Protection Agency (Statens Forurensningstilsyn), the County governor (Fylkesmannen) or those the Environmental Protection Department may authorise.

Generators of hazardous waste have to deliver the waste to companies that are authorised to do so, and the delivery of the waste has to be accompanied by a declaration form, approved by the Environmental Protection Agency.

According to the Report to the Parliament (Stortinget), “The Government’s Environmental Protection Policy and the State of the Environment of the State” (“Regjeringens miljøvernpolitikk og rikets miljøtilstand”, St.meld. no. 25, 2002-2003) the overall national target concerning treatment of hazardous waste is that practically all hazardous waste fractions should be handled in a safe way, and it should happen either through recycling or by providing sufficiently treatment capacity at national level.

Furthermore, it is stated that the amount of hazardous waste not treated properly was bigger than original thought. Hence, it was recommended that more information should be given to the waste producers. In line with this, it is recommended to strengthen the enforcement of the present rules for hazardous waste. Finally, it was recommended to strengthen the harmonisation with EU legislation.

Norway has implemented legislation or binding agreements with the involved parties for the following hazardous waste fractions:

- Heavy metal containing batteries
- PVC containing waste
- Certain dangerous chemicals (ex. PCB).
- Asbestos containing waste
- Discarded refrigerators
- Electric and electronic device
- Used tyres
- Discarded cars.

#### *Regulations relating to Environmentally Hazardous Batteries*

The Regulations relating to Environmentally Hazardous Batteries (REHB)(Forskrift om miljøskadelige batterier, FOR-1990-07-17-616) is issued by the Environmental Protection Agency 17 July 1990, and changed 13 July 2000 (no. 774) and 22 September 2003 (no.1193).

The REHB regulates the following aspects:

- Labelling of environmentally hazardous batteries
- Prohibition of production of certain types of batteries
- Import, export and trade of certain types of batteries
- Obligations for collection of labelled batteries.

The REHB defines environmentally hazardous batteries through mentioning particular types of batteries such as:

- Lead batteries
- Nickel-Cadmium batteries for both domestic and industrial use.

All batteries containing more than a certain amount of lead, cadmium or mercury has to be labelled with information regarding this.

Furthermore, it is prohibited to produce, import, export or sell batteries containing more than 5 ppm of mercury (Hg).

The Norwegian legislation is more or less an implementation of the EU battery directives.

Manufacturers and importers of environmentally hazardous batteries are obliged to establish a system for collection and delivery of the batter-

ies for either recycling or environmentally safe treatment of the waste. Furthermore, they are obliged to ensure that at least 95% of the batteries that they deliver to the market are returned for either recycling or treatment.

Companies selling batteries that have to be labelled are obliged to take back used batteries and to deliver them to certain collection points for such batteries.

For this purpose the industry manufacturing, importing and selling batteries have established two companies to collect, dismantle, recycle and export batteries and materials from batteries, namely Batteriretur AS in 1993 and Returbatt AS in 1999.

Batteriretur has established a national network of collection points (e.g. shops selling batteries and shops selling apparatus containing batteries), where everybody can deliver used lead batteries. The lead batteries are collected at a central storage facility and exported to Sweden (Boliden-Bergsøe Factory), where the lead is recycled, the plastic boxes are either recycled or incinerated, and the acid is neutralised.

The importers of rechargeable batteries have established their own company, Returbatt, to take care of, in particular, NiCd batteries, which pose a special problem. The two companies work closely together to ensure that as many used batteries as possible are collected and treated in an environmentally sound way. The companies also work together with Elektronikkretur AS, which collects discarded electric and electronic waste, and hence recover a considerable number of different batteries.

The NiCd batteries are exported to either Sweden or France for recycling and treatment.

#### *PVC containing Waste*

It is prohibited to use ftalates in some uses of PVC in Norway (e.g. products designed for children). However, there are no specific collection systems for PVC waste, except a few municipalities that have established special containers for the PVC waste at recycling stations. Norway has one PVC manufacturing company, Hydro Polymers, which has a PVC plant in Hydro Porsgrunn Industripark. This plant regenerates its own PVC waste. The hazardous waste treatment facility, NOAH, receives small quantities of PVC waste from the municipalities.

#### *PCB containing Waste*

In the EU PCB and PCB containing waste is regulated according to a "Directive on polychlorinated biphenyl's", directive no. 413 of 17 April 2000. This directive is implemented in Norwegian legislation through "Regulations relating to the use etc. of certain dangerous chemicals"

(Forskrift om begrensninger i bruk m.m. av enkelte farlige kjemikalier, FOR-2002-12-20-1823, currently changed).

According to this regulation it is prohibited to manufacture, import, export, sell, recycle and use new PCB and PCB containing product from the time when the regulation was put into force, which was 9 July 2000. Likewise, it is prohibited to have PCB containing transformers and larger capacitors in operation.

By the 1 January 2005 it is no longer allowed to have PCB containing fluorescent tube capacitors in operation. Furthermore, PCB containing waste has to be labelled clearly to ensure that it receives the right treatment.

PCB containing electric and electronic products have to be disposed of through the same channels as other electric and electronic products as described below.

#### *Asbestos containing Waste*

Asbestos and asbestos containing waste are regulated according to a number of EU directives, which are implemented through a regulation issued by the Department of Labour and Government Administration, 16 August 1991 (Forskrift om asbest, FOR-1991-08-16- no. 600).

#### *Discarded Refrigerators*

Discarded refrigerators and freezers are regulated according to a "Directive on the Handling of Discarded CFC Containing Refrigerators" ("Forskrift om handtering av kasserte KFK-haldige kuldemøbler", directive no. 1310 of 10 December 1996).

According to this directive the municipalities have to establish collection facilities, where both private citizens and companies can deliver discarded refrigerators containing CFCs and HCFCs. Similarly, shops selling these products are obliged to take back old refrigerator when selling new ones to customers. The companies can deliver the old refrigerators to the municipal collection stations or directly to those companies recovering the CFC/HCFC from the devices.

The further disposal of the recovered CFC is covered by the specific Regulation on ozone depleting substances (Forskrift om ozonreducerende stoffer, FOR-2002-12-20-1818), issued according to among others the "Product Control Act".

Discarded refrigerators not containing CFC/HCFCs should be delivered to the collection system for EE waste.

*Electric and Electronic Device*

The collection and treatment of discarded electric and electronic products are regulated according to a "Directive on Discarded Electric and Electronic Products" ("Forskrift om kasserte elektriske og elektroniske produkter") approved 16 March 1998 and put into force 1 July 1999. The regulation was revised at the latest on 4 July 2003.

The Electric and Electronic products (EE products) are defined as products that are depending on electricity or electro magnetic field to work. It includes among others the following products: TV sets, PCs, photocopy machines, cooking stoves, mobile phones, cables, electric tools, vacuum cleaners. The EE products also include fluorescent tubes, low energy bulbs and refrigerators, if they do not contain ozone depleting substances. Products containing ODS is regulated according to the legislation mentioned above.

The responsibility for the disposal of the discarded EE products is basically placed at the manufacturers and the dealers of the products. The dealers has to allow consumers and companies to return discarded EE products of the kind they are selling, irrespective of the make, without charging the consumer. The individual EE manufacturers have the responsibility to take care of an amount of the EE products that corresponds to their market share.

Furthermore, the manufacturers have the responsibility to recover recyclable components from the collected products and ensure that the recyclable materials are brought to companies that actually are recycling the materials and that materials that cannot be recycled is treated in an environmentally sound way.

Alternatively, the consumers and the companies can deliver the EE products to municipal or regional collection centre for such products. It is free of charge for consumers to deliver the products to the collection centres, as it is supposed to be covered through the general waste management fee. However, the municipalities can charge companies for delivering products to the collection centres.

At the same day as the "Directive on Discarded Electric and Electronic Products" was approved (16 March 1998) an agreement between the Department of Environment and the EE Industry (industrial sector for electric and electronic products) was signed, defining the framework for a national collection system for EE products.

According to this agreement the EE industry has to establish a system with regional collection stations, where municipalities and others can deliver their discarded EE products for further recycling and treatment. The agreement furthermore mention that the industry has to work for substitution of environmentally hazardous materials/components in the product, and that they has to reach a collection rate of 80% of the estimated discarded EE products by 1 July 2004.

For the purpose of taking care of their responsibilities the EE industry associations have established a mutual company, Renas A/S, that takes care of the practical work of establishing the collection stations and the daily operation of it and the recovery of recyclable materials.

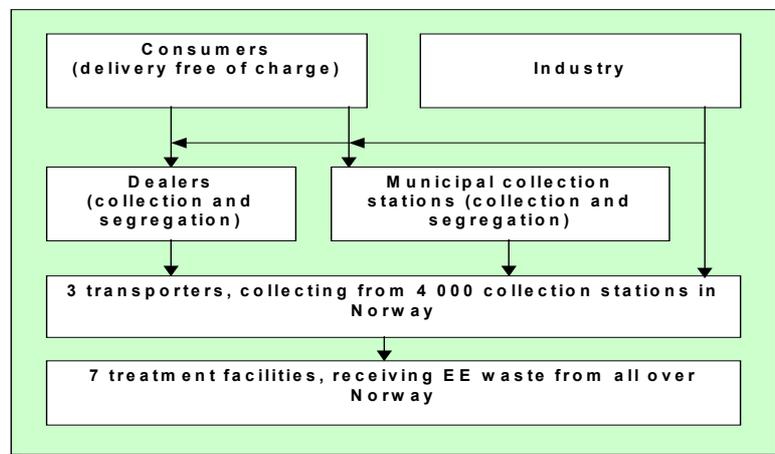
Renas has established agreements with 142 collectors and 19 collection stations around the country, at least one in each county (fylke). Renas charges the deliverers between 0.1 and 1% of the import value of the products for the disposal of the discarded products.

Besides Renas the industry has established two other companies to take care of domestic products, electronics and kitchen appliances. These two companies, Hvitevareretur AS and Elektronikkretur AS, are joined in a mutual company El-retur AS. All the companies work closely together and share the different parts of the collection and treatment facilities.

Parallel and in cooperation with the industry the municipalities have to provide collection points, where the citizens can deliver their discarded EE products free of charge.

All the shareholders within EE waste collection are obliged to provide public information about the collection system. The collection system is illustrated in Fig.1 below.

**Figure 1: Collection system for EE waste in Norway.**



### *Discarded Tyres*

Used tyres are regulated according to a “Regulation on collection and recycling of discarded tyres” (“Forskrift om innsamling og gjenvinning av kasserte dekk”, Regulation no. 246 of 25 March 1994, revised on 11 October 2001). The regulation went into force 1 January 1995.

According to this regulation it is not allowed to dispose of used tyres by land filling, all used tyres have to be recycled, either through reuse, material recycling or utilisation for energy production.

It is the responsibility of the dealers to take back used tyres from the users free of charge, and it is the responsibility of the manufacturers and

importers to take back the used tyres from the dealer also without charging them. The manufacturers have to ensure that the tyres are recycled in one or the other way.

For this purpose the industry (Dekkimportørenes forening, Bilimportørenes Landsforening og Norges Bilbransjeforbund) established a company, Norsk Dekkretur A/S, which was given the responsibility to establish a national system for collecting and recycling of discarded tyres.

In order to ensure that the consumers can return the used tyres free of charge to the dealers, from which Dekkretur collects the tyres, a claim for compensation is imposed on all new tyres by 1 January 1995.

#### *Discarded Cars*

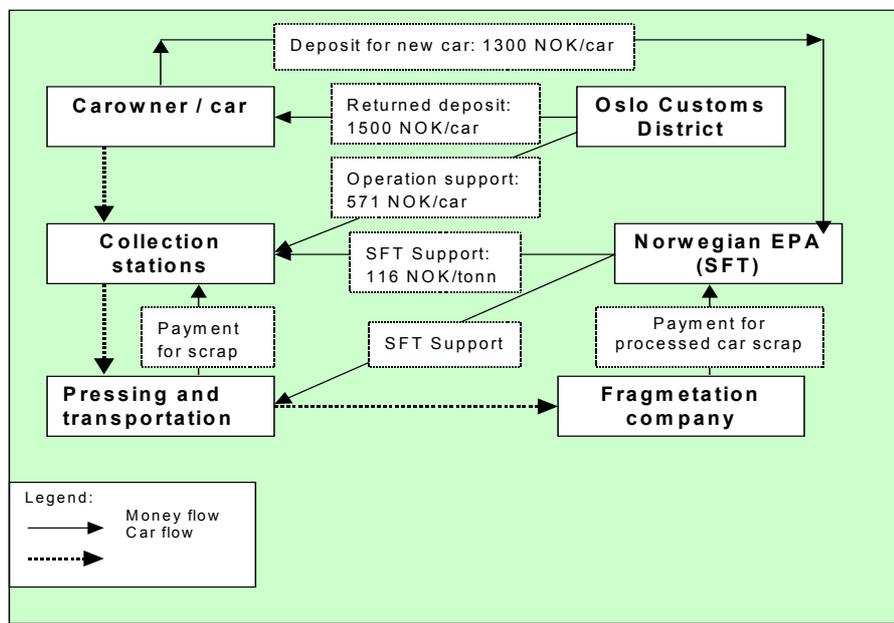
The collection and treatment of discarded cars are regulated according to the “Regulation on discarded vehicles” (“Forskrift om kasserte kjøretøy”, FOR-2002-06-26-750), from 26 June 2002.

The collection system is based on a deposit system implemented in 1978, where a deposit on 1,300,- NOK has to be paid by the owners of new cars (below 3.5 tonnes). A deposit on ,500,- NOK is returned to the last owner of the car to encourage him/her to deliver it to a certified scrap dealer.

Both those companies that are dismantling the cars and the scrap dealers, who are crushing and segregating the materials, are supported by a central fund to ensure that the recycling system is running. In 2001 depolluting companies were paid 355 NOK for removing environmentally hazardous materials (batteries, refrigerants, lubrication oil, mercury switches, lead parts etc.).

In fig. 2 below the principles of the system is illustrated.

Fig. 2: Illustration of the Norwegian recovery/recycling system for vehicles.



The system has been changed recently through implementation of the EU directive on end-of life vehicles (Directive 2000/53/EC). This is changing the system gradually from the presently state driven system to a system based on the manufacturer's producer liability, partly from 1<sup>st</sup> of June 2002 and in full from 1<sup>st</sup> of January 2007.

### *Impregnated Timber*

The use of impregnated timber is regulated according to a "Directive on prohibition of the use of CCA impregnated timber" ("Forskrift om forbud mot bruk av CCA impregnert trevirke", directive no. 1120 of 10 September 2001).

According to this directive it is prohibited to import, export, sell, use or recycle timber that is impregnated with chromium and arsenic containing substances.

Impregnated timber waste is regulated according to the general hazardous waste regulation. The waste can be delivered to the municipal waste collection system. From here the impregnated timber waste is brought to a central station, where it is shredded, and exported for treatment in Sweden (at SAKAB). As this is an expensive solution investigation has been undertaken to find out if a Norwegian treatment plant can be established.

During 2003 SFT financed an investigation of ways to establish a new collection and treatment system and to stimulate the collection of impregnated timber waste (Ref.: "Collection systems for impregnated timber", SFT 2003 ("Innsamlingsordninger for impregnert trevirke", SFT,

TA-1975/2003)). It is proposed that a fee should be added to the price of new impregnated timber, and that the fee should be collected in a fund that should finance the collection system. It is estimated that 1 000 NOK per tonnes is needed to ensure an efficient collection of impregnated timber waste. This will lead to an increase of the price of new impregnated timber on less than 5%.

#### *Fluorescent Tubes*

Fluorescent tubes and low energy bulbs are covered by the regulation for electric and electronic waste.

## 2.6 Sweden

Sweden has implemented legislation or binding agreements for the following hazardous waste fractions:

- Heavy metal containing batteries
- PVC containing waste
- PCB containing waste
- Asbestos containing waste
- Discarded refrigerators
- Electric and electronic equipment
- Used tyres
- Discarded cars
- Impregnated timber
- Fluorescent tubes

#### *Producer Liability*

Producer liability has become the basic principle for collection, treatment and recycling of special waste fractions in Sweden, and hence the legislation will be more and more harmonised with the principles of the EU Regulation in this field.

The long-term purpose of introducing the producer liability is to encourage the manufacturers to develop products that:

- minimises resource consumption and reduces emissions to the environment
- makes it easier to recycle materials
- minimises the content of environmentally hazardous substances.

The producer liability principle was introduced by Parliament already in 1975. The principle was included in the legislation in 1993, formally through amendment of the waste management legislation in 1994.

### *Heavy Metal containing Batteries*

Sweden has had – just like the other Nordic countries - a number of different collection schemes for batteries.

The collection of batteries was initiated in the mid 1970s, mainly focusing on the mercury batteries. In 1987 a national campaign for the collection of batteries containing mercury and cadmium was launched. In 1993 this collection scheme was replaced by another one, SIMBA (Stiftelsen Insamling av Miljöfarliga Batterier), focusing on NiCd batteries, organised by the industry.

This scheme has recently (1998) been replaced by a new collection scheme organised by the municipalities, and including all types of batteries. This collection scheme is established according to a directive on batteries (“Förordning om batterier”(original 1997:645, later amended)), which went into force 1 January 1998.

The purpose of the directive is to avoid the release of the heavy metals, mercury, cadmium and lead, to the environment.

According to the directive all types of batteries, hazardous as well non-hazardous, has to be collected and afterwards segregated for the purpose of recycling and treatment.

The municipalities have the responsibility for establishing the collection of batteries, and in most cases the generators of used batteries are requested to deliver their batteries to the municipal recycling centres. Car batteries can also be delivered to the recycling stations, but those (shops selling spare parts and car repair workshops) selling such batteries have to take used batteries back.

The waste collection system is financed through a tax on new batteries that is 300-500 SEK/kg for smaller batteries (alkaline, silver oxide, zinc sulfite and NiCd batteries), and 30 SEK/kg for car batteries.

The tax is paid to a fund (Batterifonden), which is administrated by the Swedish EPA (Statens Naturvårdsverk). The fund is used to cover the cost of those organisations that take care of the collection, sorting and transportation of the batteries, primarily the municipalities. The Municipalities receive the following compensation for handling of batteries:

- Mercury oxide batteries and bottom cell batteries: 30 SEK/kg
- Closed NiCd batteries: 30 SEK/kg
- Lead batteries below three kilos: 5 SEK/kg

According to a report from Statens Naturvårdsverk (Ref.: “Collect and recycle!” Swedish EPA, report 5237, 2002 (“Samla in, återvinn!”), Statens

Naturvårdsverk, Rapport 5237, 2002)) the Battery Fund received 70 million SEK from selling of lead batteries in 2001 and 41 million SEK from selling of NiCd batteries. Until 2001 the fund has received 496 million SEK. During 2001 42 million SEK was spent for collection systems and 10 million SEK for information activities.

#### *PVC containing Waste*

The producer liability principle has already been introduced for packaging waste, including PVC containing packaging, but the use of PVC for packaging is only minimal. The primary share of PVC in waste originates from the building and construction sector as well as cars, electric and electronic equipments (Ref. Swedish EPA Press Release 960628, 1996).

Hence, basically the PVC containing waste is not regulated in Sweden, and there are no collection system specifically directed towards PVC.

#### *PCB containing Waste*

Sweden was one of the first countries to determine PCB as a serious pollutant.

In the beginning of 1970's the first regulation took place, implementing a prohibition on the use of PCB in "open uses" (applications where the PCB could escape to the environment) (Produktkontrollnämndens kungörelse om hantering och märkning av PCB och PCB-vara PKFS (1976:5), which originally was issued in 1970).

In the 1980's the use of PCB in closed systems was prohibited as well. At last - in 2000 - a total prohibition of the application of new PCB containing equipment was declared. The prohibition of application of new use of PCB is based on a "Directive on PCB etc." ("Förordning om PCB m.m.", SFS 1985:837).

The collection of PCB containing waste is covered by a directive on disposal of PCB containing waste, which is based on the EU directive on disposal of PCB and PCT (COUNCIL DIRECTIVE 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)). However, the collection and treatment of PCB containing waste is furthermore covered by directives on waste oil ("Förordning om spillolja") and a directive on incineration of PCB ("Förordning om förbränning av PCB m.m.").

#### *Asbestos containing Waste*

The handling of asbestos containing waste is regulated through the occupational health and safety regulation, while the land-filling is regulated through a "General Advice Note on Disposal of Asbestos" from the EPA (Naturvårdsverkets allmänna råd 87:3, "Deponering av asbest"). Accord-

ing to this Note, that was negotiated with the Municipal Association, the asbestos containing waste should be disposed of separately, its location should be documented and it should be covered immediately after dumping.

#### *Discarded Refrigerators*

According to the Waste Management Directive refrigerators, freezers etc. containing CFCs, have to be delivered to places appointed by the municipalities for recovering the CFCs. This collection schemes was put into action by 1 January 1995.

The collected discarded refrigerators etc. are brought to companies that have been licensed to recover the CFCs.

#### *Electric and Electronic Equipment*

During 2000 and 2001 the Swedish government decided three new Regulations for handling electric and electronic waste, all put into force 1 July 2001. The Regulation include the following components:

- Producer liability concerning electric and electronic equipments (Förordning (2000:208) om producentansvar för elektriska och elektroniska produkter)
- Amendment of municipal waste management directive (Avfallsförordning (2001:1063), in particular § 24)
- Commercial pre treatment of electric and electronic waste (Naturvårdsverkets föreskrifter och Allmänna råd om yrkesmässig förbehandling av avfall som utgörs av elektriska eller elektroniska produkter; NFS 2001:8).

#### *The Producer Liability*

The producer liability gives the consumer the right to leave old electric or electronic equipments of same type, when they buy new ones. It is, then, the responsibility of the dealer to ensure that the old equipment is treated according to the rules for electric and electronic waste.

The producer liability includes the following electric and electronic equipment:

- Electric and electronic hand and garden tools
- IT goods from household and offices
- Tele communication equipment
- TV, audio and video equipment
- Camera and photo equipment
- Electric and electronic clock works
- Electric and electronic toys and sports equipment

- Light pulp and light armatures
- Medico technical equipment
- Laboratory equipment.

Discarded refrigerators and freezers are not included under this producer liability, because they are covered by the special regulation of products containing ozone depleting substances.

Furthermore, the manufacturers are responsible for informing the consumers about the waste collection scheme.

#### The Amendment of the Waste Management Directive

The municipal waste management directive describes among others the responsibility of the municipalities to collect municipal waste from the household. By implementing the new regulation on producer liability for electric and electronic equipments the municipalities will only be responsible for those products that are not brought back to the manufacturers.

#### Pre Treatment

The third component of the new Regulation includes different rules to ensure environmentally sound treatment of the collected electric and electronic waste. The aim of these rules are to ensure that as much of the electric and electronic waste is dismantled and segregated so that the environmentally hazardous components are recovered for recycling or environmentally sound treatment.

The rules determines that all companies handling electric and electronic waste should:

- Be in possession of a certified quality or environmental management system
- All employees dealing with the electric and electronic waste should receive the necessary information
- Pre treatment methods applied should be documented
- Unsorted waste is considered as hazardous waste and should be treated as such
- Waste components containing bromated flame retardants should be treated separately
- Special precautions should be taken in order not to affect the surroundings.

#### *Discarded Cars*

The handling of discarded cars and used car parts are covered by a general producer liability for cars, determined in a directive of 1997 (Förordning (1997:788) om producentansvar för bilar). According to this

directive the manufacturers of cars (including importers and agents as well) should:

- The manufacturer should take back registered discarded cars from the last owner of the cars, without charging the owner
- The manufacturer can however charge the car owner, if larger parts are missing or if new parts produced by other manufacturers have been installed in the car
- The manufacturer must give the car owner reasonable conditions for leaving the car to the manufacturer, and should inform the Environmental Protection Agency (Naturvårdsverket) about this
- The manufacturer has the responsibility of ensuring that the discarded cars are scrapped in an environmentally sound way, according to the Law on Car Scrapping (Bilskrottningslag (1975:343)).

Furthermore, the manufacturers have to inform the car scrapper about the content of various materials and chemicals in order to ease the dismantling and recycling of the cars. Reuse of the different car parts are given highest priority; secondly the materials should be recycled and thirdly the remaining materials should be incinerated environmentally appropriate and with energy recovery.

The following goals have been established for the reuse and recycling of discarded cars, measured for the individual manufacturers and within one year:

- By 2002 85% of discarded cars should be reused/recycled
- By 2015 95% should be reused/recycled.

The purpose of the this Directive on producer liability for cars is to:

- Reduce the environmental impact from leaking of environmentally hazardous chemicals from the discarded cars (refrigerants, lube oil etc)
- Increase the recycling of materials (metals, plastics, rubber etc.)
- Increase the reuse of valuable spare parts
- Reduce the quantities of waste to be deposited.

According to a resolution made by the Swedish Parliament (Riksdagen) the legislation for end-of-life-cars was revised in March 2000 (Proposal 2000/01:47). Both the Law on Car Scrapping (1975:343) and the Car Scrapping Directive (1975:348) were changed and put into force by 1 July 2001.

According to the new rules a car dealer selling a new car below 3 500 kg has to collect a fee on 700 SEK that is transferred to a fund that will reimburse a car scrapping premium to the last owner of the car, when the

car is sent to scrapping. Only authorized car scrapping companies can reimburse the premium, which is divided into the following levels:

- 700 SEK for cars less than 7 years old
- 1,200 SEK for cars between 7 and 16 years of age
- 1,700 SEK for cars that are more than 16 years old.

Furthermore, the Swedish EPA “Regulations and General Guidelines on vehicle dismantling operations” were adopted on 17 December 2001 and came into force on 21 April 2002. This regulation corresponds to Article 6 and Annex I of the End-of-life-vehicles Directive (2000/53/EG).

#### *Used Tyres*

The handling of used tyres is covered by the above Directive on producer liability for cars. It is the responsibility of the tyre manufacturers to ensure that discarded tyres are handled in an environmentally sound way. The following goal has been established for disposal of discarded tyres: no more than 20% of tyres should be deposited.

For the purpose of fulfilling the producer liability the industry has established the company Swedish Tyre Recycling ltd (Svensk Däckåtervinning AB (SDAB)).

#### *Impregnated Timber*

Impregnated timber is by 2002 classified as hazardous waste according to the European Waste Catalogue. As such it has to be segregated from the other waste as well as handled and treated as hazardous waste.

This means that companies/plants that until now have treated impregnated timber by incineration, have to apply for a new permit, unless they already are allowed to treat hazardous waste.

If the timber is deposited at a landfill, the landfill has to comply with the requirements for a class 1 depot.

#### *Fluorescent Tubes*

Due to its content of mercury fluorescent tubes and low energy bulbs are classified as hazardous waste. Hence, the products have to be collected and treated separately. Fluorescent tubes and low energy light bulb are furthermore considered as EE waste and as such they have to follow the same collection system. The tubes and light bulbs are brought to a special treatment/recycling plant in Bjästa that can neutralise and stabilise the mercury content (see below under Treatment).

## 2.7 Summary of Regulation, Logistics and Financial Mechanisms

### *Summary of Regulation*

Denmark and Norway have primarily based their collection systems for special waste fractions on individual regulation and agreements with the industry, and they have in most cases introduced financial mechanisms to support the collection and treatment of the waste.

Sweden has mainly based their systems on producer liability where the industry is given more of the responsibilities to ensure that the waste fractions are collected and treated in an environmentally appropriate way. For some special waste fractions financial mechanisms have been introduced.

Iceland has introduced legislation for only some of the waste fractions mentioned in the list, but new legislation is underway.

Although Norway and Island are not members of the EU they are gradually harmonising and developing new legislation in accordance with the EU Regulation within the area.

**Table 3: Summary of Regulation for collection/treatment/recycling/disposal of special waste fractions in Nordic countries**

Waste fraction	Denmark	Finland	Iceland	Norway	Sweden
NiCd batteries	Yes	Yes	Yes	Yes	Yes
Alkaline bat.	None	None	Yes	None	None
Hg batteries	Yes	Yes	Yes	Yes	Yes
Car batteries	Yes	Yes	Yes	Yes	Yes
PVC	Yes	None	None	None	Yes
PCB	Yes	Yes	Yes	Yes	Yes
Asbestos	Yes	Yes	Yes	Yes	Yes
Discarded refrigerators	Yes	Yes	None	Yes	Yes
EE waste	Yes	Yes	None	Yes	Yes
Tyres	Yes	Yes	Yes	Yes	Yes
Discarded cars	Yes	Yes	Yes	Yes	Yes
Impregnated timber	None	Yes	None	None	Yes
Fluorescent tubes	None	Yes	None	Yes	Yes

### *Summary of Collection Systems and Logistics*

All the countries have established wide spread collection networks, some of which are interlinked across the borders. The collection systems involve public authorities, usually municipals, as well private and publicly owned private companies. In all countries the municipal collection network, recycling stations, receives special waste fractions, except discarded cars, from citizens and smaller companies free of charge.

For lead batteries most countries have established collection system based on the possibility of returning the old batteries to those selling new batteries. However, the batteries can also be delivered to the municipal collection stations for further collection. Most of the discarded lead bat-

teries in the Nordic countries are delivered to the Boliden-Bergsøe company in Landskrona, where the lead is recycled.

The other types of batteries, NiCd, Hg and alkaline batteries are collected both through the retail shops and the municipal collection system. While the NiCd batteries are exported for recycling and treatment outside the Nordic countries, the Hg batteries are mostly stored in special depots. Alkaline batteries are only collected occasionally in some of the countries, and in most cases landfilled.

With regard PVC a collection system for larger parts of PVC, mainly from the building and construction industry, has been established in Denmark with the purpose of recycling. In Finland, Norway and Sweden smaller quantities of PVC is collected, primarily in areas, where the municipal waste is incinerated. In these cases the PVC is land-filled.

PCB is collected in all the Nordic countries, primarily through the municipal hazardous waste systems. The waste is treated at high temperature incineration at the special plants for hazardous waste treatment in Denmark, Sweden and Finland. The quantities of PCB containing waste collected are in general declining. In Norway there is also one company with the permission to treat PCB containing waste, but it is probably not treating any PCB waste.

In all the Nordic countries the asbestos waste is primarily collected through the municipal collection system for hazardous waste, and land-filled at special depots.

Similarly, all the countries have established collection systems for discarded refrigerator and freezers, primarily based the municipal recycling stations, that forward the items to regional stations, where the ODS refrigerant is recovered for either recycling or destruction. Each of the larger Nordic countries have a national plant for either recovery or destruction of the ODS in the insulation foam.

All the countries have established collection systems for EE waste, although the systems are still under implementation in some of the countries. The collection is based on collection systems organised either be the municipalities or the manufacturers and retail shops dealing with EE products. In all the countries a number of small companies dismantling and segregating the valuable materials have emerged. Some of the recovered metals are recycled at different plants in the Nordic countries, but in general the metal markets is global and hence the metals are sold, where the prices are best.

For old tyres all the countries have collection systems, primarily based on the retail shops and workshops new tyres selling as well as the industry associations. In all the countries some of the tyres are reused through refurbishing. In Denmark, Finland, Norway and Sweden there exist at least one company in each country converting the rubber into new products. Some tyres are incinerated and some are land-filled, although all the

countries are preparing for complying with the EU regulation that after some years will require recycling or incineration of the rubber.

All the countries have a wide spread recycling system for discarded cars based on private scrap dealers. Denmark, Finland, Norway and Sweden have steel plants receiving car scrap. However, as the steel market is global considerable quantities of car scrap is exported to countries outside the Nordic countries.

Collection of impregnated timber waste is still under development in the Nordic countries, and none of the countries have collection systems covering the entire country. In all cases the waste is land-filled on special depots. Some companies having treatment plants for hazardous waste is planning to built an incineration plant that can treat the wood and recycle some metals.

Fluorescent tubes and low energy light bulbs are collected in the four larger Nordic countries, and the collection is primarily based on the municipal collection system. Both Sweden and Denmark have plants for treating and recycling fluorescent tubes, while the remaining waste is exported to plants outside the Nordic countries.

**Table 4: Summary of nation wide collection systems for special waste fractions in Nordic countries**

Waste fraction	Denmark	Finland	Iceland	Norway	Sweden
NiCd batteries	Yes	Yes	Yes	Yes	Yes
Alkaline bat.	Yes	None	Yes	Yes	Yes
Hg batteries	Yes	Yes	Yes	Yes	Yes
Car batteries	Yes	Yes	Yes	Yes	Yes
PVC	Yes	None	None	None	None
PCB	Yes	Yes	Yes	Yes	Yes
Asbestos	None	None	None	None	None
Discarded refrigerators	Yes	Yes	None	Yes	Yes
EE waste	Yes	None	None	Yes	Yes
Tyres	Yes	Yes	Yes	Yes	Yes
Discarded cars	Yes	Yes	Yes	Yes	Yes
Impregnated timber	Yes	Yes	None	None	Yes
Fluorescent tubes	Yes	Yes	None	Yes	Yes

*Summary of Financial Mechanisms*

In most Nordic countries citizens can deliver the special waste fractions to municipal waste collection centre mainly free of charge, except for discarded cars. The municipal collection system is financed over the general municipal waste fee, hence, the citizens indirectly pay for the service. However, for the time being and before the enforcement of the WEEE Directive in Finland, disposal of bulky WEEE items is not free of charge. For discarded cars the car owners have to pay for the dismantling and scrapping of the car, depending on the cost of getting rid of the hazardous substances as well as the presence of valuable spare part and the value of the scrap metal etc.

In order to stimulate the collection of special waste fractions the countries have introduced different kinds of refund mechanism where the consumer is paying a certain deposit, when buying the product or a fee over the years. The deposit/fee or part of it is refunded when the products are delivered for recycling or treatment. In table 5 below shows which of the countries that have introduced financial mechanisms for the various products to stimulate the returning of the products at the right place.

**Table 5: Summary of financial mechanisms to encourage collection of special waste fractions in Nordic countries (treatment fees are not considered as an encouraging financial mechanism)**

Waste fraction	Denmark	Finland	Iceland	Norway	Sweden
NiCd batteries	Yes	None	Yes	None	None
Alkaline bat.	None	None	Yes	None	None
Hg batteries	Yes	None	Yes	None	None
Car batteries	Yes	None	Yes	None	None
PVC	None	None	None	None	None
PCB	None	None	None	None	None
Asbestos	None	None	None	None	None
Discarded refrigerators	None	None	None	None	None
EE waste	None	None	None	None	None
Tyres	Yes	Yes	Yes	Yes	Yes
Discarded cars	Yes	None	Yes	Yes	Yes
Impregnated timber	None	None	None	Yes	None
Fluorescent tubes	None	None	None	None	None

## 3. Quantities of Special Waste Fractions

This chapter includes information on the quantities of the special waste fraction that have been generated and collected. Only waste fractions that have been regulated in the various countries will be described.

It should be emphasised that for some of the fractions the data is not generated in the same way, e.g. in some cases the data include not only the hazardous materials but also the equipment that it is installed in, but in other cases the data include only the hazardous material. Hence, the data from the different countries may not be directly comparable in all cases.

### 3.1 Denmark

#### *Heavy Metal containing Batteries*

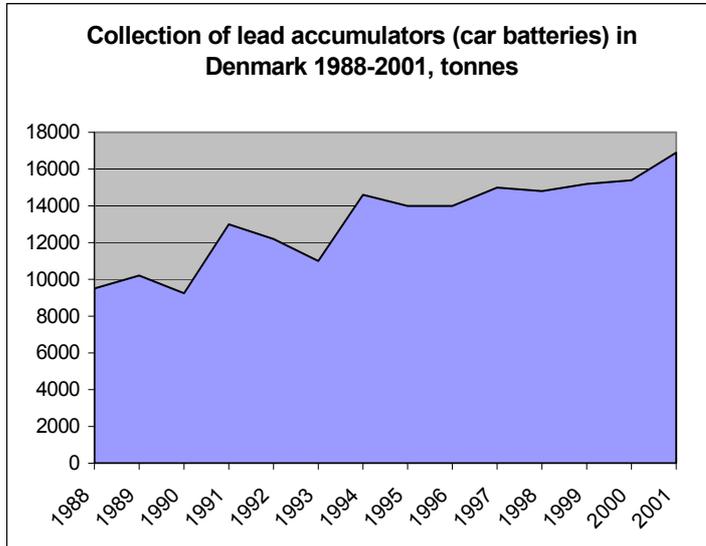
The quantities of batteries sold in Denmark in 2000 are shown in table 6 below (ref.: Danish EPA homepage, [www.mst.dk](http://www.mst.dk)).

**Table 6: Quantities of batteries sold and generated as waste in Denmark, 2000**

	Lead accumulators	NiCd batteries	Rechargable batteries, incl. NiCd	Disposable batteries
Total sale in Denmark 2000, in metric tonnes	Approx. 15 000	-	500	2 400
Waste generation 2000, in metric tonnes	Approx. 15 000	120	-	-

The development of the amount of lead accumulators collected in Denmark appears from figure 3 below (ref. ReturBat's homepage, [www.returbat.dk/](http://www.returbat.dk/)).

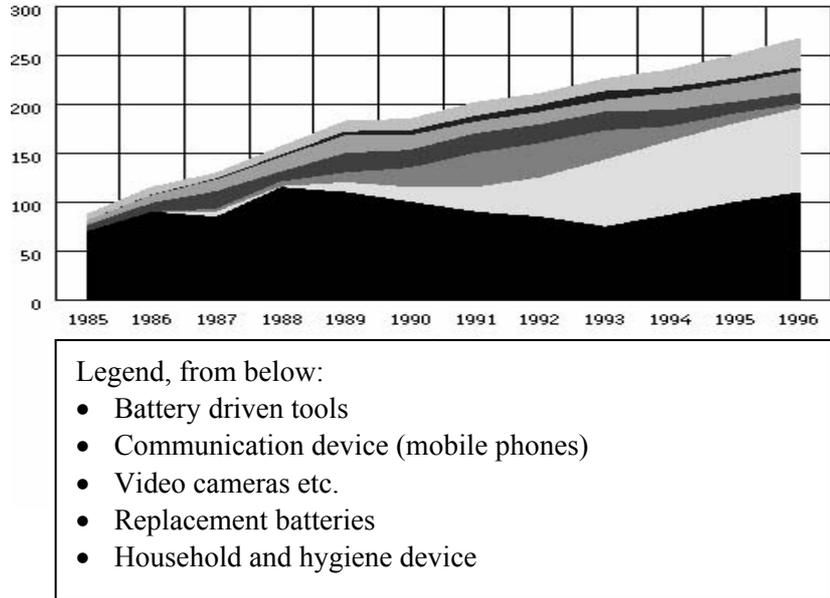
**Figure 3: Collection of lead accumulators in Denmark, 1988-2001, tonnes per year.**



As it can be seen the quantities of lead accumulators collected have been steadily increasing since 1996. Returbat's collection system was introduced in 1994.

The quantities of NiCd accumulators used in different kinds of device is shown in fig. 4 below (ref. "Mass flow analysis for Cadmium, 2000", Danish EPA, 2002, "Massestrømanalyse for cadmium, 2000", Miljøstyrelsen, 2002).

**Figure 4: Supply of NiCd batteries in Denmark, 1985-1996, approximate tonnes per year.**



*PVC containing Waste*

It is estimated that the amount of PVC waste generated in 1997 was approximately 34,000 tonnes, divided with about one third on each of the following three sectors:

- Industry and commerce
- Building and construction (incl. demolition)
- Households.

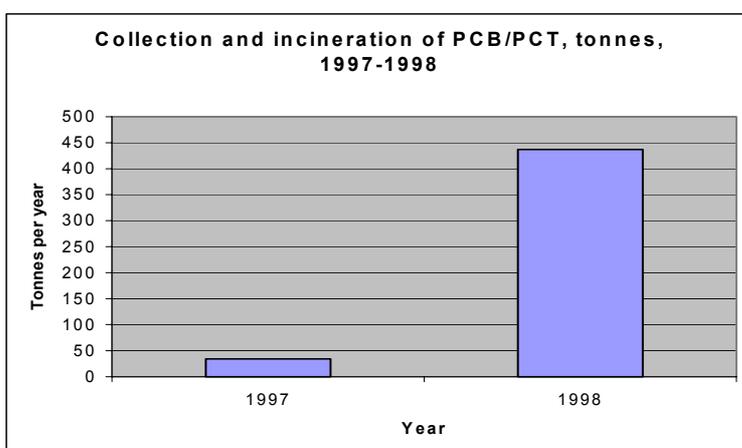
It is further estimated that 10-15% of the PVC waste from the building and construction sector is recycled (ref.: Danish EPA homepage, [www.mst.dk](http://www.mst.dk)).

The company established for collection and recycling of post consumer PVC waste, WUPPI A/S, which collects hard PVC from the building industry, estimates that the quantities collected in 1999 was 700 tonnes and that the amount in 2000 will reach about 1 200 tonnes (ref.: WUPPI homepage, [www.wuppi.dk](http://www.wuppi.dk)).

### *PCB containing Waste*

The amount of PCB containing waste has declined considerably within the last decade, and hence there is only few data on the quantities recovered. According to the Waste Statistics for 1997 and 1998, the quantities of PCB/PCT waste that was collected and sent for special treatment (incinerated in hazardous waste treatment plant, Kommunekemi), varied a lot, see fig. 5 below.

**Figure 5: Collection and incineration of PCB/PCT in Denmark, 1997-1998, tonnes per year.**



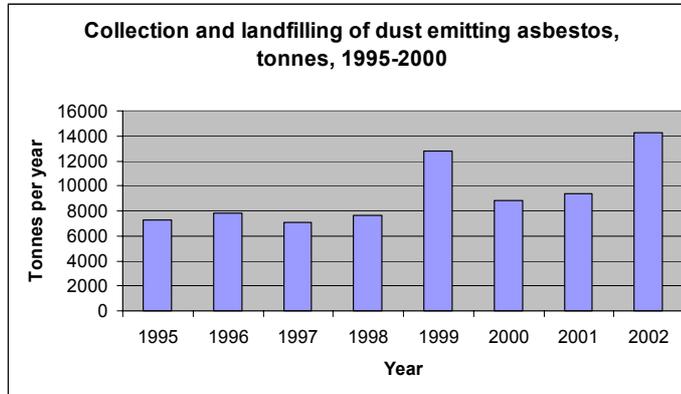
The Waste Statistics does not include specific data for PCB/PCT for other years.

### *Asbestos containing Waste*

The quantities of “dust emitting” asbestos waste (asbestos waste with “loose” fibres) collected and disposed of at landfills appear from fig. 4.4 below. (Ref.: “Waste Statistics 2002”, Information from Danish EPA, no. 6, 2003 (“Affaldsstatisk 2002”, Orientering fra miljøstyrelsen, nr. 6, 2003.)).

The Waste Statistics does not include data on asbestos cement and other asbestos containing waste categories, that contains fixed fibres.

**Figure 6: Collection and landfilling of asbestos waste in Denmark, 1995-2000, tonnes per year.**



*Discarded Refrigerators*

It is estimated that approximately 250,000 refrigerators and freezers were discarded in 1998, and that 225 000 were collected through the municipal collection system (some of them via the dealers of domestic appliances) (ref.: Danish EPA homepage, [www.mst.dk](http://www.mst.dk)).

Furthermore, it is estimated that the weight of the discarded refrigerators and freezers quantities to about 12,500 tonnes. From the collected refrigerators it is estimated that about 100 tonnes of CFC is recovered (ref.: Danish EPA homepage, [www.mst.dk](http://www.mst.dk)).

*Electric and Electronic Equipment*

It is estimated that approximately 103,000 tonnes of electric and electronic waste was generated in Denmark in 1997 (excluding refrigerators). The waste was generated from various sectors as it appears from table 7 below (ref.: Danish EPA homepage, [www.mst.dk](http://www.mst.dk)).

**Table 7: Share of electric and electronic waste divided on sectors, 1997**

Sectors	Percentage of total amount of electric and electronic waste, %
Bulky waste collection	48
Households	15
Institutions, commerce and service	20
Industry	15
Building, construction and demolition	2

Approximately 20,000 tonnes of the waste was treated by companies specialised in recovering the recyclable components and materials from the waste, while minimum 40,000 tonnes were treated by scrap dealers. In total 70,000 tonnes of materials was recycled, corresponding to about 70 to 80 % of the waste, while 15 to 20% was disposed of at landfills and 5 to 10 % incinerated.

### *Used Tyres*

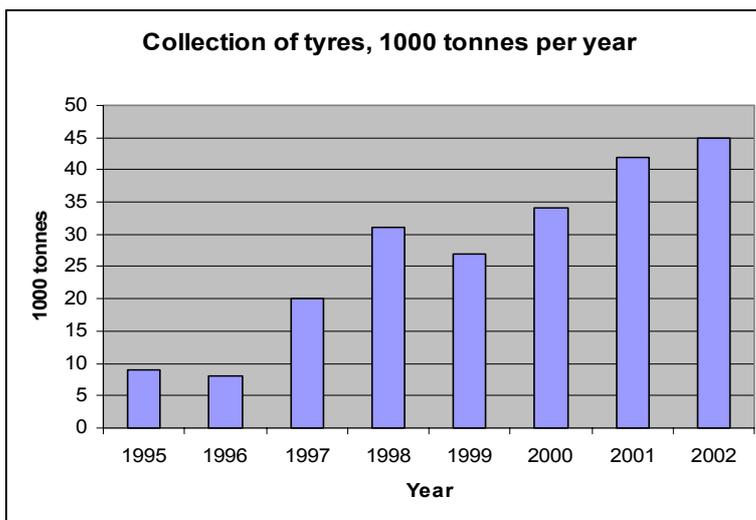
The total amount of used tyres collected in 2000 is estimated to approximately 40,000 tonnes. The 6,000 tonnes is truck tyres that are delivered to companies retreating the tyres. The 34,000 tonnes is collected through registered tyre collectors (mostly car repair workshops). 19% is recovered for reuse while the remaining 81% is delivered to companies that are licensed/approved by the Danish EPA to reutilise the tyres.

In total 27,700 tonnes were reutilised, including 24,000 tonnes that were recycled on the approved companies. The remaining 3,700 tonnes were crushed for energy recovery.

40% of the used tyres are generated by consumers, while 60% is generated by the commercial sector.

Fig. 7 below shows the quantities of vehicle tyres that have been collected through the certified collectors during 1995-2002 (Ref.: "Waste Statistics 2002", Information from Danish EPA, no. 6, 2003).

**Figure 7: Discarded vehicle tyres collected in Denmark by certified tyre collectors, 1995-2002.**

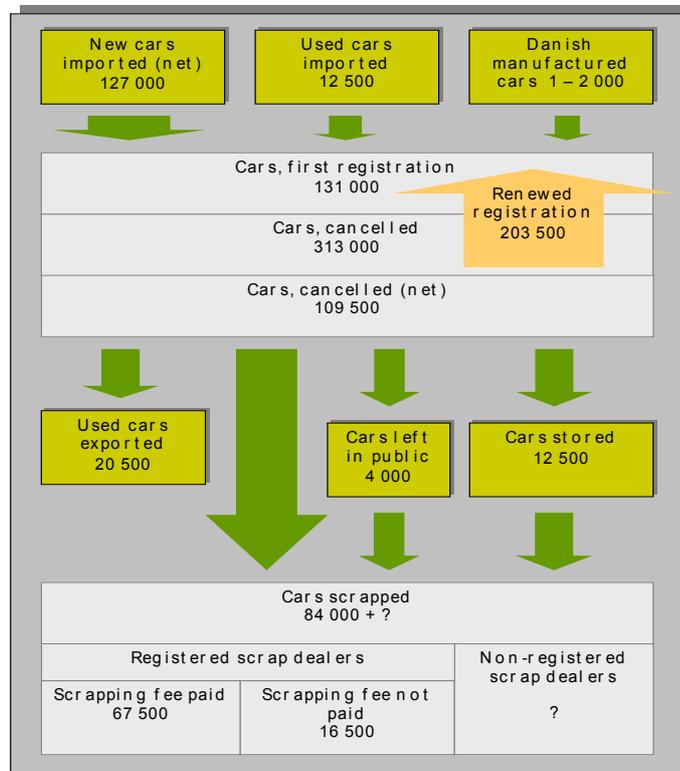


As it appears there is a current increase in the quantities of discarded tyres, which primarily can be explained by the increased number of cars and the more road traffic in Denmark during the period.

### *Discarded Cars*

It is estimated that approximately 84,000 cars (personal cars and delivery vans up to 3.6 tonnes) were delivered to the scrap dealers in period from 1 July 2000 to 30 June 2001 (ref.: "Evaluation of the vehicle scrapping scheme", Danish EPA, 2002).

Figure 8: The flow of cars during the period, 1 July 2000 – 30 June 2001.



There is a current statistics on the quantities of steel and metal scrap recycled in Denmark and exported. However, it is possible to divide these figures into scrap from discarded vehicles and others.

### Impregnated Timber

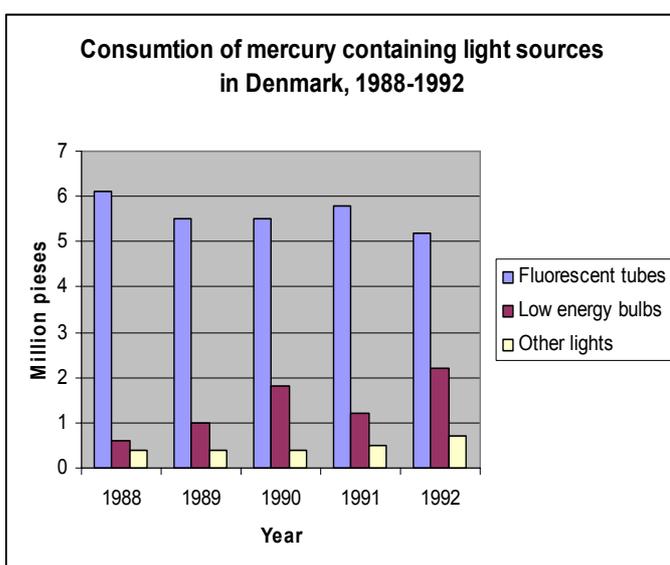
In a survey conducted in 1996 it was estimated that 2.7 million tonnes of impregnated timber was accumulated in Denmark pr 1992. The amount accumulated in 2000 is estimated to 4 million tonnes. This calculation is based on the balance: Accumulated = Production + import - export – waste. It is estimated that additionally 109,000 tonnes is installed each year. Furthermore, it is estimated that about 8,000 tonnes is generated as waste. (ref. Træbeskyttelsesmidler og imprægneret træ, Arbejdsrapport fra Miljøstyrelsen, nr. 57,1997).

According to the Waste Statistic the quantities of timber collected (Ref.: “Waste Statistics 2002”, Information from Danish EPA, no. 6, 2003) is much higher than the impregnated timber waste, around 55 tonnes in 2002. However, this figure includes other timber waste than impregnated timber.

### *Fluorescent Tubes*

According to the latest mass balance analysis for mercury in Denmark, the consumption of fluorescent tubes and low energy bulbs have been as it appears from the fig. 9 below (“Massestrømanalyse for kvivsølv”, Miljøprojekt 344, Miljøstyrelsen 1996 (Mass balance for mercury, Danish EPA, 1996). With an expected life of these tubes/bulbs on about five years time the consumption figures may very well correspond to the number of discarded tubes/bulbs in these years.

**Figure 9: Consumption of mercury containing light sources in Denmark, 1988-1992**



As it appears there seem to be a slight decrease in the consumption of fluorescent tubes, while there are similar increase in the consumption of low energy bulbs for the shown period. This means that the total number of tubes/bulbs that are discarded probably is more or less constant (around 7-8 million peaces per year). However, the numbers of tubes/bulbs that are delivered to collection systems are probably increasing as the collection systems are still under implementation and the knowledge of the collection systems are still growing.

Earlier most of the tubes were exported for treatment abroad, but now more and more are sent to Vejle for recycling at the new plant at the company H.J. Hansen Elektromiljø A/S, which is the largest company treating electronic waste.

## 3.2 Finland

The following data on special waste fractions have been derived from The Monitoring and Environment Loading Data System (VAHTI) – Waste Information and Waste Import/Export Statistics from The Register

on Transfrontier Shipment of Waste (BASEL). The waste classification used is following the National Waste Classification System, which is almost identical to the European Waste Catalogue (EWC). Information on waste disposal and recovery has been classified using the codes given for waste disposal and recovery in the EU Framework Directive on Waste (Official Title: Council Directive 75/442/EEC on waste, as amended by, Annexes II A and II B).

It is the old EWC classification that is applied in this report, as the new one will only be used from 2002 and onwards.

It should be emphasised that quantities of waste indicated under the R and D codes should not be added, since some waste materials may be subject to several different treatments during the year in question.

#### *Heavy Metal containing Batteries*

Table 8 below summarises data on the quantities of batteries collected per year in Finland. The figures are divided into five categories of batteries: lead, NiCd, mercury, alkaline and a mixed category of batteries. The data is further divided into the various categories of disposal and recovery.

**Table 8: Used batteries collected in Finland, divided on the various categories as well as disposal and recycling method for the period 1997-2001, tonnes per year**

EU Disposal (D) and recovery (R) codes		D5 Special landfilling	D9 Physico-chemical treatment	D10 Incineration	D 13 Blending or mixing	D 14 Repackaging	D 15 Inter-mediate storage	R 4 Metal recycling	R 12 Ex-change before recycling	R 13 Inter-mediate storage before recycling
Lead batteries	1997		3	37		1.759	1.513	56		13.042
	1998		1	4		2.591	1.316	611		14.544
	1999		361			5.066	2.487	91		14.615
	2000			26	215	2.279	8.409	28		27.614
	2001				390	2.153	5.939	62	90	17.903
Ni-Cd batteries	1997					39				
	1998	17				13				
	1999					24				
	2000					10	2			
	2001					144	4			
Mercury dry cells	1997					22				
	1998					19				
	1999					10	37			
	2000					1	1			
	2001						0,8			
Alkaline batteries	1997									
	1998					44				
	1999					40	1			
	2000					2	2			7
	2001						0,8			
Mixed batteries	1997				4	322	142			100
	1998			2	7	170	477			27
	1999					307	258	6		195
	2000				8	252	505	30		436
	2001				37	199	129			405

ref. Monitoring and Environment Loading Data System (VAHTI), Ministry of Environment, 2002

As it appears from the table most of the battery fractions are “repacked” and stored in “intermediate storage”. This is to a certain extent in accordance with the import-export statistics, that shows that considerable amount of lead and NiCd batteries are exported, table 9 below. On the other hand there are considerable differences between the actual figures on “repackaging” and “intermediate storage” in table 8 and the figures for “exports” in table 9. This is probably due to the fact that the batteries may pass different steps in the disposal within the same year, and hence being registered more than once.

**Table 9: Exports of used batteries from Finland, in tonnes, 1997-2001**

Exports, tonnes					
Waste	1997	1998	1999	2000	2001
Battery waste		91,3	113,0	72,6	120,4
Lead accumulator scrap	12121,1	13013,9	12451,2	12807,3	11829,0
NiCd accumulators	9,0	70,0	260,1	102,2	189,1

ref. Register on Transfrontier Shipment of Waste (BASEL), Finnish Environment Institute, 2002

#### *PVC containing Waste*

No data on PVC containing waste is available, because there are no special national rules regulating the waste, and hence no collection system.

#### *PCB containing Waste*

The following table includes the data on PCB/PCT containing waste, collected in Finland. The data includes both the PCB/PCT and the weight of the equipment, in which the PCB/PCT is contained. As the equipment counts for most of the mass, the figures can not be used for precise estimates of the quantities of PCB/PCT.

**Table 10: PCB/PCT containing waste collected in Finland, divided on the various categories of disposal and recycling method for the period 1997-2001, tonnes per year. The figures include the mass of the equipment in which the PCB/PCT is contained .**

EU Disposal (D) and recovery (R) codes		D 10	D 13	D 14	D 15	R 13
		Incineration	Blending or mixing	Repackaging	Intermediate storage	Intermediate storage before recycling
Transformers and capacitors containing PCB or PCTs		482		16	4	
	1998	248		3	5	
	1999	960		16	2,5	4
	2000	1.452		12		12
	2001		5	10	4,4	12

ref. Monitoring and Environment Loading Data System (VAHTI), Ministry of Environment, 2002

As it appears most of the PCB/CPT containing waste is incinerated. This is taking place at the Finnish treatment plant, Ekokem Oy, that have specialised in treating of PCB/PCT containing waste. In fact, to such an extent that there is a considerable import of such waste from other countries, see table 11 below.

**Table 11: Imports and exports of PCB/PCT containing waste to and from Finland, in tonnes, 1997-2001**

Imports					
Waste	1997	1998	1999	2000	2001
PCB-containing waste	596,7	264,5	941,9	1380,2	827,6
Exports					
PCB-containing waste			86,2		
Net-imports					
PCB-containing waste	596,7	264,5	855,7	1380,2	827,6

ref. Register on Transfrontier Shipment of Waste (BASEL), Finnish Environment Institute, 2002

### *Asbestos containing Waste*

The following table summarises the data on asbestos containing waste, divided on three different categories of asbestos waste: Asbestos based construction materials (with fixed fibres), Asbestos based construction materials which may form asbestos dust (with loose fibres) and Insulation materials containing asbestos.

**Table 12: Asbestos containing waste collected in Finland, divided on the various categories of waste as well as disposal and recycling method for the period 1997-2001, tonnes per year**

EU Disposal (D) and recovery (R) codes		D 1	D 4	D 5	D 9	D 10	D 12	D 13	D 14	D 15	R 13
		Land-filling	Surface	Special landfilling	Physico-chemical treatment	Incineration	Permanent storage	Blending or mixing	Repackaging	Storage before disposal	Storage before recycling
Asbestos based construction materials	1997	6.732		114						30	45
	1998	2.590		95	8					13	33
	1999	6.748	8	598	17					1	
	2000	7.656	67	32						1	703
	2001	54.229	37								478
Asbestos based construction materials which may form asbestos dust	1997	751		1.166							5
	1998	681		880					1.499		33
	1999	1.670		402				1.020	1		16
	2000	1.453		815				280			63
	2001	1.140		152					1		
Insulation materials containing asbestos	1997	2.819	70								
	1998	170	32	333			81				
	1999	553		216		4	60				
	2000	654	160	207		3	64	208			
	2001	943		313			48	438	8		

ref. Monitoring and Environment Loading Data System (VAHTI), Ministry of Environment, 2002.

As it appears most of the asbestos containing waste is disposed of by land-filling and special land-filling. No imports or export is registered for this waste. The extraordinary quantity of “asbestos based construction materials” in 2001 is explained by delivery of waste from a certain storage facility or the like.

#### *Discarded Refrigerators*

Discarded refrigerators and deep freezers are not classified separately. Instead, they are included in the class of waste from electric and electronic equipment (see below) as is the case in the EWC.

#### *Electric and Electronic Equipment (WEEE)*

The information is not derived from The Monitoring and Environment Loading Data System (VAHTI), but obtained from the relevant industry organizations:

- The total quantity of WEEE waste was estimated to be 112,000 tons per annum in 1999, including discarded refrigerators and deep freezers. An estimated 22,000 tons of the waste was recovered.

In addition to the in-the-country disposal, there are also some exports of electronic and electric devices. This appears from table 13 below. The export data is divided on three categories of EE waste.

**Table 13: Export of electronic and electric equipment collected in Finland, divided on the various categories for the period 1997-2001, tonnes per year.**

Exports	1997	1998	1999	2000	2001
Waste					
Cartridges from copying machines		0,1	1,7		
Electronic and electric devices	4,5	7,2	31,6	297,6	60,9
TV- and computer screens				65,2	85,1

#### *Used Tyres*

Table 14 below includes the data on used tyres collected in Finland, 1997-2001, and the method of disposal.

**Table 14: End-of-life tyres collected in Finland, divided on the various categories of disposal and recycling for the period 1997-2001, tonnes per year**

		Collected tyres	Retreated tyres	Utilisation as material	Utilisation as energy
End-of-life tyre	1997	26,140	2,223	13,404	4,428
	1998	28,417	1,773	17,599	770
	1999	30,121	1,813	27,998	248
	2000	32,832	1,387	24,792	
	2001	32,306	987	40,294	

ref. Register on Used Tyres, Finnish Environment Institute, 2002.

As it appears from the table most of the tyres are recycled as material, while a smaller part is retreated (refurbished) for renewed use as tyres. An even smaller amount is used for energy production.

The import/export statistic shows that there has been a certain export of used tyres in the period 1997-2000, as it appears from the table 15 below.

**Table 15: Export of end-of-life tyres from Finland, in tonnes, 1997-2001 .**

Exports					
Waste	1997	1998	1999	2000	2001
Used tyres	88,8	75,2	106,5	65,3	0

ref. Register on Transfrontier Shipment of Waste (BASEL), Finnish Environment Institute, 2002

The tyres were primarily exported to Baltic countries for refurbishing

### *Discarded Cars*

The following table shows the data on discarded vehicles collected in Finland, and the disposal of them. The data includes all kinds of discarded vehicles, and not only cars. There appear to be some few data on collection and disposal of discarded cars for 1997-1998, but not for the following years.

**Table 16: Discarded vehicles collected in Finland, divided on the various categories of disposal and recycling for the period 1997-2001, tonnes per year**

EU Disposal (D) and recovery (R) codes		D 1	D 14	D 15	R 4	R 5	R 13
		Landfilling	Repackaging	Storage before disposal	Metal recycling	Recycling of inorg. matters	Storage before recycling
Discarded vehicles	1997	15	50	5	127,610		794
	1998		40	345	184,772	500	453
	1999			1,050	112,244	600	1,334
	2000	6	1,102		101,669		2,550
	2001			1,095	101,088	150	1,979

ref. Monitoring and Environment Loading Data System (VAHTI), Ministry of Environment, 2002). (figures include many kinds of vehicles and other metal scrap)

As it appears most of the materials from the vehicles are recycled. Only smaller quantities are disposed of at landfills. According to the imports and exports statistic, there was a small import of discarded vehicles in 2001 on 203 tonnes.

#### *Impregnated Timber*

No data available.

#### *Fluorescent Tubes*

Fluorescent tubes are disposed of at three facilities storing the chemically bound Hg on a licensed landfill. Because of some missing data in the register, data on treated fluorescent tubes is given only for years 2000 and 2001. It can be assumed that the quantity has been in the range of 770-800 tons/year.

Metal is mainly recovered. Glass has been recovered to some extent, but has until recently been disposed of on landfill.

### 3.3 Iceland

Only some data on the generation, collection, treatment and disposal of special waste fractions are available for Iceland.

However, according to surveys carried out by the Icelandic EPA (Hol-lustuvernd ríkisins) and the national waste statistics reported to the EU some data is available for the following special waste fractions: PCB/PCT waste, discarded electronic and electric equipment, used tyres and discarded vehicles.

#### *Heavy Metals containing Batteries*

Table 17 shows the reported quantities of accumulators imported, the quantities returned as waste and the estimated percentage returned.

**Table 17: The quantities of accumulators imported, returned as waste and return-%.**

Accumulators (tonnes)	1998	1999	2000	2001
With acid	460	463	429	660
Without acid	409	246	357	163
Accumulators in devices	534	477	517	325
Import total	1403	1186	1303	1148
Returned as waste	700	881	1044	905
Return-%	50	74	80	79

Table 18 shows the reported quantities of batteries imported and the quantities reported as waste.

**Table 18: The quantities of batteries imported as waste.**

Batteries (tonnes)	1998	1999	2000	2001
Import	12,1	8,6	8,5	?
Returned as waste	39,4	38,8	39,4	32,7

*PCB containing Waste*

According to the national waste statistic the following generation of PCB/PCT/PBB containing waste has been registered for the years 1995 to 2001.

**Table 19: Quantities of PCB/PCT/PBB generated in Iceland, 1995-2001, tonnes per year.**

	1995	1996	1997	1998	1999	2000	2001
PCB/PCT/PBB	21	-	1,2	14,7	15,8	16,3	16,6

All the PCB containing waste is exported to Denmark for treatment at Kommunekemi.

*Discarded Refrigerators*

Import, export and return of ozone depleting refrigerants (HCFC, primarily for the fishing industry) is shown in table 20 below.

**Table 20: Quantities of ozone depleting refrigerants (HCFC) imported/returned/exported in/from Iceland, 1997-2001, tonnes per year.**

	1997	1998	1999	2000	2001
Import	35	83	58	109	127
Export	-	-	-	-6	-2
Returned used oil	-	-	-	0,8	1,5
Return %	-	-	-	0,8%	1,2%

The exported refrigerant is sent to Denmark for treatment at Kommunekemi.

*Electric and Electronic Equipment*

No specific data are available for this kind of waste. In 2001 some research was done on the import of such devices during the last decade. It became clear that until 1995 the import figures were rather stable, with around 100 tonnes per annum. From 1995-1998, however, an enormous boost was observed; import figures increased from 100 to 2,000 tonnes a year. A plausible explanation for this enormous increase has not been found yet.

According to the national waste statistics 20,000 ton of electronic and electric waste was generated in 2001. The statistics does not include data for other years, yet.

*Used Tyres*

It is estimated that around 3.500 tonnes of used tyres was generated 1998. There is, however, some uncertainty about this estimate as no special registration is taking place. Figures are mainly based on information on quantities imported and estimates on the general lifetime.

*Discarded Cars*

It is estimated that approximately 39,000 tonnes of scrap metal (cars, trucks, other) were delivered to the scrap dealers in 2000. (Ref: "Quantities of waste generated, by sector, 1992-2000", Environment and Food Agency of Iceland). Scrap metals are mainly exported, mostly to the United States after processing (sorting, pressing).

*Impregnated Timber*

No specific data are available for disposal of impregnated timber. However, a distinction is made between disposal of clean wood and treated wood at disposal. Around 40% of all timber waste (building and demolition waste, as well as pallets being the most important waste streams) appears to be treated (painted, impregnated etc.). A substantial percentage of untreated wood (around 20% estimated) has been incinerated during the last couple of years, but treated wood is being land-filled so far.

*Fluorescent Tubes*

No data are readily available on the import and disposal of fluorescent tubes. However, it should be possible to get some data on imports by using information from custom-authorities, but this has not been done so far.

### 3.4 Norway

#### Special Waste

The quantities of “special waste”, now referred to as “hazardous waste”, generated in Norway for the period 1999-2001 appear from table 21 below.

**Table 21: Special waste/hazardous waste generated in Norway, 1999-2001, tonnes per year.**

	1999	2000	2001
Total	650 252	684 397	684 207
Oil containing waste	169 089	185 826	188 568
Solvents	15 672	15 090	13 858
Other organic special waste	15 513	15 812	15 062
Heavy metal containing waste	166 761	181 368	174 135
Acidic waste	240 423	250 790	253 546
Other unorganic special waste	1 481	1 365	1 358
Photo chemicals	6 897	4 660	5 481
Process water	32 301	25 198	21 513
Unclassified	2 115	4 288	10 686

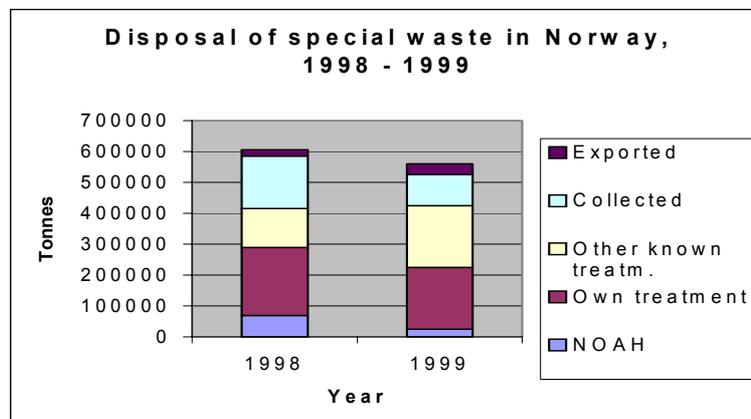
Reference: <http://www.miljostatus.no>; 2003.

In 1998 the waste was disposed of in the following way:

- Approx. 35% is treated by the companies where it originates
- Approx. 50% is treated by special plants
- Approx. 8% is exported.

Fig. 10 below shows how the hazardous waste is disposed of in Norway, 1998-1999, divided on various disposal and treatment methods.

**Figure 10 Disposal and treatment of special/hazardous waste in Norway**



Note: "Collected" indicates quantities collected, but the type of treatment is not know. Reference: <http://www.miljostatus.no>; 2002.

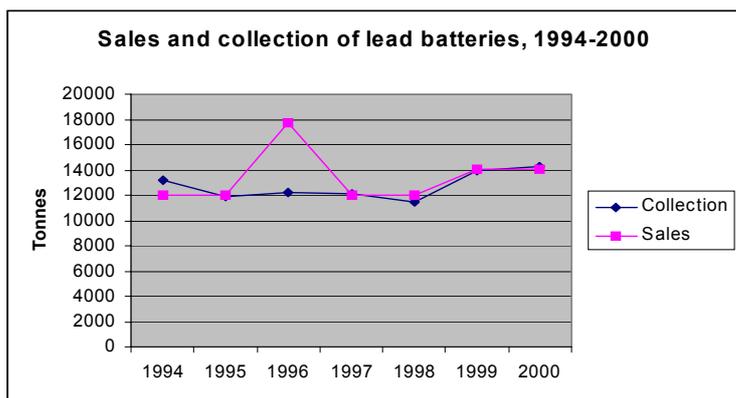
As it appears from figure 10 there seems to be an increasing amount of the special/hazardous waste that is moved from treatment at “NOAH” (Norsk Avfallshandtering AS; Norway Waste Management Ltd) and “own treatment” to treatment to “other known plants”.

*Heavy Metal containing Batteries*

A/S Batteriretur and A/S Rebatt have the responsibility for registering the number of batteries received by their member companies, and they are also responsible for the export of the batteries for recycling of the metal and treatment of the other parts of the batteries.

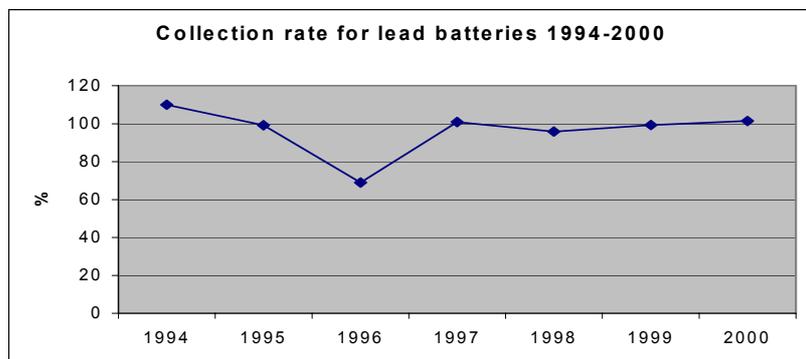
The data on the quantities of batteries sold and collected as well as the collection percentage in the period 1994-2000 appear from figures 11 and 12 below.

**Figure 11: Sales and collection of lead batteries 1994-2000, tonnes per year (includes the whole batteries (lead, fluid and box)).**



Reference: <http://www.miljostatus.no>; 2003.

**Figure 12: Collection rate for lead batteries in Norway, 1994-2000, percentage.**

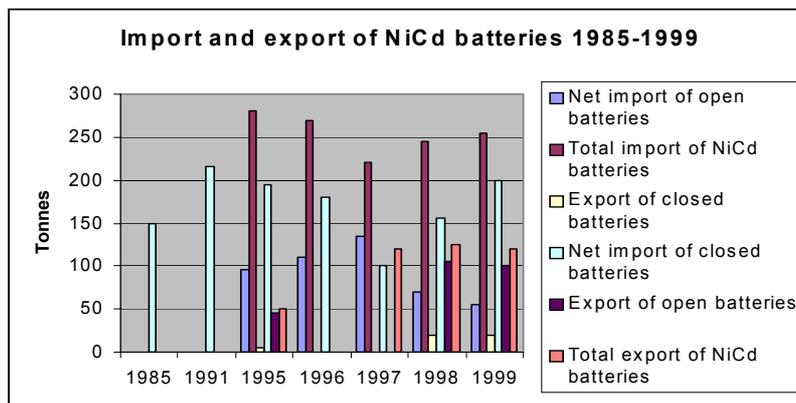


Reference: <http://www.miljostatus.no>; 2003.

As it appears from figure 12 the collection rate is above the required 95% as an average for the whole period. The reason that the collection rate exceeded the sales rate for some years is that the batteries have a life longer than one year and that batteries were stored at the collectors before the refund system was introduced. Before 1994 battery owners had to pay for delivering used batteries, while this is not the case after 1994. In 1997 a considerable number of cars were delivered to scrap dealers, probably because the refund for delivering cars for scrapping was increased that year.

Figure 13 shows the import and export of NiCd batteries for Norway in the years 1985-1999 as well as the calculated net import/export of the batteries.

**Figure 13: Import and export of NiCd batteries for Norway, 1985-1999, tonnes per year**



Reference: <http://miljostatus.no>; 2003

As it appears the total import of NiCd batteries has been relatively stable in the period 1995-1999, with an import of about 250 tonnes per year.

#### *PVC containing Waste*

No data available.

#### *PCB containing Waste*

According to the Environmental Status in Norway (the Norwegian EPA homepage, [www.miljostatus.no](http://www.miljostatus.no)) the total amount of PCB used in Norway over time amounts to about 1200 tonnes, including all applications (both as fluids in transformers and as ingredients in e.g. paint and jointing foam). It is estimated that approximately 450 tonnes is still in use, while 735 tonnes has been disposed of. Approximately 400 tonnes of this has been treated, while the rest have either been land filled or dumped.

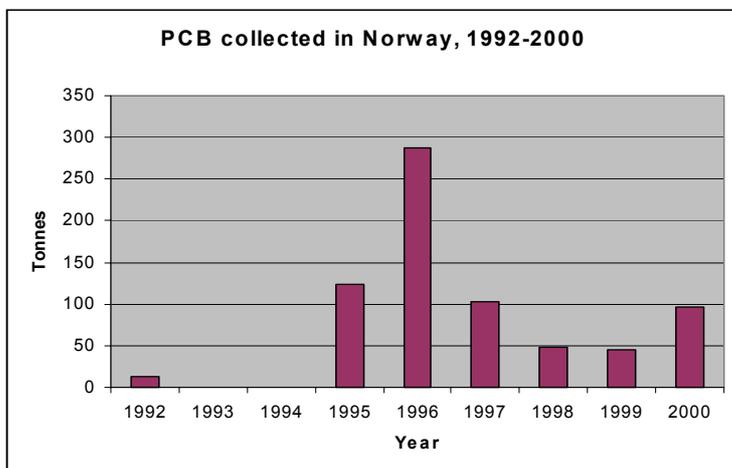
The various applications and its disposal appear from table 22 below.

**Table 22: Various applications of PCB and its disposal, in tonnes**

Type of Product	Remain- ing amount	Original amount installed	Period in use	Amount out of operation	Disposal method
Large capacitors and transformers	0	400	1952-72	400	Destruction/stored
Capacitors in fluorescent tubes	100	200	1960-80	100	Land filled
Other small capaci- tors	5	30	1955-80	25	Land filled
Current regulators	5	approx. 0	1964-68	approx. 5	?
Jointing foam	50	100	1963-72	50	Land filled
Concrete additive	80	120	1960-75	40	Land filled
Insulation glass glue	200	250	1965-75	50	Land filled
Paint and ship paint	10	75	1952-75	65	Land filled / spread in the sea
Total	approx. 450	approx 1185	1952-80	approx. 735	

Reference: <http://www.miljostatus.no>; 2003.

According to the statistics for hazardous waste the total quantities of PCB's collected as hazardous waste for the period 1992-2000 appears from fig. 14 below.

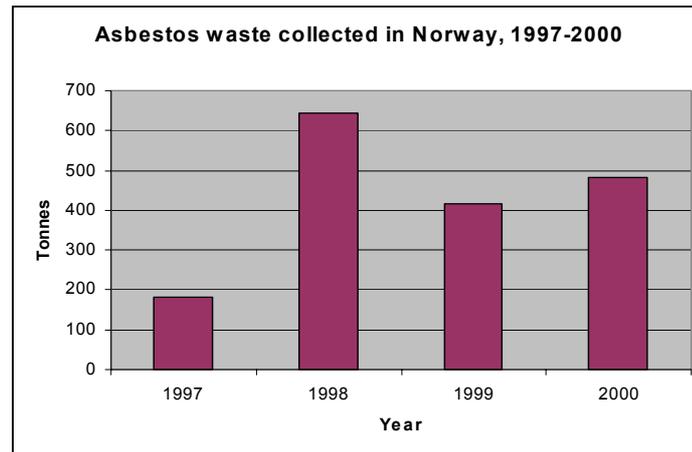
**Figure 14: Quantities of PCB collected in Norway, 1992-2000, tonnes per year.**

As it appears there are not much data for the period up to 1995. After that period there is an increase of the quantities collected, and then there seems to be a decline – probably due to the fact, that the use of PCB has been declining earlier.

*Asbestos containing Waste*

According to the statistics for Special Waste the quantities of asbestos waste collected in Norway 1997-2000 is as it appears from fig. 15 below.

**Figure 15: Asbestos waste collected in Norway, 1997-2000**



As it appears still considerable amounts of asbestos waste is collected, probably originating from demolition of buildings, constructions and machinery.

*Electric and Electronic Equipment, including Refrigerators*

The Norwegian EPA has, in association with the suppliers of electric and electronic equipments, estimated the total quantity of EE waste generated in Norway in these years to approximately 144,000 tonnes per year (1999) (Ref. "Collection and treatment of EE Waste" ("Innsamling og behandling av avfall fra elektriske og elektroniske produkter", Miljøvern-departementet, 1996)).

10,000 tonnes of the EE waste is exported, some of it for recycling of metals and some of it as second hand products for continue use in e.g. East European countries. Another 38,000 tonnes is recovered for material recycling in Norway, 20,000 tonnes is incinerated, while the remaining 76,000 tonnes is land-filled. The incinerated EE waste will result in approximately 14,000 tonnes of slag and ashes that will have to be land-filled as well.

Three major collection companies have estimated the collection rate for their areas; see table 23 below.

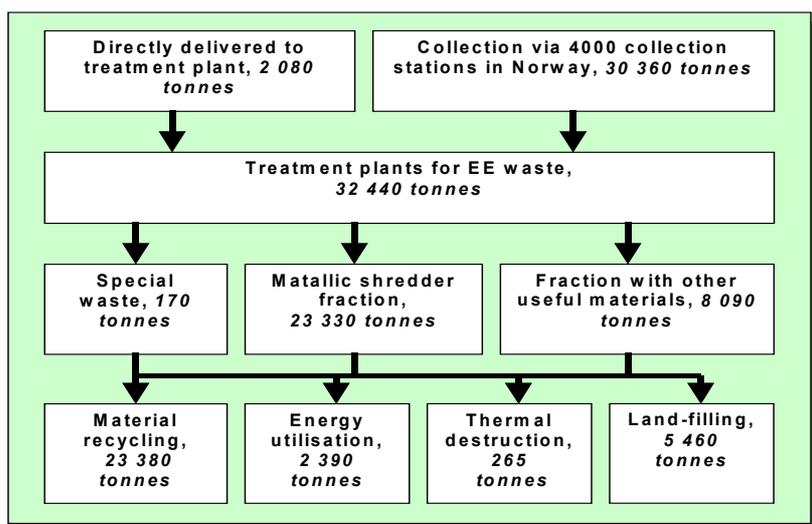
**Table 23: Estimated rates of recovery, recycling, land-filling/incineration and hazardous waste system for EE waste (data collected from 1 July 1999 to 31 December 1999).**

	Hvitevare-retur	Elektronikkretur	Renas
Recovery rate, %	43	28	18
Recycling, % (reuse, material recycling or energy utilisation)	85	75	88
Land-filling or incineration, %	14,5	10	4
Special/hazardous waste system, %	0.5	15	8

Ref. "Collection and treatment of EE Waste" ("Innsamling og behandling av avfall fra elektriske og elektroniske produkter", Miljøverndepartementet, 1996).

The quantities of refrigerators and other domestic appliances collected and handled by Hvitevareretur A/S and Elektronikkretur A/S in 2001 is illustrated in Fig. 16 below.

**Figure 16: Collection and treatment of refrigerators and other domestic appliances by EI-retur, 2001**



Ref.: [www.elretur.no/EIRetur/FILES/Miljorapport\\_2001](http://www.elretur.no/EIRetur/FILES/Miljorapport_2001)

Table 24 below shows the estimated quantities of hazardous substances contained in the EE waste.

**Table 24: Content of hazardous substances in the total amount of EE waste collected (144 000 tonnes, 1999)**

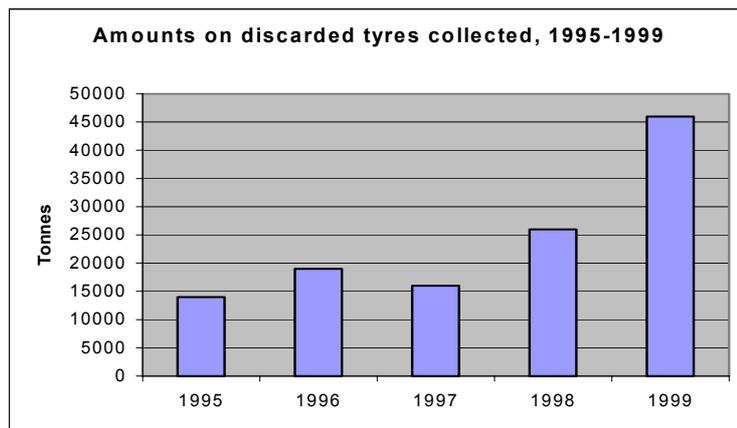
Substance	Amount, kg
Lead	462 000
Lead oxide	264 000
Cadmium	61 000
Mercury	1 000
Beryllium	630
Flame retardants	711 000
CFCs	136 500
PCB	9 300
Total	1 645 430

Source: Hjeltnes Cowi AS

### Used Tyres

The quantities of tyres collected for recycling in the period appears from figure 17 below.

**Figure 17: Quantities of discarded tyres collected, 1995-1999.**



Source: SFT 2001

As it appears there is an increasing amount of tyres collected. It may be due to both an increasing car park, more traffic and increased efforts to collect the tyres through the established collection system.

The amount of discarding of tyres does not fully follow the amount of collected tyres, as some years considerable quantities of discarded tyres are stored, before they are sent further for recycling. On the other hand some years, e.g. 1999, considerable quantities of stored tyres are released for recycling or treatment.

The 16,000 tonnes of tyres collected in 1997, corresponds to 1.8 million tyres (in average 9 kg per tyre).

### Discarded Cars

Statens Forurensningstilsyn (Norwegian EPA) estimates that approximately 110,000 cars (below 3,5 tonnes) are delivered to scrap dealers, which

makes up around 90% of all discarded cars. Close to 80% of the cars become recyclable materials, while 20% is treated as waste (Ref.: “Collection system for discarded cars in Norway for 25 years” (Biloppsamlingssystem I norge 25 år”, SFT homepage [www.sft.no](http://www.sft.no), 16.10.2003).

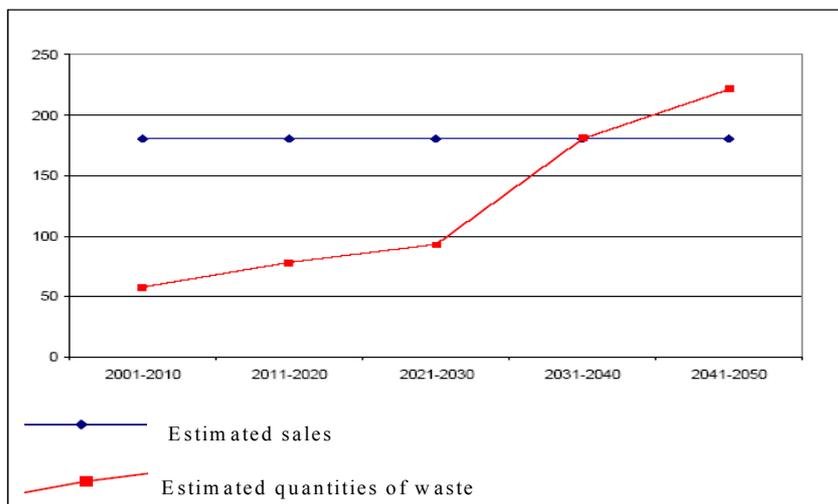
In all 346,000 tonnes of steel scrap was delivered to the steel works, out of which most of it come from cars. The number of cars sent for dismantling and recycling in 1997 was 45,082. However, it should be emphasised that the number has varied a lot the latest years due to considerable variation in the scrapping fee.

### *Impregnated Timber*

A rough estimate says that the amounts of impregnated timber waste at present amounts to about 10-20,000 tonnes per year (Personal communication: George Nelson, SFT, January 2004), collected through the municipal system. This waste is shredded and exported for treatment at SAKAB in Sweden.

According to a study conducted by Hjellnes COWI for Statens Forurensningstilsyn the future quantities of impregnated timber sold and generated as waste is estimated as it appears from fig. 18 below (Ref.: “Collection systems for impregnated timber”, SFT 2003 (“Innsamlingsordninger for impregnert trevirke”, SFT, TA-1975/2003)).

**Figure 18: Estimated quantities of sold and disposed impregnated timber in Norway, 1,000 tonnes per year, 2000-2050**



Some of the larger users of impregnated timber have their own collection system, besides the municipal collection system.

In 2002 the national rail road company (Jernbaneverket) collected 2,600 tonnes of creosot-impregnated timber. The national road administration (Statens Vegvesen) has collected 1,725 tonnes of CCA-impregnated timber waste until now. The power plants collected 2,400 tonnes of

CCA-impregnated and 2 400 tonnes of creosot-impregnated timber waste in 2002 (Ref.: “Collection systems for impregnated timber”, SFT 2003 (“Innsamlingsordningar for impregnert trevirke”, SFT, TA-1975/2003)).

All this waste will be delivered to the recycling/destruction plant IQR (Industrial Quality Recycling AB) in trolhättan in Sweden. Recently IQR has applied for the establishment of a treatment plant for impregnated timber in Norway.

*Fluorescent Tubes*

No data available.

### 3.5 Sweden

*Heavy Metal containing Batteries*

Table 25 below shows the supply of batteries delivered to the Swedish market in the period 1994-1999, representing the quantities that later on will be generated as waste.

**Table 25: Quantities of batteries delivered to the Swedish market, 1994-1999, Tonnes.**

Type of battery	1994	1995	1996	1997	1998	1999
Flashlight batteries	3000	..	..	..	..	..
Disposable mercury cell batteries	> 16	n.a.	n.a.	n.a.	n.a.	n.a.
NiCd batteries, closed	570	450	400	400	250	210
NiMH- & litiumbatteries	200	n.a.	n.a.	n.a.	n.a.	n.a.
Car batteries, lead	21000	22500	23000	24000	ca 35000*	ca 35000*
Industry batteries, lead	4000	n.a.	n.a.	n.a.	n.a.	n.a.
NiCd- batteries, open **	300	310	350	320	230	220

Sources: Naturmiljön i siffror, SCB, 1996;  
 Batterierna - en laddad fråga, SOU 1996:8; Naturvårdsverket  
 Notes:  
 n.a.: Data not available  
 \* Including industry batteries  
 \*\* Data from SAFT A/B.

As it appears from table 25 the quantities of car batteries are increasing, while the quantities of NiCd batteries are declining, for the period 1994-1999.

Table 26 below shows the amount of discarded batteries collected in the period 1990-1999.

**Table 26: Quantities of discarded batteries collected, 1994-1999, Tonnes.**

Year	Mercury and cell batteries	NiCd batteries		Car batteries, lead
		Delivered to SAKAB	Delivered to SAFT A/B	
1990	13	35	n.a.	23,000
1991	12	46	n.a.	25,000
1992	13	51	n.a.	25,000
1993	5	51	n.a.	21,000
1994	7	.	102	23,000
1995	6	.	111	22,500
1996	5	.	112	23,500
1997	5	.	141	24,258
1998	11	.	143	29,000*
1999	15	.	170	30,337*

Source: Naturmiljön i siffror, SCB, 1996; Naturvårdsverket

Notes:

n.a.: Data not available

\*Including industry batteries.

As it appears the collection of mercury containing batteries has been declining for some years, but that it started to increase again in 1998. The collection of NiCd batteries was taken over by SAFT A/B in 1994, which resulted in a doubling of the quantities of NiCd batteries collected. The collection of car batteries has been on the same level until 1998, when industry batteries were included in the figures.

According to a study made by the Swedish Association of Waste Management (Svenska Renhållningsverksföreningen, RVF), based on questionnaire answered by municipalities representing 92% of the population, 1,408 tonnes of “small batteries” and 9,469 tonnes of car batteries were collected via the municipal recycling stations in 2001 (Ref. “Collection systems and taxes – Statistics 2001”, RVF report 2003:04; “Insamlingsystem och avgifter – Statistik 2001”).

### *PVC containing Waste*

Statens Naturvårdsverk estimates that approx. 40,000 tonnes of PVC waste is generated in Sweden per year, and that most of it (28,000 tonnes) is landfilled and that the remaining part (12,000 tonnes) is incinerated. The incinerated PVC waste makes up more than half of the chlorine contribution to the incineration plants (Ref. Press release, Naturvårdsverket, 960628).

The annual consumption of PVC for new products is estimated to approx. 100,000 tonnes, and more than 90% is used for long life products such as building and construction products, electric device etc. The amount of PVC in waste is expected to increase the coming years.

### *PCB containing Waste*

According to an inventory, carried out in 1994 (Ref.: “The quantities of PCB and PCN in goods and chemical products in Sweden” (“Förekomst av PCB och PCN I varor och kemiska produkter I Sverige”, prepared by Tomas Öberg, Tomas Öberg Konsult AB, published by Kemikalieinspektionen, PM-18/94, 1994), the annual flow of PCB can be summarised as follows:

- 170 – 630 tonnes of PCB is contained in buildings and building materials
- Approximately 20 tonnes of PCB is contained in other products
- 3 – 30 tonnes of PCB is disposed of together with demolition and construction waste
- 0.5 – 0.7 tonnes of PCB is disposed of together with municipal waste
- The quantity of PCB sent to destruction is not determined.

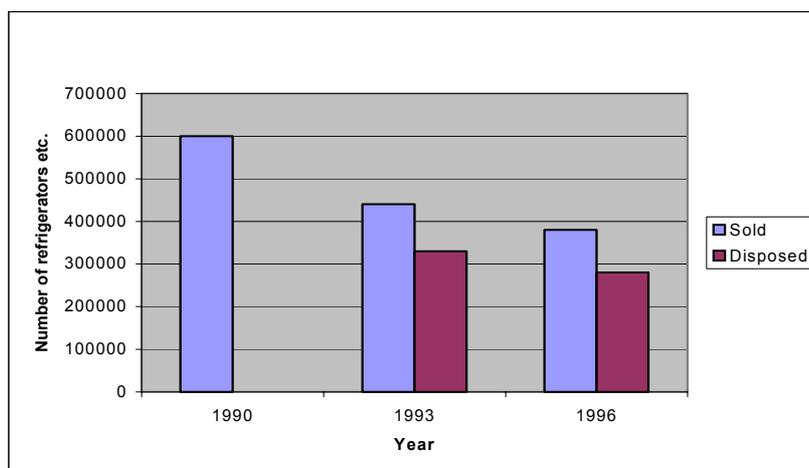
### *Asbestos containing Waste*

According to the Swedish Waste Management Association (Svenska Renhållningsverkföreningen, RVF) 14,000 tonnes of asbestos containing waste was land-filled in 1999.

### *Discarded Refrigerators*

Figure 19 below shows the number of refrigerators sold, respectively disposed of in Sweden, 1990-1996 (Ref. Swedish EPA, 2002).

**Figure 19: Number of refrigerators etc. sold and disposed of in Sweden, 1990-1996**



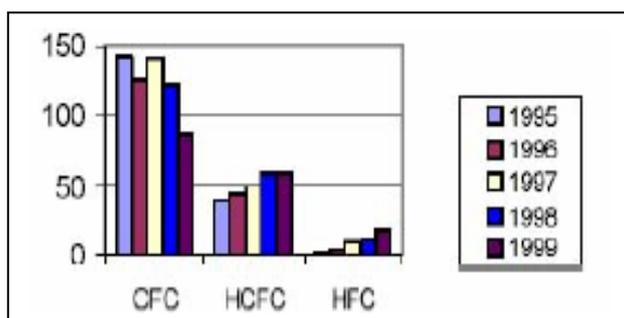
ref. Environmental Department of Västernorrland County, SEPA

In 1996 about 275,000 refrigerators were scrapped and 78 tonnes of CFCs was recovered. In 1995 some 56 tonnes CFC was recovered.

According to the RVF Study (Ref. "Collection systems and taxes – Statistics 2001", RVF report 2003:04) 19,079 tonnes of refrigerators and freezers were collected via the municipal recycling stations in 2001.

In addition to the CFC from refrigerators some CFC, HCFC and HFC is recovered from other refrigeration equipment. The total recovery of CFC, HCFC and HFC in the period 1995-1999 appear from the fig. 20 below.

**Figure 20: Quantities of CFC, HCFC and HFC handled in Sweden 1995-1999, tonnes per year**

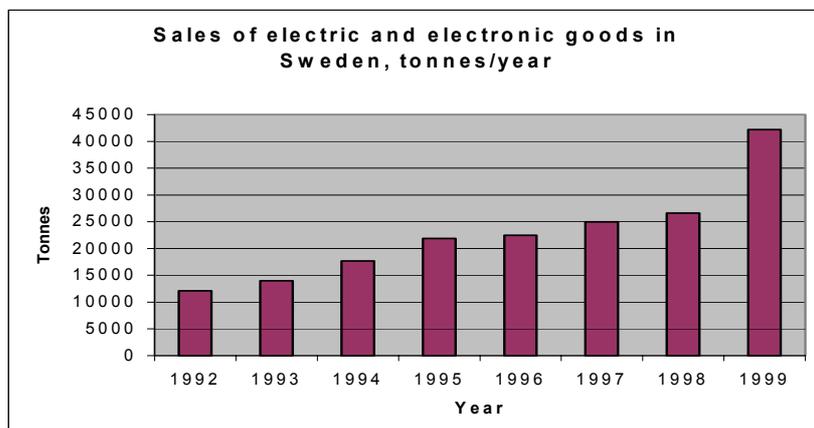


The recovered CFC, HCFC and HFC is either recycled or treated (thermal decomposition) at SAKAB. In the period 1996-1998 468 tonnes of CFC was destroyed at SAKAB. In 1999 97.7 tonnes was destroyed. The amounts of HCFC and HFC destroyed in the same periods indicates that CFCs were the first ozone depleting substances to be phased out, while HCFCs later were phased out.

*Electric and Electronic Equipment*

According to the IT manufacturer’s association the weight of the total sales of electric and electronic equipments on the Swedish market for the period 1992-1999 developed as it appears from fig. 21 below.

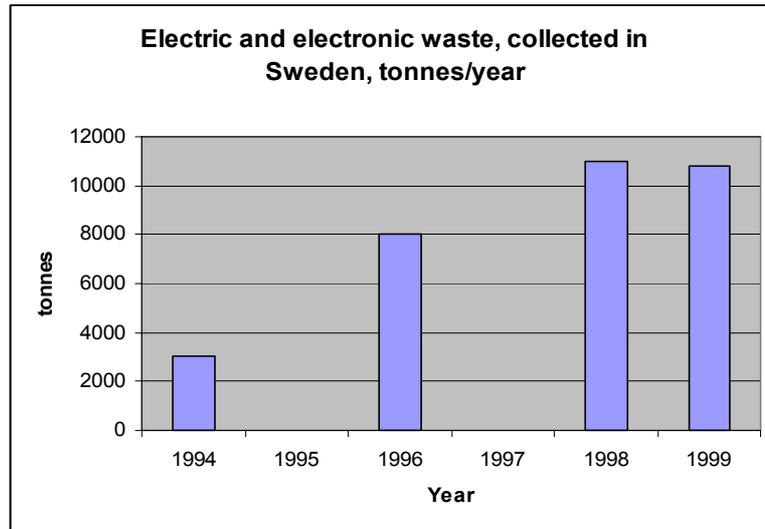
**Figure 21: Sales of electric and electronic goods in Sweden, 1992-1999, tonnes per year.**



As it appears there is clearly a growing sales of electric and electronic equipment, and hence a growing potential for electric and electronic waste.

According to the Waste Management Association of Sweden the collection and pre-treatment of electric and electronic waste has developed as it appears from fig. 22 below.

**Figure 22: Waste of discarded electric and electronic equipment in Sweden, 1994-1999, tonnes per year.**



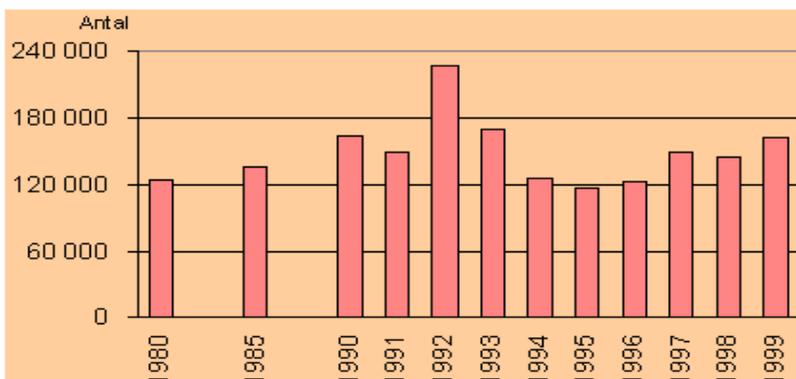
As it appears from fig. 22 the amounts of electric and electronic collected is increasing – just like the sales of new products indicates.

*Discarded Cars*

The Association of Swedish Car Manufacturers, Bil Sweden (BIL), is responsible for establishing a network of authorised car scrapping companies. In 2000 there were 80 such authorised car scrappers.

In 2000 the BIL-network handled 51,000 end-of-life-cars, which is 32% of the total number of scrapped cars that year.

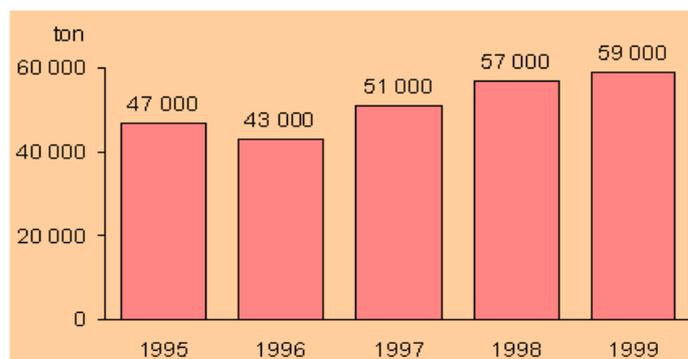
81 of the materials were reported to be recycled. The total number of cars scrapped for the period 1980-1999 appears from fig. 23 below (Ref. Association of Car Industry).

**Figure 23: Number of cars that have been reported as being scrapped, 1980-1999.**

### *Used Tyres*

Approximately 64,500 tonnes of car tyres were disposed of in 1999 and about 59,500 tonnes were collected for special treatment. This means that 92% is collected. The tyres are collected through 100 collection stations that have been established by 150 importers and manufacturers.

According to the association of Swedish Tyre Recycling Association (Svensk Däckåtervinning AB) the collection of discarded tyres has developed as it appears from fig. 24 below.

**Figure 24: Tonnes of discarded tyres that have been collected, 1995-1999.**

### *Impregnated Timber*

The total production of impregnated timber in Sweden in 1995 is estimated to approximately 550,000 m<sup>3</sup>. It has not been possible to find data on the amounts of impregnated timber waste in Sweden.

### *Fluorescent Tubes*

Bjäste Återvinning, which is one of the three Swedish companies that recycle and treat discarded fluorescent tubes and other light sources containing mercury, has estimated that approximately 10 million fluorescent

tubes and 6 million other light sources are discarded every year (Ref. Bjäste Återvinning AB, 2003).

*Summary of Quantities of Special Waste Fractions*

Below in table 27 the data on the quantities of waste collected within the various categories are summarised.

**Table 27: Average quantities of the different special waste fractions collected in the Nordic countries(tonnes/year, latest data ). The figures in the brackets indicates the relevant year.**

Special Waste Fraction	Denmark	Finland	Iceland	Norway	Sweden
NiCd batteries	250 (1995)	190 (2001)	?	?	170 (1999)
Alkaline bat.	?	?	?	?	1400 (2001) 8)
Hg batteries	?	?	?	?	15
Car batteries	17 000 (2001)	12 000 (2001)	900 (2001)	14 000 (2000)	30 000 (1999)
PVC	700 (1999)	0	0	0	0
Asbestos	8 000 (2000)	2 000 3) (2001)	?	500 (2000)	14 000 (1999)
PCB	450 (1998)	1 450 2) (2000)	16 (2001)	100 (2000)	?
Refrigerators	12 500 (1998)	4 200 (2001)	?	?	19 000 7) (2001)
Electronics and electric appliances	66 000 (1997)	112 000 6) (1999)	4 000 5) (1998)	144 000 6) (1999)	10 000 (1999)
Tyres	40 000 (2000)	32 300 (2001)	3 500 5) (1998)	45 000 (1999)	59 000 (1999)
Car scrap	67 000 1) (2000)	101 000 4) (2001)	39 000 (2000)	80 000 1) (1999)	136 000 1) (1999)
Impregnated timber	8 000 (1996)	?	?	10-20 000 (2003)	?
Fluorescent tubes etc.	?	770 (2001)	?	?	16 million pieces

Notes:

- |   |  |
|---|--|
| 1. Estimated average scrap weight of cars: 800 kg | 5. Amount of waste generated   |
| 2. Including 1380 tonnes imported                 | 6. Including refrigerators etc.  |
| 3. Construction materials not included            | 7. Estimated average weight 30 kg  |
| 4. Metal recycling                                | 8. May also include other small batteries than alkaline batteries, includes only municipal collection. |



# 4. Treatment of the Special Waste Fractions

This chapter includes descriptions of the different treatment technologies applied for the special waste fractions in the various Nordic countries. The descriptions of each of the treatment technologies are - to the extent that the available information allows - structured in the following way:

- Description of the treatment process
- Capacity
- Energy and other requirement
- Treatment costs.

## 4.1 Denmark

### *Heavy Metal containing Batteries*

In general, the collection system for batteries is relatively complex, including a number of different collection systems, some of which are interlinked. There are two major systems, one for lead accumulators and one for all the other batteries. Scrap dealers are the central stakeholder in many of the collection systems, but not the only partners in the systems. Although there is some competition between the different companies, they are in general cooperating so that companies that only handle small quantities of some batteries usually sell them to other partners.

The primary collectors of lead accumulators are scrap dealers, petrol stations and other dealers of lead containing accumulators. All accumulators end up at a small number of collectors that keep the batteries in stainless steel containers until they are exported.

All the lead accumulators are sent to Sweden for treatment and recycling at the Boliden-Bergsöe factory in Landskrona. The lead is melted and used for manufacturing of among others new lead electrodes. The collectors receive a collection fee from a special fund (administrated by Returbat), so that the total revenue for collection and transport always reaches 0,90 DKK per kilo, including the price of lead scrap.

The NiCd batteries are collected by a number of different collectors, who export them for treatment, mostly in France and Sweden, where the metals are recycled for renewed use. The new types of NiMH (nickel metal hydride) batteries, that are supposed to substitute the NiCd batte-

ries, are also sent abroad for treatment, which include recycling of the nickel.

Mercury cell batteries are, sent abroad for treatment (Germany and Sweden), where the mercury is recovered and demobilised e.g. in concrete and disposed of in mines. Those old alkaline batteries that are collected contain some mercury, and they are disposed of at a special landfill in Denmark (at Klintholm).

Some new types of batteries, e.g. lithium batteries are treated by incineration at Kommunekemi.

Kommunekemi informs the following prices for batteries (Pricelist 1. January 2004, Kommunekemi A/S):

- Mixed batteries, packed: 10,650 DKK/tonnes
- Mercury batteries for recycling, packed: 51,500 DKK/tonnes

H.J.Hansen Elektromiljø A/S, the largest recycling company for electronic waste, informs the following prices for batteries (Pricelist 20. January 2004):

- Mixed batteries: 4-8,000 DKK/tonnes
- Alkaline batteries: 1,750 – 7,000 DKK/tonnes
- Mercury batteries: 35,000 DKK/tonnes
- NiCd batteries, closed: - 8,000 DKK/tonnes
- NiCd batteries, open: 8,000 DKK/tonnes

#### *PVC containing Waste*

In 1998 five Danish manufacturers of PVC products established a company for collection and recycling of PVC waste products, Wuppi A/S. The company offers generators of hard PVC waste, waste management companies, recycling stations etc. containers for collecting hard PVC waste materials. Wuppi collects the containers when they are full and brings the materials to the company, Swerec AB, in Sweden for regeneration. The regenerated PVC is returned to the Danish companies for incorporation in new PVC products.

Earlier some PVC materials was collected and recycled by some of the larger manufacturers of hard PVC product. However, by establishing the mutual company Wuppi, the companies anticipate to make the collection system more efficient.

Considerable quantities of PVC waste, including both soft and hard PVC components, are following the ordinary waste streams (municipal and industrial waste) and hence brought to the municipal incineration plants or landfills.

New initiatives to treat PVC by pyrolysis are underway. Among others the recycling company RGS90 is developing a new technology to

treat PVC. Through pyrolysis it should be possible to decompose the PVC to the various basic elements, chlorine etc.

Kommunekemi demands the following payment for treatment of PVC Waste (Ref.: Pricelist 1 January 2004):

- PVC waste, packed: 1,730 DKK/tonnes
- PVC waste, unpacked: 1,180 DKK/tonnes

In addition 600 DKK per load is added for chemical analyses.

#### *PCB containing Waste*

PCB containing waste (from e.g. transformers) is collected by Kommunekemi, which send the waste to Germany for treatment. The cost of delivering PCB waste to Kommunekemi is:

- Capacitors per kg: DKK 20,40
- Transformers, max. 4,000 kg per piece: DKK 33,70
- Transformer oil etc. per kg: DKK 26,50

#### *Asbestos containing Waste*

In most cases asbestos waste is sealed in plastic lining and then disposed off at landfills.

According to Waste Information Centre, who have made a survey of the disposal fees for asbestos containing waste for a number of European countries (Ref. : RenViden no. 3, 2003) the disposals fee varies a lot from landfill to landfill and depends on the type of asbestos waste. In Denmark the disposal fee lies within an interval from 115 – 841 DKK per tonnes. In addition to this a national disposal tax on 375 DKK per tonnes has to be paid, as well as VAT on 25%. The average disposal fee will amount to about 560 DKK per tonnes.

#### *Discarded Refrigerators*

Many municipalities have established mutual collection and treatment facilities, usually at the municipal recycling centres/stations, which receive discarded refrigerators from citizens and shops. Some of these centres are recovering the refrigerant and dismantling the refrigerators.

The refrigerators are dismantled into the following fractions:

- Pure ODS refrigerant (e.g. CFC-12)
- Lubrication oil contaminated with ODS refrigerant
- Insulation materials (e.g. polyurethane foam (PUR)) containing ODS (e.g. CFC-11)

- Metals (iron sheets, copper hoses, aluminium evaporator etc.)
- Plastics (e.g. inner panels of PVC)

Some of the ODS containing waste materials (e.g. lube oil and insulation material) is treated by incineration at Kommunekemi. A few other municipal incineration plants are allowed to treat the insulation materials as well.

Metals are sold to scrap dealers. Plastic waste, including the CFC/HCFC containing insulation foam, is treated as hazardous waste and incinerated at incineration plants with special permission for this.

All handling of recovered ODS is registered by the KMO scheme.

H.J.Hansen Elektromiljø A/S, informs the following prices for refrigerators delivered at the factory (Pricelist 20. January 2004):

- Refrigerators etc.: 85 DKK/piece

If delivered at one of the company's affiliates the price will be 130 DKK/piece.

#### *Electric and Electronic Equipment*

Within the latest few years a number of companies dismantling electric and electronic equipments with the purpose of recycling the most valuable materials and components, have emerge. Usually, these companies receive the electric and electronic equipment from the municipal recycling stations as well as shops and companies that now and then replaces their old computers.

The companies recover materials for recycling, especially precious and semi-precious metals, as well as segregating different waste categories to reduce cost of waste treatment. Some reuse of certain components of the devices also takes place.

The prices for treatment of EE Waste vary from company to company. However, Kommunekemi demands the following payment for treatment of EE Waste (Ref.: Pricelist 1 January 2004):

- EE Waste, not containing picture tubes: 3,600 DKK/tonnes
- EE Waste containing picture tubes: 4,020 DKK/tonnes

H.J.Hansen Elektromiljø A/S, informs the following prices for EE waste (Ref.: Pricelist 20. January 2004):

- Mixed EE waste, excluding picture tubes: 3,000 DKK/tonnes
- Picture tubes: 2,500 DKK/tonnes
- IT waste, excluding monitors: 2,500 DKK/tonnes
- TV monitors: 3,500 DKK/tonnes

- Printed circus board, low grade: - 250 DKK/tonnes
- Printed circus board, others: 1 – 2,000 DKK/tonnes
- Cables: -1,000 DKK/tonnes

### *Used Tyres*

The recycling of used tyres are divided on three different categories:

- Reuse (refurbishing): Adding new tread pattern on existing tyres
- Material recycling: Grinding rubber from used tyres and using it for new rubber products such as rubber wheels
- Reutilisation: Incineration of grinded rubber from used tyres.

Reuse of tyres take place in a number of different companies in Denmark, some of them organised in the Association of Manufacturers Refurbishing of Tyres in Denmark (Fabrikantforeningen for Regummierede Dæk i Danmark).

Material recycling is carried out by four companies, including Genan A/S and Imdex A/S. These companies are crushing the tyres for manufacturing different kinds of rubber powder that are used for coating and surface protection of e.g. ship decks, athletic fields, as well as solid rubber products e.g. rubber wheels. The price of the powder is around 1 DKK per kg.

Reutilisation for energy production takes place in a limited number of municipal incinerators.

### *Discarded Cars*

Most of the auto dismantling companies are members of the Danish Car Scrapping Scheme (Miljøordning for Biler), including approximately 200 car dismantling companies. The companies vary in size and conduct many different services, including:

- Recovery of spare parts for reuse
- Recovery of environmentally hazardous materials (lube oil, refrigerants etc.) for treatment
- Crushing of the car body for recycling of the metals and treatment of residuals.

Five of the larger companies are conducting all services, while the smaller ones only carry out the first one or the two first mentioned processes.

The recovered metals are in principle sold on the world market for metals, but due to considerable transport cost most of the metals are sold to recycling companies in Northern Europe.

Until recently, one Danish steel work (Stålvalseværket i Frederiksværk) used scrap iron, for manufacturing different steel product. It was closed down in 2002, but some parts of the steel work may be re-established. A number of steel foundries still receive some iron scrap. However, most of the Danish metal scrap is now exported.

According to the Danish scheme for collection and environmental dismantling of cars, the last owner receives 1,750 DKK from a central fund, based on current fee on 60 DKK/year paid by all car owners through the car insurance. The car owner will still have to pay a certain fee to the scrap company for dismantling, recovery of chemicals etc. varying between 550-1,100 DKK.

### *Impregnated Timber*

It has been estimated that about 4,000 tonnes of impregnated timber waste was incinerated by the municipal incinerator plants in 1999, corresponding to 10% of the total amount of impregnated timber waste (ref. "Affaldsforbrænding i 2004 og 2008, mængder og kapaciteter", Orientering fra Miljøstyrelsen, nr. 11, 2001).

However, as impregnated timber is considered as hazardous waste that should not be treated by the municipal incinerator plants, different initiatives has been planned (ref. Affald 21) to ensure separation of the timber, followed by disposal of the waste at landfills. A number of municipalities have already placed separate containers for this kind of waste at their recycling stations. The disposal at the landfills is however an intermediate solution.

Kommunekemi is planning to establish a gasification plant for treatment of 25,000 tonnes of impregnated timber per year. The plant is designed to recover the energy and metals such as copper, chromium and arsenic from the timber. The recovered energy will either be used at the plant or sold to the district heating system that Kommunekemi is connected to. The copper and chromium will be sold, while the arsenic will be encapsulated and disposed off.

### *Fluorescent Tubes*

Those fluorescent tubes that are collected by some municipalities are brought to different companies in Europe for dismantling and recovery of the mercury (there are at least one company in Germany (Werec in Strausberg-Hohenstein) and a one in Sweden that treats such waste.

The tubes/bulb are dismantled in closed chambers, where the mercury vapour is condensed and recovered and the other materials are segregated in different fractions (metals, glass, plastics and chemicals) for recycling or destruction. The process for a recycling plant is described further on Werec's homepage ([www.werec.com](http://www.werec.com)).

The charge for treatment of the tubes/bulbs can range from 0.5-1.5 Euro per tube/bulb, depending on the number and mix of the delivered products.

The recently, installed recycling plant at H.J. Hansen Elektromiljø A/S, is designed after a new concept developed through a cooperation with some of the world's leading manufacturers of fluorescent tubes (GE lighting, Osram, Philips and Sylvania Lumiance).

The plant works fully automatic and is able to split the tubes into the following recyclable fractions:

- Mercury
- Glass (two types of glass)
- Metals (aluminium, steel etc)
- Luminance powder (sorted after the various manufacturers prescription).

The luminance power is returned to the manufacturers, while the remaining recycling materials are sold at the market.

Kommunekemi informs the following prices for mercury containing light sources for recycling (Pricelist 1. January 2004, Kommunekemi A/S):

- Mercury containing light sources: 14,500 DKK/tonnes

H.J.Hansen Elektromiljø A/S, informs the following prices for batteries (Ref.: Pricelist 20. January 2004):

- Fluorescent tubes, straight, unsorted: 12,500 DKK/tonnes
- Fluorescent tubes, straight, sorted: 7,500 DKK/tonnes
- Other light sources with mercury: 12,500 DKK/tonnes
- Light sources, smashed: 30,000 DKK/tonnes

## 4.2 Finland

The treatment of the special waste fractions in Finland is summarised in table 28 below.

**Table 28: Treatment of special waste fractions in Finland**

Waste fraction	Collection	Disposal/Treatment method
NiCd batteries	Yes	Exported for recycling/treatment in France and Sweden
Alkaline bat.	Yes	Disposed of together with municipal waste
Hg batteries	Yes	Exported to Germany
Car batteries	Yes	Exported for recycling in Sweden
PVC	No	Disposed of together with municipal waste
Asbestos	Direct delivery to landfills	Landfilled (Disposal fee 140 EURO/tonnes)**
PCB	Yes	Treated by own incineration plant, Ekokem
Refrigerators	Yes	See electronics below *)
Electronics	Yes	Some materials recovered by small workshops for export and recycling Recovered in Finland. Some materials exported for recovery.
Tyres	Yes	Recycled either as new tyres refurbishing, material recycling or energy recovery.
Car scrap	Yes	Waste is segregated and processed. Scrap metal is sent to steelwork or exported. Residuals are landfilled.
Impregnated timber	Some collection	Incinerated or landfilled
Fluorescent tubes	Yes	Recycled in Finland

### 4.3 Iceland

Generally, there is no treatment of the special waste fractions in Iceland. The special waste fractions are either disposed of at landfills or exported for either treatment or recycling abroad. Table 29 below shows the disposal of the various fractions.

**Table 29: Treatment of special waste fractions in Iceland**

Waste fraction	Special collection system	Disposal/Treatment method
NiCd batteries	Yes	Sent to Denmark for re-export for recycling/treatment in France/UK
Alkaline bat.	Yes	Segregated from other types of batteries and land-filled
Hg batteries	Yes	Sent to Denmark for special land-filling
Car batteries	Yes	Exported for recycling in Sweden, via Denmark
PVC	No	Landfilled or incinerated together with municipal and health care waste
Asbestos	Direct delivery to landfills	Landfilled
PCB	Yes	Exported for treatment in Denmark
Refrigerators	No	Landfilled together with bulky waste
Electronics	Yes, some of the waste	Some materials are recovered by small workshops for export and recycling
Tyres	No	Land-filling, but will not be allowed after 2003.
End-of-life vehicles	Yes	Waste is segregated and processed in Iceland. Scrap metal is exported to USA. Residuals are landfilled.
Impregnated timber	No	Landfilled
Fluorescent tubes	No	Disposed of together with municipal waste.

## 4.4 Norway

### *Heavy Metal containing Batteries*

In Norway used batteries are primarily collected separately in two streams, one for lead batteries and one for other batteries.

Half of the first category is sent to the Boliden-Bergsöe factory in Landskrona in Sweden (50%) for recycling and treatment there (see section 5.5.1), while the other half is sent to H.J. Enthoven & Sons ltd in Derbyshire in UK for recycling there. The cost is covered partly by the metal price paid by the recycler, and partly by a fee paid by the importers of the batteries. The import fee is transferred through the customs that adjust it according to the revenue from selling the metals.

The second category is segregated into different categories, including NiCd and other Ni containing batteries, mercury containing batteries and alkaline batteries.

The Ni containing batteries are sent to S.N.A.M in France (two plants: one in St. Quentin and one in Viviez) for recycling and treatment.

Mercury containing batteries are sent to NOAH for solidifying and storage. It is considered at a later stage to send this kind of batteries to S.N.A.M. in France for recycling.

Alkaline batteries are sent directly from the collection stations to the municipal waste disposal facilities for either land filling or incineration.

For both mercury and alkaline batteries the handling costs are covered by the collection stations, which means the municipal waste management budgets.

NOAH (Ref.: Jan Petter Linstad, 29.01.2004) have informed the following prices for receiving/treatment of old batteries:

- Mercury containing batteries: 50,000 NOK/tonnes
- NiCd batteries: 25,000 NOK/tonnes
- Alkaline batteries: 25,000 NOK/tonnes

It should be emphasised that these prices are list prices. In case of larger deliveries discount can be negotiated.

### *PVC containing Waste*

NOAH received a little PVC containing waste as part of general plastic waste that is categorised as hazardous waste.

One of the largest European PVC manufacturer, Hydro Polymers, recently started a project to investigate the possibilities of recycling of PVC waste (Ref.: [www.hydropolymers.com/en/media](http://www.hydropolymers.com/en/media)).

*PCB containing Waste*

PCB containing waste is collected through the collection system for hazardous waste. It is sent through NOAH for destruction at a cement factory that also treats pesticide waste. Only small quantities of PCB containing waste are collected nowadays.

*Asbestos containing Waste*

Asbestos containing waste is deposited at landfills. The waste is disposed of at the landfills free of charge.

*Discarded Refrigerators*

The collected refrigerators are treated in the El-Retur system, which means that they are first brought to one of seven treatment plants, where the refrigerant is recovered. Then the refrigerators are brought to scrap dealers that are shredding the refrigerators to segregate metals, plastics and others.

The metals are brought from the metal scrap system to steel works, and the plastics and other materials are incinerated or disposed of at landfills.

*Electric and Electronic Equipment*

The collected electric and electronic equipments are treated through the same El-retur system, although these devices are segregated in more fractions. Some of the fractions are exported for recycling and treatment outside the country.

*Used Tyres*

Used tyres collected through the Dekkretur system are either:

- Exported as second hand tyres to e.g. Africa or Eastern Europe
- Refurbished for renewed use in Norway
- Shredded for material recycling (new products) or
- Shredded for energy recovery.

*Discarded Cars*

Discarded cars have to be delivered to authorised companies for dismantling and recycling of useful materials and products. The drained (recovery of coolant, motor oil, petrol etc.) and compressed cars are sold to scrap dealers. After fragmentation the metal products are sold on the world market for ferrous and non-ferrous metals.

*Impregnated Timber*

All the impregnated timber waste that is collected by larger users is brought to Trollhättan in Sweden for treatment and energy utilisation at the IQR plant (Industrial Quality Recycling AB). The larger users have informed the following treatment fees:

- The National Road Administration: 1,200 – 2,000 NOK/tonnes
- The National Rail Road company: 1,000 NOK/tonnes
- REKOM (recycling broker): 1,500 – 2,000 NOK/tonnes

*Fluorescent Tubes*

Collected mercury light sources are exported to e.g. Sweden for recycling and treatment.

## 4.5 Sweden

*Heavy Metal containing Batteries*

Sweden has one company that is specialised in recycling of lead and tin scrap, including lead batteries (primarily car batteries). The plant is the Boliden-Bergsöe melting work in Landskrona. This plant receives annually 4 million car batteries and other lead scrap from the Nordic and Baltic countries.

The car batteries are crushed and separated in three fractions: lead electrodes, battery liquid (sulphuric acid) and plastics.

The lead scrap is melted and refined, and about 47,000 tonnes of lead and 1 500 tonnes of tin alloys are manufactured annually (2000). Most of the lead is sold to the car battery industry for manufacturing of new car batteries.

The acid is neutralised in the plant's own waste water treatment facility, while the plastics is incinerated in the melting oven.

Collected NiCd batteries are exported to countries outside the Nordic Countries for recycling of the metals.

Mercury containing batteries are deposited at a special depot at SAKAB waiting for further treatment to be decided by the Swedish EPA (Statens Naturvårdsverk).

Other batteries, mainly alkaline batteries, that are also collected, are deposited at a landfill.

SAKAB (Ref.:SAKAB Price list, 01.01.2004) have informed the following prices for receiving/treatment of mercury containing batteries:

- Mercury containing batteries: 125,650 SEK/tonnes

In addition to this comes a basic fee on 8,810 SEK/tonnes. It should be emphasised that these prices are list prices. In case of larger deliveries discount can be negotiated.

#### *PVC containing Waste*

Statens Naturvårdsverk estimates (1996) that approx. 40,000 tonnes of PVC waste is generated per year, and that most of it, 70%, is land-filled and that the remaining part, 30%, is incinerated together with other waste.

Although the Swedish company, Swerec AB, is processing PVC for the Danish, PVC collecting company, WUPPI A/S, it is not processing PVC waste from Sweden.

#### *PCB containing Waste*

Collected PCB/PCT containing waste is incinerated at SAKAB.

SAKAB (Ref.:SAKAB Price list, 01.01.2004) have informed the following prices for receiving/treatment of different kinds of PCB containing waste:

- PCB containing oils: 1,540 – 6,550 SEK/tonnes
- PCB containing solutions: 28,800 SEK/tonnes
- Capacitors for fluorescent tubes: 18,550 – 35,980 SEK/tonnes
- Transformers: 15,480 – 35,980 SEK/tonnes
- PCB containing jointing foam: 15,990 SEK/tonnes
- PCB containing solid waste: 35,780 SEK/tonnes

In addition to this comes a basic fee on 8,810 SEK/tonnes. It should be emphasised that these prices are list prices. In case of larger deliveries discount can be negotiated.

#### *Asbestos containing Waste*

Asbestos containing waste is deposited at special depots at landfills.

According to Waste Information Centre (Ref.: RenViden no. 3, 2003) the disposals fee for asbestos waste is approximately 655 SEK per tonnes. In addition to this a national disposal tax on 375 SEK per tonnes has to be paid, as well as VAT.

#### *Discarded Refrigerators*

The collected refrigerators end up at a number of recycling plants that are able to extract the ODS refrigerant and some ODS from the insulation foam.

The companies having permit for handling the refrigerators for recovering the ODS appear from table 30 below.

**Table 30: Companies having permit to recover ODS from discarded refrigerators etc.**

Company	Municipality	Number of refrigerators handled in 1995
Lator Miljö AB	Nordmaling	7 128
Bjästa Återvinning	Örnskölsvik	15 645
Stena Bilfragmentering	Halmstad	80 558
Svensk Freonåtervinning	Stockholm	75 000
Elektronik o Återvinning	Söderhamn	3 289
Pjala kommun	Pajala	211
SAVO Boden	Boden	5 594

Bjästa Återvinning, located in Västernorrlands Län, is part of Arvamet AB, which is a metal recycling company with its headquarter based in Skellefteå. Both companies are part of the Finnish Kuusakoski Group, which is Finnish a metal recycling company.

Bjästa Återvinning's primary market is the Stockholm area and the northern part of Sweden as well as Finland.

Recovered CFC and HCFC are destructed in Sweden or other European countries. SAKAB have destructed 468 tonnes of CFC and HCFC in the period 1996-1998, and 97,7 tonnes in 1999.

#### *Electric and Electronic Equipment*

Most of electric and electronic waste is treated at a number of branches under the company Arvamet AB, that is part of the Kuusakoski Group. The company is decomposing the waste products and are recycling some of the metals. Other components are sent to other companies for recycling, treatment or land-filling.

#### *Used Tyres*

According to Swedish EPA (Naturvårdsverkets) report no. 5237, 2002, the used tyres collected in 1996/2001 were handled as it is shown in table 31 below.

**Table 31: Disposal of collected tyres in 1996-2000.**

Utilisation of used tyres	2001	2001	2000	2000	1999	1999	1996
	tonnes	%	tonnes	%	tonnes	%	tonnes
Reuse (refurbishing)	3 000	4.8	5 800	8.1	5 400	7.2	2 600
Export of whole tyres	3 200	5.1	4 800	6.8	7 900	10.5	2 650
Reuse	500	0.8	1 100	1.6	4 700	6.2	350
Recycling for flooring	2 700	4.3	3 100	4.4	4 500	6.0	2 200
Material substitution	15 000	24.1	3 400	4.9	5 900	7.8	-
Material recycling	19 200	30.8	18 000	25.7	8 500	11.3	4 900
Export of crushed tyres	3 600	5.8	300	0.4	6 100	8.1	-
Energy recovery at heating station	8 400	13.5	10 400	14.8	10 700	14.2	16 250
Energy recovery at cement factory	6 700	10.8	22 800	32.4	20 000	26.6	23 250
Disposal at landfill	0	0	600	0.9	1 600	2.1	3 350
Total	62 300	100	70 300	100	75 300	100	55 550

Source: Naturvårdsverket, report no 5237

As it can be seen from the table more and more of the tyres are recycled and that the share of the tyres that are exported, used for energy production or land-filled is decreasing. In 2001 the land-filling of tyres was totally eliminated.

#### *Discarded Cars*

Discarded cars are treated through a number of car dismantling dealers (more than hundred) spread over the entire country. They are recovering recyclable parts and environmentally hazardous items, oil and liquid. The remaining parts are sent to a number of defragmentation companies, who are shredding the car and segregate metals and residuals (Ref. SBR Sveriges Bilsrotares Riksförbund, [www.sbrservice.se/](http://www.sbrservice.se/)). The metal are sold either to Swedish metal works or sold on the market.

#### *Impregnated Timber*

There is at least one plant that treats impregnated timber waste. That is the IQR plant (Industrial Quality Recycling AB) in Trollhättan in Sweden, which incinerate the waste with energy utilisation. Impregnated timber waste that is not incinerated is landfilled.

#### *Fluorescent tubes*

Fluorescent tubes and other mercury containing low energy light bulbs are either treated in Bästa Återvinnig AB (a company within the Kuusakoski Group) or at SAKAB in Kumla.

At the SAKAB plant both the glass and the mercury is recovered and recycled at the manufacturers of the new tubes and bulbs.

- The process includes the following steps:
- A special camera identify the different type of light powder in the tube/bulb
- The following process steps are adjusted to the type of light powder
- The ends of fluorescent tubes are cut off, and the metals are recycled
- The light powder is blown out of the tube, stored and then returned to the manufacturers
- The glass is melted and recycled by the manufacturers.

At Bjästa Återvinning the process include recycling of the glass and neutralisation of the mercury.

The process is as follows:

- The fluorescent tubes and bulbs are brought through an air tight passage into a crushing mills
- The pulverised material is transported into a melting furnace (1350-1400 degr. C), where the glass is melted and the mercury is evaporated
- From the furnace the evaporated mercury is led to a reaction chamber where selenium is added for reaction with the mercury, forming a stable compound (selenide of mercury).

The plant is located in Bjästa in Västernorrland Län. The company also sell turnkey plants of the above type.

## 4.6 Summary on Treatment

In table 32 below the information on the availability of the treatment facilities for the various special waste fractions are shown.

**Table 32: Summary of the availability of treatment facilities for special waste fractions in the Nordic countries.**

Special Waste Fraction	Denmark	Finland	Iceland	Norway	Sweden
NiCd batteries <sup>1)</sup>	No	No	No	No	No
Alkaline bat. <sup>2)</sup>	No	No	No	No	No
Hg batteries <sup>3)</sup>	No	No	No	No	No
Car batteries	No	No	No	No	Yes
PVC	Yes	No	No	No	Yes
Asbestos <sup>4)</sup>	No	No	No	No	No
PCB	Yes	Yes	No	Yes	Yes
Refrigerators (recovery of ODS)	Yes	Yes	Yes	Yes	Yes
Destruction of ODS	Yes	Yes	No	Yes	Yes
EE waste (dismantling)	Yes	Yes	Yes	Yes	Yes
Tyres (recycling of rubber)	Yes	Yes	No	Yes	Yes
Car scrap (steel works)	No	Yes	No	Yes	Yes
Impregnated timber	No	Yes	No	No	Yes
Fluorescent tubes etc.	Yes	Yes	No	No	Yes

Notes:

1. Exported to France/UK.
2. Not considered hazardous
3. Some of the countries is land-filling those batteries
4. Disposed of at landfill, no treatment relevant.



## 5. Proposals for Selection of New Waste Fractions

This chapter includes proposals for new waste fractions, which it could be environmentally beneficial to extract from the current waste flow.

The proposals are based on a review of the EU list of waste categories and review of reports dealing with hazardous waste categories, including the “Study on hazardous household waste with main emphasis on hazardous household chemical”, (European Commission, Directorate General Environment, July 2002)

**Table 33: Proposal for new waste fractions to be segregated from the general municipal solid waste stream**

Waste category/material	Environmental aspects	Potential treatment
Surface treated metal objects	E.g. cadmium, nickel and chromium emitted from incineration plants or landfills	Melting/recycling
Impregnated leather	E.g. chromium emitted from incineration plants or landfills	Incineration with flue gas cleaning
Pesticide waste/residuals	Persistent organic compounds emitted via incineration plants or landfills	Incineration with flue gas cleaning
Lead containing materials	Lead and lead compounds emitted from incineration plant or landfills	Melting/recycling
Mercury containing objects	Mercury emitted directly to air or from incineration plants or landfills	Recycling/storing
Copper containing objects	Copper emitted from incineration plants or landfills	Melting/recycling
Mineral wool	Volume at landfill, dust emitted	Segregation/recycling
Photo paper and other photo products	Silver and heavy metals emission from incineration plants or landfills	Incineration and recovery of heavy metals
Hard PVC containing products	Emission of acidic and dioxins containing fume when incinerated	Recycling
Soft PVC containing products	Emission of softening agents when land filled. Emissions from incineration	Environmentally sound destruction



# Sammendrag

## Formål og afgrænsning

Formålet med dette projekt har været at udarbejde en oversigt over udvalgte affaldsfraktioner, som kræver separate håndtering og behandling i de nordiske lande. Hensigten med oversigten er at udveksle information om hvilke erfaringer, der er gjort indenfor området, samt at udvælge nye fraktioner, som det kan være hensigtsmæssigt at inddrage de kommende år.

Oversigten indeholder beskrivelser af gældende lovgivning, fysiske udformning af indsamlingssystemer, finansielle virkemidler, indsamlede mængder samt behandlings- og deponeringsmetoder for affaldsfraktionerne.

De affaldsfraktioner, der er omfattet af undersøgelsen er:

- Tungmetalholdige batterier
- PVC-holdigt affald
- PCB-holdigt affald
- Asbest-holdigt affald
- Kasserede kølemøbler
- Affald af elektriske og elektroniske produkter
- Kasserede bildæk
- Bilskrot
- Imprægneret træaffald
- Kasserede lysstofrør og lavenergi lyskilder.

## Lovgivning

På EU-plan er der indført lovgivning i form af direktiver for følgende af de affaldsfraktioner, som er omfattet af projektet:

- PCB og PCT
- Brugte batterier og akkumulatorer
- Kasserede biler
- Kasserede elektriske og elektroniske produkter.

Derudover har EU vedtaget et Europæisk Affaldskatalog, som definerer de forskellige affaldskategorier og –fraktioner.

Alle nordiske lande har indført eller er i gang med at indføre lovgivning, der dækker de nævnte EU-direktiver, også de nordiske lande, som ikke er medlem af EU.

Med hensyn til national lovgivning har alle de nordiske lande specifikt reguleret alle de fraktioner, der er omfattet af projektet, bortset fra PVC, imprægneret træ og lysstofrør. I alle tilfælde gælder dog, at de nævnte fraktioner, som ikke er dækket af specifik regulering, er dækket af landenes generelle lovgivning for farligt affald.

## Indsamlingssystemer

Overordnet set har de nordiske lande etableret et to strenget system for specielle affaldsfraktioner, der består dels af et kommunalt system, der omfatter de fleste affaldsfraktioner, dels af et antal private systemer, som hver især håndterer enkelte affaldsfraktioner.

Det kommunale system omfatter alle de specielle affaldsfraktioner, bortset fra kasserede biler. I de fleste tilfælde modtages de specielle affaldsfraktioner på genbrugsstationer, som også modtager genanvendelige materialer som papir, pap, glas m.v. De kommunale genbrugsstationer er åben for alle borgere og mindre erhvervsdrivende. I de fleste tilfælde kan affaldet og de genanvendelige materialer afleveres uden betaling.

De private indsamlingssystemer er for det meste baseret på producentansvars-princippet, og omfatter specifikke affaldsfraktioner og drives dermed af forskellige industrisektorer. I de fleste nordiske lande omfatter private indsamlingssystemer: batterier, kasserede kølemøbler, affald af elektriske og elektroniske produkter, kasserede dæk og kasserede biler.

I en del tilfælde har de enkelte industrisektorer etableret fælles virksomheder, som har fået overdraget ansvaret for at etablere og drive indsamlings- og behandlingssystemerne for de pågældende affaldsfraktioner.

For visse produkter – f.eks. blybatterier, dæk og kasserede biler – er der etableret afgiftssystemer til sikring af en miljørigtig og effektiv indsamling og behandling af affaldsfraktionerne.

## Behandling og deponering

For de fleste af de specielle affaldsfraktioner, omfattet af dette projekt, er behandling og endelig deponering tilgængelig indenfor de nordiske lande. Imidlertid, nogle af de indsamlede NiCd-batterier samt visse fraktioner af affald fra elektriske og elektroniske produkter genanvendes og behandles udenfor de nordiske lande. Desuden forhandles en del af de indsamlede genanvendelige materialer, f.eks. jernskrot fra kasserede biler, på verdensmarkedet, selvom der findes oparbejdningskapacitet i de nordiske lande.

## Forslag til nye affaldsfraktioner

Selvom indsamling, genanvendelse og behandling af specielle affaldsfraktioner har fundet sted i de nordiske lande gennem de sidste 25 år, må en del af systemerne stadig betragtes som under udvikling og etablering. Den stadige udvikling skyldes bl.a. at affaldshåndteringssystemerne bliver mere avancerede og at behandlingen og deponeringen bliver dyrere.

Følgende liste indeholder forslag til nye affaldsfraktioner, som det ud fra en miljømæssig synsvinkel, kunne overvejes at udsortere med henblik på separat håndtering og behandling.

**Tabel 1: Forslag til nye affaldsfraktioner, som kunne udsorteres fra den generelle affaldsstrøm.**

Affaldsfraktion/materiale	Miljøaspekts	Potentiel behandling
Metal-overfladebehandlede genstande	F.eks. udledning af cadmium, nikkel og chrom fra forbrændings- og deponeringsanlæg.	Smeltning/genanvendelse
Imprægneret læder	F.eks. udledning af chrom fra forbrændings- og deponeringsanlæg.	Forbrænding med røggasrensning
Pesticidaffald og -rester	Udledning af persistense organiske forbindelser fra forbrændings- og deponeringsanlæg.	Forbrænding med røggasrensning
Bly og blyholdige genstande	Udledning af bly og blyholdige forbindelser fra forbrændings- og deponeringsanlæg.	Smeltning/genanvendelse
Kviksølvholdige genstande	Udledning af kviksølv direkte til luft eller fra forbrændings- og deponeringsanlæg.	Genanvendelse og lagring
Kobberholdige genstande	Udledning af kobber fra forbrændings- og deponeringsanlæg.	Smeltning/genanvendelse
Brugt stenudd	Beslaglæggelse af volumen på deponeringsanlæg og afgivelse af støv.	Udsortering og genanvendelse
Fotopapir og andre fotografiske produkter	Udledning af sølv og tungmetaller fra forbrændings- og deponeringsanlæg.	Forbrænding og opsamling/genanvendelse af tungmetaller
Produkter indeholdende hård PVC	Udledning af sure og dioxinholdige røggasser fra forbrænding.	Genanvendelse
Produkter indeholdende blød PVC	Udledning af blødgøringsmidler ved deponering. Udledning af sure gasser og dioxin fra forbrænding.	Miljørigtig destruktion

Det skal understreges at visse af de ovennævnte stoffer og materialer – såvel som de specielle affaldsfraktioner udvalgt i dette projekt – indgår i ”renere produkt”-initiativer, f.eks. substitution af miljøfarlige stoffer, og at flere lignende initiativer kan ventes, parallelt med initiativer for miljørigtig genanvendelse, behandling deponering af fraktionerne.



# Appendix 1: Numbering of Waste Fractions according to EWC

Lead containing batteries (car batteries)	160601
NiCd containing batteries (rechargeable batteries)	160602
Mercury containing batteries (small cell batteries)	160603
Other batteries (e.g. alkaline batteries)	160604
Batteries from households (all types)	200133
PVC containing waste	170204
Transformers and capacitors containing PCBs	160209
Discarded equipment containing PCBs	100210
Construction and demolition materials containing PCB	170902
Asbestos containing waste	170105
Insulation materials containing asbestos	170601
Construction materials containing asbestos	170605
Construction materials containing asbestos, loose fibres	170606
CFC/HCFC/HFC containing refrigerants	140601
Discarded equipment (refrigerators) containing CFC/HCFC	200123
Discarded equipment containing CFC/HCFC	160211
Discarded electrical and electronic equipment, containing hazardous	200135
Discarded electrical and electronic equipment	200136
End-of-life tyres	160103
End-of-life cars containing hazardous substances (discarded cars)	160104
End-of-life cars not containing hazardous substances (discarded cars)	160106
Wood etc. containing hazardous substances (impregnated timber)	170204
Wood etc. containing hazardous substances (impregnated timber)	200137
Discarded fluorescent tubes and other mercury containing waste	200121



## Appendix 2: Key Data for Nordic Countries

	Danmark	Finland	Iceland	Norway	Sweden
Population, million inhabitants	5.3	5.2	0.3	4.5	8.8
Area, km <sup>2</sup>	43,090	338,130	103,000	323,900	449,960
Population density, inh./ km <sup>2</sup>	122.9	15.3	2.9	13.8	19.5
Exchange, per EURO <sup>1)</sup>	7.45 DKK	1 EURO	86.12 ISK	8.72 NOK	9.19 SEK

Note: <sup>1)</sup> As of 2 Febr. 2004.