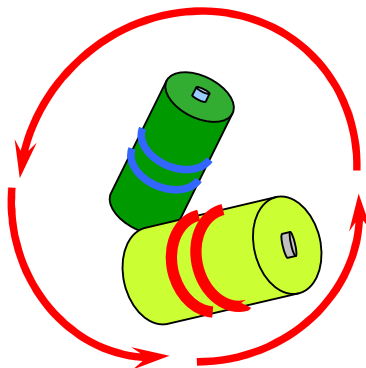




REGION OF CRETE – TERRA NOVA - UNIVERSITY OF
ATHENS

**LIFE ENVIRONMENT PROGRAMME
“GREEN BATTERIES”**

**Deliverable of Phase 1: Analysis of existing situation
Part 1: Existing experience in the European Union in
collection and recycling programmes (Action 6)**



APRIL 2003

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PROJECT TITLE

Development of a Pilot Separate Collection and Management Scheme in Crete for Batteries and Accumulators (LIFE02 ENV/GR/000373)

The Green Batteries Project is co funded by the EU Program LIFE ENVIRONMENT.



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1. INTRODUCTION

The aim of this report is to examine the European and International policy concerning collection and recycling of spent batteries in order to evaluate the policy followed, the advantages and constraints of collection and recycling systems, their structure, the information campaigns that have followed and the design of these schemes.

The information presented in this report is based on literature survey, personal contacts with the responsible persons in several countries and reports presented in the internet.

In particular the main data examined include:

- Information on the types of batteries used today, their uses as well as main manufacturers worldwide
- Environmental policy and legislation
- Market trends for batteries today
- Analytical profiles of the most characteristic recycling systems for lead-acid batteries (mainly car batteries) and all the other batteries. The analytical profiles include data on the main recycling schemes exist in each country, their legal status, the activities performed (collection, recycling, dissemination), collection rates, financial data and effectiveness of each system.

2. INTRODUCTION TO BATTERY TYPES

A battery is an electrochemical device that converts chemical energy into electricity by use of a galvanic cell. A galvanic cell is a device consisting of two electrodes (an anode and a cathode) and an electrolyte solution. Batteries consist of one or more galvanic cells. Electrodes (two plates, each made from a different kind of metal or metallic compound) are placed in an electrolyte solution. External wires connect the electrodes to an electrical load. The metal in the anode (the negative terminal) oxidizes releasing negatively charged electrons and positively charged metal ions. The electrons travel through the wire (and the electrical load) to the cathode (the positive terminal). The electrons combine with the material in the cathode. At the interface with the electrolyte, this ion causes a water molecule to split into a hydrogen ion and a hydroxide ion. The positively charged hydrogen ion combines with the negatively charged metal-oxide ion and becomes inert. The negatively charged hydroxide ion flows through the electrolyte to the anode where it combines with the positively charged metal ion, forming a water molecule and a metal-oxide molecule. Metal ions from the anode will "dissolve" into the electrolyte solution while hydrogen molecules from the electrolyte are deposited onto the cathode. When the anode is fully oxidized or the cathode is fully reduced, the chemical reaction will stop and the battery is considered to be discharged.

The amount of voltage and current that a galvanic cell produces is directly related to the types of materials used in the electrodes and electrolyte. The length of time the cell can produce that voltage and current is related to the amount of active material in the cell and the cell's design.

Batteries are classified in categories based on their life cycle, the type of electrolyte, their composition and their use:

- **Classification according to their life cycle**

Based on their life cycle batteries are divided in primary and secondary.

A primary battery is a battery that is designed to be cycled (fully discharged) only once and then discarded. Although primary batteries are often made from the same base materials as secondary (rechargeable) batteries, the design and manufacturing processes are not the same. Primary batteries have a single use and cannot be recharged. Primary cell batteries include alkaline, carbon-zinc, lithium, silver-zinc and zinc air.

A secondary battery is commonly known as a rechargeable battery. It is usually designed to have a lifetime between 100 and 1000 recharge cycles, depending on the composite materials.

Secondary batteries contain reversible chemical materials allowing them to be recharged and used again. Examples of rechargeable systems include Nickel Metal Hydride (NiMH), Nickel Cadmium (NiCd), Lithium Ion (LiIon) and Sealed Lead Acid (SLA) batteries.

- **Classification according to the type of electrolyte**

Based on the type of electrolyte batteries are categorized in dry and wet cells. Wet cells refer to galvanic cells where the electrolyte is liquid in form and is allowed to flow freely within the cell casing. Most automobile batteries are wet cells (lead batteries).

Dry cells are cells that have a solid or powdery electrolyte. These kind of electrolytes use the ambient moisture in the air to complete the chemical process.

- **Classification according to their use**

Batteries can further be classified by their intended use. In the following categories of batteries:

- vehicular batteries
- household batteries
- industrial batteries

The main battery categories are presented in table 1 and table 2. Over the years, battery specialists have experimented with many different combinations of material and have generally tried to balance the potential energy output of a battery with the costs of manufacturing the battery. Nowadays the battery Industry is constantly growing. The R&D departments of the battery manufacturers are developing new technologies trying to optimize factors such as battery weight and size, shelf life, and environmental impact.

Table 1. Types of primary batteries


Primary batteries	Types of batteries	Characteristics & Uses
Zinc-carbon (Z-C)	<p>Zinc-carbon cells ("Leclanche cells") are widely used because of their relative low cost. Zinc-carbon cells are composed of a manganese dioxide and carbon cathode, a zinc anode and zinc chloride (or ammonium chloride) as the electrolyte. They were the first widely available household batteries. Eveready carbon zinc batteries meet a wide variety of device applications utilizing light to moderate drains, such as:</p> <p>Alarm Systems, Barricade Flashers, Calculators, Clocks, Communications equipment, Electrical fence controllers, Electronic games, Flashlights, Fluorescent lanterns, Garage door openers, Home entertainment remote controls, Kerosene heater igniters, Home security devices, Laboratory instruments, Lanterns, Marine depth finders, Motion displays, Motor driven devices, Penlights, Personal care devices, Portable tape recorders and players, Radios, Radio controlled toys, Remote control transmitters, Small lighted toys and novelties, Smoke detectors, Specialty High voltage electronic photo flash, Stereo headsets, Test equipment, Toys.</p>	
Alkaline batteries: Zinc-Manganese Dioxide Alkaline Cells	<p>Alkaline batteries have an alkaline electrolyte instead of the mildly acidic electrolyte that is used in a regular zinc- carbon battery. An alkaline battery can have a useful life of five to six times that of a zinc-carbon battery. There are widely used in household appliances such as:</p> <p>Camera Motor Drives, Cassette Players and Recorders, Shavers, Portable Radios, Portable TV's, Motor Toys, Clocks, Remote Controlled Models, Transceivers, Electronic Games, Cellular Telephones, Electronic Photoflashes, Security Devices (Alarms, Smoke Detectors), Compact Disc Players, Portable Computers, Electronic Organizers, Video Cameras, Toothbrushes, etc.</p>	
	Lithium Primary	<p>Lithium primary batteries are the reliable power source for critical applications offering more than twice the energy of alkaline batteries. These batteries can replace the respective alkaline batteries in any application. However due to their high cost, their use until now is marginal.</p>

Table 1. Types of primary batteries (continued)


Primary batteries	Types of batteries	Characteristics & Uses
	Lithium coin Button	<p>Button-size lithium batteries are becoming popular for special applications where changing the battery is difficult and the long lifetime of the lithium battery as well as its other characteristics (good low temperature operation, high operating voltage and excellent leakage resistance) makes it a competitive choice.</p> <p>Some applications are: Audio Equipment, Calculators, Cameras & Light Meters, Data Acquisition Systems, Electronic Communication Devices, Electronic Games, Electronic Wristwatches & Clocks, Hearing Aids, Industrial Monitors/Controls, Medical Equipment, Memory Retention, Micro Cassette Recorders, Military Electronics, Remote Keyless Entry, Small Electronic Instruments, Security Devices, Switchboards, Transceivers & Radios.</p>
	Alkaline button	<p>The miniature manganese dioxide primary battery is designed to provide an economical power source for device applications that do not require the flat voltage discharge curve characteristic of mercuric and silver oxide batteries. Device applications in which miniature manganese dioxide batteries can be used as substitutes include: calculators, automatic exposure control cameras, some watches and a variety of small toys. The substitution of miniature manganese dioxide batteries for comparable mercuric or silver oxide batteries should only be made where recommended by the device manufacturer.</p>
	Metal-Air Cells (Zinc air)	<p>A very practical way to obtain high energy density in a galvanic cell is to utilize the oxygen in air as a “liquid” cathode. A metal, such as zinc or aluminium, is used as the anode. The oxygen cathode is reduced in a portion of the cell that is physically isolated from the anode. By using a gaseous cathode, more room is available for the anode and electrolyte, so the cell size can be very small while providing good energy output. Small metal-air cells are available for applications such as hearing aids, watches and other small devices. Metal-air cells have some technical drawbacks, however. It is difficult to build and maintain a cell where the oxygen acting as the cathode is completely isolated from the anode. Also, since the electrolyte is in direct contact with air, approximately one to three months after it is activated, the electrolyte will become too dry to allow the chemical reaction to continue. To prevent premature drying of the cells, a seal is installed on each cell at the time of manufacture. This seal must be removed by the customer prior to first use of the cell.</p>

Table 1. Types of primary batteries (continued)


Primary batteries	Types of batteries	Characteristics & Uses
	Silver Oxide	<p>Silver oxide cells use silver oxide as the cathode, zinc as the anode, and potassium hydroxide as the electrolyte. Silver oxide cells have a moderately high energy density and a relatively flat voltage profile. Due to the high cost of silver, silver oxide technology is currently limited to special uses such as hearing aids, calculators, watches, and photographic devices.</p> <p>Silver oxide cells are the most common batteries applied in watches.</p>
	Mercury Oxide	<p>Mercury oxide cells are constructed with a zinc anode, a mercury oxide cathode, and potassium hydroxide or sodium hydroxide as the electrolyte. Mercury oxide cells have a high energy density and flat voltage profile resembling the energy density and voltage profile of silver oxide cells and metal air cells. Mercury creates significant environmental and health problems and therefore due to the new European legislation the use of these batteries has been forbidden.</p>

Table 2. Types of secondary batteries (rechargeable)


Secondary batteries	Types of batteries	Characteristics & Uses
	NiCd batteries	<p>The basic galvanic cell in a Ni-Cd battery contains a cadmium anode, a nickel hydroxide cathode, and an alkaline electrolyte. Batteries made from Ni-Cd cells offer high currents at relatively constant voltage and they are tolerant of physical abuse. They exhibit a high power capability, a wide operating temperature range, and a long life cycle. Nickel-cadmium cells are the most commonly used rechargeable household batteries nowadays. They are used in powering small appliances such as: Garden tools, Cellular phones, Calculators, Cassette players and recorders, Digital Cameras, Instruments, Photoflash equipment, Portable communications equipment, Portable hand tools and appliances, Portable computers, Radios, Radio control models, Shavers, Tape recorders, Television sets, Toothbrushes</p>
	Nickel metal Hydride (NiMH)	<p>The anode of a Ni-MH cell is made of a hydrogen storage metal alloy, the cathode is made of nickel oxide, and the electrolyte is a potassium hydroxide solution. Ni-MH cells can last longer than the same size Ni-Cd cells and will have a life-span of up to 600 cycles. Ni-MH batteries have a high self-discharge rate and are relatively expensive.</p> <p>The Nickel-Metal Hydride cell is currently finding widespread application in those high-end portable electrical and electronic products where battery performance parameters are a major consideration in the purchase decision. They are usually applied in high-energy devices such as laptop computers, cellular phones, and camcorders, drillers, cleaning tools, etc.</p>
	Nickel-Iron (Ni-I)	<p>Nickel-iron cells, also known as the "Edison battery", are much less expensive to build and to dispose of than nickel-cadmium cells. Nickel-iron cells were developed before the nickel-cadmium cells. The cells are rugged and reliable, but do not recharge very efficiently. They are widely used in industrial settings and in Eastern Europe, where iron and nickel are readily available and inexpensive.</p>
	Nickel-Zinc (Ni-Z)	<p>The performance of the nickel zinc cells is not as good as the performance of NiCd and therefore they are not so popular. Although the nickel-zinc cell yields promising energy output, the cell has some unfortunate performance limitations that prevent the cell from having a useful lifetime of more than 200 or so charging cycles. When nickel-zinc cells are recharged, the zinc does not redeposit in the same "holes" on the anode that were created during discharge. Instead, the zinc re-deposits in a somewhat random fashion, causing the electrode to become misshapen. Over time, this leads to the physical weakening and eventual failure of the electrode.</p>

Table 2. Types of secondary batteries (continued)








Secondary batteries	Types of batteries	Characteristics & Uses
	Lithium	It's a battery that uses lithium metal or a lithium aluminium alloy in its negative electrode (anode) and manganese dioxide in its positive electrode (cathode). The most common applications for rechargeable Lithium batteries are: Cameras, Electronic meters (water, gas, electricity), Electronic car keys etc
	Lithium Ion batteries	Lithium-ion batteries have a good high-power performance, an excellent shelf life, and a better life span than other rechargeable batteries. However, they have a very high initial cost. They are becoming less expensive and over time we will see their price decrease significantly. The most common applications for Lithium-ion Batteries are: video cameras, digital still cameras, cellular phones, PHS phones, laptop computers, MD players, various portable equipment, PDA's etc. Lithium ion batteries are not available in standard cells sizes (AA, C and D) like NiMH and NiCd batteries. Prismatic lithium ion batteries are used for cellular phones
	Lithium Ion Polymer	The development of lithium ion polymer batteries is based on a new technology that is under development and is expected to be improved in the next years. The Li-polymer differs from other battery systems in the type of electrolyte used which is a dry polymer. This battery is mainly applied in new generation cellular phones and laptop computers.
	Titanium	Titanium unlocks the power by making the cathode more conductive and allows electrons to flow more freely. This means improved performance and longer life compared with lithium and alkaline batteries. These batteries are available in all common sizes (AAAA, AAA, AA, C, D, 9V) and can be applied to all appropriate devices.
	Rechargeable Alkaline Batteries	Like zinc-carbon batteries, alkaline batteries are not generally rechargeable. However, some manufactures distribute alkaline rechargeable batteries that can be recharged for at least 25 times. Rechargeable alkaline batteries are most appropriate for low - and moderate - power portable equipment, such as hand-held toys and radio receivers.

Table 2. Types of secondary batteries (continued)

Secondary batteries	Types of batteries	Characteristics & Uses
  	Lead-acid	<p>Rechargeable lead-acid batteries have become the most widely used type of battery in the world. In fact, battery manufacturing is the largest use for lead in the world. Lead-acid batteries' come in a great variety of shapes and sizes, from household batteries to large batteries for use in submarines. The most widely known uses of lead-acid batteries are as automobile batteries.</p> <p>Lead-acid batteries are further grouped (by typical usage) into three different categories:</p> <ul style="list-style-type: none">▪ SLI batteries: The SLI (starting, lighting, ignition) battery used in all motor vehicles. These batteries typically have a lifetime of approximately 4 years in Europe. The average weight of a European car battery is 13 kg, with a lead content of 7.6 kg. Typical uses of these batteries are cars, motor vehicles, tractors, etc.▪ Traction batteries provide moderate power through many deep discharge cycles. The traction battery, used to power vehicles such as golf carts, airport vehicles, fork lift trucks, where quietness and lack of emissions are important, and journey distances are short.▪ Stationary batteries - Stationary batteries must have a long shelf life and deliver moderate to high currents when called upon. These batteries are used for backup power supplies in case of power failure (for example UPS), emergency lighting in stairwells and hallways and alarms. Most are used for computer systems and telecommunications for industrial/utility customers, medical and military/government users. They can provide instant supply, either alone, or for the brief interval between power cut and a diesel generator starting to supply power. This type of battery use is also called Standby or Float Batteries for stationary power supply. They have a life time of approximately 10 years and they are usually sealed batteries.

2.1 MARKET DISTRIBUTION

Lead acid batteries hold by far the largest battery market share. Concerning all the other type of batteries the leading position is held by the primary alkaline and zinc carbon batteries. During the last years rechargeable Ni-Cd and Li batteries have increase their market share significantly. The battery circulation in Germany is presented in the following table.

Table 3. Batteries circulating in Germany by type

Battery	Form	Type	Dry batteries in Germany (mil.) (1996)	Percentage of total batteries in Germany (1996)
Primary batteries	Cylinders	Alkali manganese	358	together 79 %
		Zinc-carbon	315	
	Buttons	Zinc-mercury	74	together 8,7 %
		Silver oxide		
		Alkali manganese		
		Zinc-oxygen		
		Lithium		
Rechargeable	Cylinders	Nickel-cadmium	56 *	7 %
		Nickel-hydride	35 *	4 %
	Buttons	Nickel-cadmium	together 10,2	together 1,2 %
		Nickel-hydride		
	Sum			ca. 850 mil **
Accumulators	Car and starter batteries	Lead	14 million	

Source: Arbeitsgemeinschaft Batterien, Hannover, 1998

* an additional ca. 6 -8 million NiCd (and NiMH) rechargeable batteries come onto the German market supplied with equipment sold

** includes built-in fixed accumulators

According to EPBA, general purpose batteries (alkaline manganese and zinc carbon) account for the 90% of the battery market, button cells make up 2% of the battery market and rechargeable batteries (comprise 8% of the battery market).

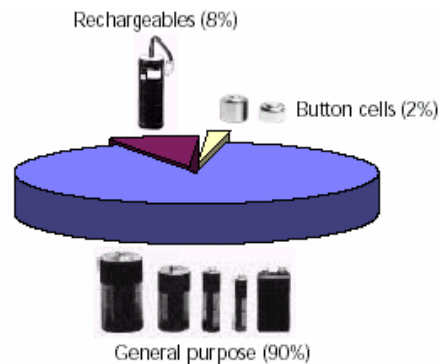


Figure 1. Battery market (source: EPBA)

3. MAJOR BATTERY MANUFACTURERS WORLDWIDE

The major battery manufacturers worldwide are given in the following table.

Table 3. Battery manufacturers

Battery Engineering http://www.batteryeng.com/	PolyStor Corporation http://www.polystor.com/
Duracell Batteries http://www.duracell.com/	Radio Shack http://www.radioshack.com/
Eveready Batteries http://www.eveready.com/	Rayovac Batteries http://www.rayovac.com/
Kodak Corporation http://www.kodak.com/	Sony Corporation http://www.sel.sony.com/
NEXcell http://www.battery.com.tw/	Saft America inc. http://www.saftbatteries.com
Sanyo Batteries http://www.sanyobatteries.com	Suncom Battery Enterprises Ltd. http://www.suncombattery.com.hk/
Panasonic Batteries http://www.panasonic-batteries.be/	Unross Batteries SA http://www.uniross-batteries.com

4. EU LEGISLATION CONCERNING BATTERIES

In this chapter it is provided a short presentation of the so called "battery Directive", the Council Directive 91/157/EEC of 18 March 1991 on batteries and accumulators containing certain dangerous substances.

The objective of this Directive was to introduce measures for the upgrading and controlled disposal of spent batteries and accumulators containing dangerous materials in the Community. This directive was amended by the following measures:

- Commission Directive 93/86/EEC of 4 October 1993
- Commission Directive 98/101/EC of 22 December 1998.

The contents of the Directive are the following:

1. Directive 91/157/EEC prohibited, with effect from 1 January 1993, the placing on the market of:

- Manganese alkaline batteries designed for prolonged use in extreme conditions and containing more than 0.05% by weight of mercury;
- Any other alkaline battery with a mercury content of more than 0.025% by weight.

Directive 98/101/EC will tighten up these standards sharply as from 1 January 2000. From then on, Member States must prohibit the marketing of batteries and accumulators containing more than 0.0005 % of mercury by weight. The same will also apply to appliances incorporating such batteries and accumulators.

2. Batteries of the "button" type or those composed of elements of the "button" type are excluded from the scope of these Directives.

3. The Member States will draw up programmes aimed primarily at reducing the heavy-metal content of batteries and accumulators.

4. Under these programmes, the Member States must encourage the separate collection of batteries and accumulators with a view to their upgrading or ultimate disposal. The batteries and accumulators, or the appliances in which they are incorporated, must be marked in such a way as to indicate separate collection and recycling requirements and heavy-metal content.

The deadline for implementation of the legislation in the member states was:

- Directive 91/157/EEC: 18.09.1992
- Directive 93/86/EEC: 31.12.1993
- Directive 98/101/EC: 01.01.2000

5. BATTERY RECYCLING SYSTEMS: EUROPEAN AND INTERNATIONAL EXPERIENCE

5.1 LEAD – ACID BATTERIES

5.1.1 General data

By far the greatest use of lead worldwide is in lead-acid batteries. Batteries have been the greatest consumer of lead since the 1960s, but their importance has risen hugely: in 1960 batteries accounted for 28% of lead use worldwide, whereas in 1999 74% of lead consumed was for this application. In Western Europe, 57% of the lead consumed is used in batteries and in the USA, over 80% of lead is used in batteries. The demand for lead-acid batteries, both for automotive applications and for stationary output, is continuing to increase.

5.1.2 Lead Market trends in Europe and worldwide

The main steps in the production of lead are:

- Extraction from mines
- Primary production of refined lead from ore
- Secondary production of refined lead from scrap (recycling of lead)

According to the statistical data given by the International Lead and Zinc Study Group for 2000 the main producers of lead from mines are China, Australia, Canada and Central-South America.

Western Europe is an important producer of refined lead (primary and secondary production). It is important to mention that in several European countries there are no industrial units producing lead from ore and in most of the countries the production of secondary lead is higher than the production of primary lead. On average in Europe the 65 % of lead production is secondary. This means that lead recycling is significantly developed in Europe, covering a significant percentage of the needs for lead products.

It is likely that the proportion of secondary lead produced will continue to increase as patterns of lead use change. The phasing out of the major diffuse applications of lead (particularly in paints and petrol additives) from which lead is virtually impossible to recover began in the 1950s and is still continuing, while applications where lead is recycled (in particular batteries) are increasing. Therefore secondary production of lead constitutes a growing market.

The production of lead in Europe and Worldwide is shown in the next tables based on the data given by ILZSG. It must mention that the secondary lead production data for Greece can differ significantly from the official data, taken into account that there are several secondary lead plants without official permits. Particularly concerning Greece, according to national data (1998), 12 companies deal with the construction of lead batteries and 5 companies deal with recycling of lead batteries. The amount of lead batteries produced per year is 2500 tones containing 1500 tones of lead (National plan for the integrated and alternative management of waste and refuse, Ministry of Environment, 1998).

Table 4. World wide production of lead (2000, ILZSG)

	Mine production (lead content, in thousand tonnes)	Total production of refined lead (primary and secondary)
Central and Eastern Europe	121	309
Africa	181	135
North America	607	1705
Central and South America	446	478
China	560	1051
Rest of Asia	135	1017
Australia	650	261
Western Europe	242	1578

Table 5. Production of lead in Europe (2000, ILZSG)

	Mine production (thousand tonnes)	Primary production of refined lead (thousand tonnes)	Secondary production of refined lead (thousand tonnes)	Total (thousand tonnes)
Germany		174	213	387
UK		152	179	331
France		123	139	262
Italy	7	57	171	228
Belgium		9	108	117
Spain	51	0	97	97
Sweden	109	30	47	77
Austria		0	24	24
Netherlands		0	21	21
Ireland	57	0	10	10
Switzerland		1	9	10
Greece	18	1	5	6
Portugal		0	5	5

Table 6. Lead smelting primary and secondary plants in Europe (ILZCG)

	Primary	Secondary
Austria	0	4
Belgium	1	3
France	1	6
Germany	3	6
Greece	0	1
Ireland	0	1
Italy	0	6
Netherlands	0	1
Spain	0	5
Sweden	1	1
UK	1	6
TOTAL	7	40

5.1.3 Lead acid battery recycling programmes

The recycling of lead acid batteries constitutes a practice that was initiated by financial motives, since the middle of the previous century. Due to the fact that recycling of lead consumes much less energy than the production of primary lead, the secondary lead industry was in place a long time before the introduction of the environmental concerns (the production of recycled lead requires 35-40% of the energy needed to produce lead from ore).

Lead acid recycling rates worldwide are very high (reaching 70-90%) although official recycling systems has not been established in the majority of the countries. One of the most well-known officially established systems is COBAT that has been developed in Italy. Comprehensive profiles of the established systems are provided in the next tables.

5.1.3.1. Italy

Country	Italy
Recycling system	Organized formal recycling system COBAT
Recycling rates	above 95% (189603 tones/year, 3.28 kg/person)
Legal status of the organization	<p>COBAT is an association founded on the model of the public/private partnership: the public sector exercising the function of policy and control, the private sector entrusted with management. It has been instituted by law (<i>COBAT, The "Official Recycling Association for Spent Lead Batteries and Lead Waste" is a non profit-making organization instituted under law 475/1988; its charter was approved by a Decree of the Ministry for the Environment and Industry published 16th May 1990</i>).</p> <p>The board of directors includes representatives from the Ministry of Industry and Environment.</p> <p>The Association currently includes: Recycling companies, Battery Manufacturers, Collection and scrap companies and Installers.</p> <p>According to the law <i>"anyone in possession of spent lead batteries or lead waste is required to hand these over to COBAT either directly or by delivering them to agencies appointed by the Association"</i></p> <p><i>A modification of this law has been performed during the last years because there was an accusation that this law is against the principles of free market.</i></p>
Activities	<p>COBAT collects spent lead batteries and transports them to its own recycling sites, where the sulphuric acid is neutralized and the lead metal recovered.</p> <p>The main steps followed are:</p> <p>Collection : vehicles with a capacity between 3.5 and 16 tons,</p> <p>Transportation : vehicles with capacity equal to or in excess of 28 tones</p> <p>Battery processing : 6 treatment plants - the process is based on reduction at high temperatures of lead compounds, oxides and sulphates, using classic reducers such as coal or coke.</p>

	<p>Main steps of processing:</p> <ul style="list-style-type: none"> • Fusion and refinement of lead • Pulverization of accumulator tank and separation of polypropylene (granulation and sale) • Treatment of acid • Recovery / disposal of plastic mix
Financial data: income - outcome	<ul style="list-style-type: none"> • Income from a surcharge applied to the price of new batteries by manufacturers and importers and paid directly to the Association, which can then be recovered from each successive purchaser in the chain of distribution and ultimately from the end user. The fee on each battery ensures that the activity of collecting and recycling can be carried on in any trading conditions, irrespective of movements in the price of lead on international markets. Each year, with a specific decree, the Departments of the Environment, Industry, Commerce and Crafts define the amount, on the basis of the total number of new batteries produced and sold, as well as lead quotations on the L.M.E. • Income from the sale of spent batteries to recycling companies. <p>The income of COBAT from the sale of spent batteries to recycling companies change every year depending on the price of lead in London Metal Exchange. Depending on this fluctuation the surcharge applied to the price of batteries change every year. The total income of the Recycling Association is around 0,12 €/kilo of spent batteries and the surcharge for starter batteries is approximately 0.8 €.</p> <p>Financial data are given in Table 7.</p>
Dissemination activities	<ul style="list-style-type: none"> • institutional communication, aimed to publicize COBAT, its mission and the results obtained • environmental education addressing schools and young people and directed to promote new generations' awareness on ecological problems connected to industrial development • tailored communication directed towards specific users' categories with a higher risk of waste dispersion in the environment

Table 7. COBAT financial data for the last decade

Year	Quotation (London Metal Exchange) (€/kg)	Collector income (€/kg)	Surcharge (€/kg of used batteries)	Total income (€/kg)	Collection cost (€/kg) (payment of official collectors)
1991 – 1996 (average)	0,44	0,051	0,058	0,11	0,090
1997	0,55	0,075	0,040	0,12	0,104
1998	0,47	0,056	0,060	0,12	0,104
1999	0,47	0,054	0,066	0,12	0,104
2000	0,49	0,061	0,063	0,12	0,109
2001	0,53	0,068			



Collected batteries by COBAT

5.1.3.2. United Kingdom

Country	United Kingdom
Recycling system	Free market
Recycling rates	estimated greater than 90%
Legal status of the organization	<p>There is no organization.</p> <p>The system already in place achieves collection rates estimated at over 90%. This has been described as “a working but fragmented collection system, which can and does have weaknesses, particularly when the market value of lead is low” as in 1993, when the collection rate fell below an estimated 80%. There was then support from the lead industry to introduce a more formal collection system to ensure high collection rates even when the market price of lead is low.</p> <p>A further difficulty now faced in Britain is that UK Waste Regulations now require documentation and a fee to be paid for battery movement (£10 for 5 or more batteries): some small scrap dealers have stopped collecting batteries. The effect of this on overall recycling rates is not known.</p> <p>Even when the collection rate is over 90%, considered high by most, with an annual consumption of 100,000 t of lead in batteries in the UK, this would mean that up to 10,000 t of lead from this source is unaccounted for per annum.</p> <p>However, rather than being disposed of, most of this shortfall is believed to be stored in private garages etc., and should eventually enter the recycling system. There is clearly room for improvement. An organised collection scheme could improve return rates, though such a scheme would entail administration costs.</p>
Activities	<p>Old batteries are usually returned to garages or suppliers of new batteries, or they are separated from waste at municipal dumps and from there returned to scrap merchants who sell them to lead smelters. It was deemed unnecessary to implement a formal system of battery collection: the only change in law was to require labelling.</p> <p>There are several companies dealing with the collection of used batteries. For example G&P batteries Ltd. operates the UK's largest nation-wide scrap lead acid battery collection service.</p>
Financial data: income - outcome	<p>There is no ecotax or surcharge. There is a tax connected to disposal to the dump. The income totally depends on L.M.E (London Metal Exchange).</p> <p>Economic instruments, such as a levy on batteries produced, could ensure that a reasonable price can be paid for scrap lead, even at times of low lead price on the world market; these would also be expected to improve collection rates. The lead industry would eagerly welcome any such development, because at times of low lead price, secondary production is not profitable (can even operate at a loss) and there can be shortages of batteries available for smelting.</p>
Dissemination activities	No dissemination activities

5.1.3.3 Denmark

Country	Denmark
Recycling system	Consortium
Recycling rates	Approximately 100% (16000 tones/year, 2.98 kg/person/year)
Legal status	All retailers are obliged to accept used accumulators free of charge.
Activities	
Financial data : income - outcome	A fee is imposed on all producers and importers of lead accumulators, and all retailers are obliged to accept used accumulators free of charge. This fee is given as a bonus to collectors who deliver used accumulators. The surcharge is: 0,81 € for batteries <100Ah 1,62 € for batteries >100Ah

5.1.3.4 Austria

Country	Austria
Recycling system	Consortium
Recycling rates	90 - 95% - (21649 tones/year, 2.66 kg/person)
Legal status	There is an obligation on all retailers of batteries and accumulators to take back used batteries returned by the customer.
Activities	Not available
Financial data : income - outcome	There is a voluntary surcharge 2€/battery.

5.1.3.5 Sweden

Country	Sweden
Recycling system	Consortium
Recycling rates	95% (32052 tones/year, 3.6 kg/person)
Legal status	The producer or importer pays a fee, which is used to fund collection, transportation, information and public relations, to keep the recycling rate above 95%.
Activities	Batteries can be returned to retail outlets where they were purchased, to municipality recycling yards or to scrap collectors.
Financial data : income - outcome	There is an ecotax (fee) The ecotax for starter batteries is 3.22 €+ VAT/ pæ battery and for industrial batteries is 0.18 €/ kg

5.1.3.6 Germany

Country	Germany
Recycling system	Commercial system with refundable deposit
Recycling rates	97.5%
Legal status	An obligation is placed on retailers of batteries to accept old ones from consumers, and on battery producers to accept them from retailers. The Batteries Ordinance provides for no common return system by manufacturers in the case of car batteries. Since the old batteries are generally returned in any case when batteries are changed at garages, a high level of return and recycling has already been achieved for these batteries. However, in order to extend this practice to all batteries, the customer must put down a deposit of 7.5 € when buying a new battery, unless they return an old one at the same time. The deposit is returned in exchange for the old battery.
Activities	As has been the practice to date with voluntary return schemes from manufacturers, a disposal company commissioned by the manufacturer or a scrap merchant called by the retailer collects the used starter batteries. The same applies for public collection points (recycling yards or mobile pollution units), from which the batteries are also collected on demand. The collection points are also obligated to accept used car batteries without charge. The ordinance does not obligate them to return any deposit. The lead is recovered from the batteries in secondary lead smelters and generally used for manufacturing new batteries.
Financial data : income - outcome	A deposit of 7.5 € per lead battery is levied on the buyer of a new battery if an old battery is not returned. This is a special regulation for starter-type lead batteries.

5.1.3.7 France

Country	France
Recycling system	Network – free market
Recycling rates	A minimum acceptable recycling rate of 85% has been set, with a commitment to reach 100% as soon as possible
Legal status	Not available
Activities	A network exists which allows the return of lead-acid batteries from the public to smelters. A committee exists to organise publicity and information, to secure commitments from all parties, to calculate recycling yields and to set economic instruments if goals are not reached.
Financial data : income - outcome	Not available

5.1.3.8 Belgium

Country	Belgium (Flemish Region)
Recycling system	Consortium
Recycling rates	55.9 % (2183 tones/year, 0.37 kg/person)
Legal status	Not available
Activities	
Financial data : income - outcome	Eco tax: 0.49 € +VAT for each battery Contribution: 0.12 €+VAT

5.1.3.9 Norway

Country	Norway
Recycling system	Consortium
Recycling rates	95.4 % (14263 tones/year, 3.15 kg/person)
Legal status	Not available
Activities	
Financial data : income - outcome	Import tax based on voluntary scheme Battery Pb: 2.71 € Battery Pb industrial: 0.14 €/kg

5.1.3.10 The Netherlands

Country	The Netherlands
Recycling system	Free market
Recycling rates	99% (44000 tones/year, 2.73 kg/person)
Legal status	There not an organization legally defined
Activities	Collection of end-of-life vehicles is organised and financed by Auto Recycling Netherlands BV, with a fee on every new car. STIBAT, the organization for recycling small batteries in the Netherlands, collects also these batteries. However due to their commercial value, the collection and recycling of these batteries usually take place outside the channels of STIBAT. Lead-containing batteries go to the Belgian company Campine in Beerse.
Financial data : income - outcome	No ecotax or surcharge for batteries

5.1.3.11 USA

Country	USA
Recycling system	Refundable deposit system
Recycling rates	96% for New York, 93% on average
Legal status	<p>Each state has each own system and regulations:</p> <ul style="list-style-type: none"> • 37 States and 1 City with the BCI Model (with and without deposit); • 7 States with a \$5 deposit in lieu of trade-in requirement; and • 2 States with a \$10 deposit in lieu of trade-in requirement. • 5 States with a ban on municipal solid waste disposal (landfills and/or incinerators) <p>In general the disposal of lead/acid batteries in landfills and the incineration of those batteries is prohibited. The statute requires lead/acid batteries to be sent to a permitted secondary lead smelter, a battery manufacturer or a recycling facility. Retailers must accept used batteries from customers and distributors must accept batteries from their retailers. Retailers and Distributors must:</p> <ul style="list-style-type: none"> • Accept, free of charge, up to two used batteries per month from any individual. • Post signs displaying the universal recycling symbol and stating the following: IT IS ILLEGAL TO DISCARD VEHICLE BATTERIES. STATE LAW REQUIRES US TO ACCEPT VEHICLE BATTERIES - FREE OF CHARGE FOR RECYCLING. <p>The responsibility for educational signs varies between states as shown in table 8.</p> <ul style="list-style-type: none"> • Retailers can legally keep unredeemed payments. <p>Finally, several states have adopted separate household or dry cell battery recycling laws that include provisions strictly applicable to small sealed lead-acid batteries. These states are California, Florida, Illinois, Iowa, Maine, Maryland, Minnesota, New Hampshire, New Jersey, New York, Oregon, and Vermont.</p>
Activities	<p>In many states used lead-acid batteries are collected and shipped out of state for recycling. They are sent to secondary smelters or overseas to Asian markets. There the acid is neutralized, the lead reclaimed for use in manufacturing new batteries, and the plastic casing either melted down for reuse or put in a landfill. There have been some reports of environmental problems caused by stockpiling and inadequate handling of used batteries overseas.</p> <p>The battery recycling process separates the lead plates, polypropylene plastic, and sulfuric acid. The lead and the polypropylene are reclaimed for use in new batteries, and the sulfuric acid is neutralized so it can be disposed of safely.</p>

**Financial data :
income - outcome** In several states a refundable deposit system exists. The deposit is paid by any person who purchases a new battery without returning a used battery at the same time. There is a refund deposit period varying between 7 – 30 days depending on the state. During this period the retailer, who sold the battery, will refund the deposit if the consumer return a used battery within the above mentioned period. The deposit is a responsibility of the retailer in all these states. Analytical data for all the states are given in the table 8.

Table 8. Summary of US State lead acid battery laws and organizations (source: Battery Council International)

State/County	Refundable deposit for purchasing a new battery without returning a used battery at the same time (deposit refund period)	Point of sale sign	Non Refundable fee	Comments
Arizona	\$5 (30 days)	Retailer		AZ requires all lead batteries sold to be labeled with a universally accepted recycling symbol. Also requires that State agencies and political subdivisions comply with the battery recycling law.
Arkansas	\$10 (30 days)	State		
California		No		
Connecticut	\$5 (30 days)	Retailer		Retailers in CT must take back batteries one-for-one at the point of sale.
Florida		No	\$1.50	FL requires the collection of a \$1.50 fee per battery at the retail level.
Georgia		Retailer		
Hawaii		State		
Idaho	\$5 (30 days)	Retailer		ID requires all lead batteries sold to be labeled with a universally accepted recycling symbol. In addition, batteries used in motorcycles, off-road recreation vehicles or lawn and garden equipment are exempt from the deposit in lieu of a trade-in requirement.
Illinois		Retailer		
Indiana		Retailer		
Iowa		Retailer		
Kansas City, Missouri		Retailer		Kansas City's ordinance requires that retailers take back up to 3 batteries not at the point of sale, and it requires that junk batteries be stored in "an adequately ventilated enclosure in good repair that protects its contents from any precipitation, etc." Any spilled acid must be immediately collected and neutralized.
Kentucky		Retailer		
Louisiana		Retailer		
Maine	\$10 (7 days)	State	\$1.00	ME requires the collection of a \$1.00 fee per battery at the retail level.
Massachusetts		No		
Michigan		State		
Minnesota	\$5	State		
Mississippi		State		
Missouri		State		
Nebraska				
Nevada		No		
New Hampshire		No		
New Jersey		Retailer		
New Mexico				
New York	\$5 (30 days)	Retailer		
North Carolina		Retailer		
North Dakota		No		
Oklahoma		Retailer		

Table 8. Summary of US State lead acid battery laws and organizations (source: Battery Council International)

State/County	Refundable deposit for purchasing a new battery without returning a used battery at the same time (deposit refund period)	Point of sale sign	Non Refundable fee	Comments
Oregon		Retailer		OR requires that until 12/31/93 retailers must accept at least 1 battery from consumers, after which they must only accept batteries one-for-one at the point of sale.
Pennsylvania		State		
Rhode Island	Unspecified (7 days)	State		RI law specifies that retailers may voluntarily add a core charge (amount unspecified) to the price of a new vehicle battery. The core charge must be refunded if a used battery is returned within 7 days of the date of purchase
South Carolina	\$5 (30 days)	State	\$2	SC requires retailers to collect a \$2.00 fee for lead batteries sold to the ultimate consumer. The retailer may retain three percent of the collected fees to cover administrative costs. Fees collected by the state treasurer are to be deposited into a Solid Waste Management Trust Fund. Small sealed lead-acid batteries are now exempt from the fee and BCI model provisions
South Dakota		No		SD requires wholesalers and retailers to "accept, on a one for one exchange basis, used lead-acid batteries and ensure the proper handling and disposal of the batteries." Further, after July 1, 1995, all lead-acid batteries shall be eliminated from landfilled wastes."
Tennessee		No		
Texas		State	\$2/\$3	TX requires the collection of a \$2.00 and \$3.00 fee for batteries less than 12volts, and, equal to or greater than 12 volts respectively. Exempted from the fee is any battery that is: 1) rated at less than 10 ampere hours; 2) sealed so that no access to the interior of the battery is possible without destroying the battery; and 3) with dimensions (sum of height, width and length) less than 15 inches. The fees are to be collected by any wholesaler or retailer who sells a battery not for resale. To cover administrative costs, the dealer may retain 2-1/2 cents per unit. All remaining money, less four percent to cover state administrative costs, goes to the state comptroller to be placed in a waste remediation fund.
Utah		Retailer Wholesaler		UT requires retailers to take back a maximum of two used lead batteries from customers. In addition to the BCI model law, a 1998 regulation prohibits solid waste disposal of lead acid batteries.
Vermont		Retailer		
Virginia		State		
Washington	\$5 (30 days)	State		
West Virginia		Retailer Wholesaler		
Wisconsin	5\$	State		WI law allows retailers to charge a \$5 deposit in lieu of a trade-in, and to charge \$3 for taking a battery.
Wyoming		State		

5.2 SMALL BATTERY RECYCLING SYSTEMS

The recycling of small batteries (excluding lead acid batteries) started as a result of the significant environmental concerns created during the last decades. The majority of the batteries contain heavy metals (mercury, cadmium, lead) that can cause severe environmental and health effects if they disposed in landfills.

Therefore, the European Union (91/157/EEC) as well as several other countries (Japan, USA) have developed during the last decade a strict legislation concerning the disposal of batteries. This legislation provides mainly the minimization of mercury content in new batteries as well as the elimination of batteries' disposal in landfills taking into account mainly batteries containing heavy metals.

Aiming at the implementation of this legislation several countries have taken initiatives concerning the establishment of recycling systems. Due to the fact that these systems are not as profitable as the recycling systems for lead acid batteries, most of the systems show low recycling rates compare to the recycling rates of lead acid batteries and are based on compulsory fees included in batteries cost. Especially for spent Ni-Cd batteries, the quantities of batteries collected and recycled in several European Countries are shown in the following table (Source CollectNiCad 2000).

Table 9. Quantities of batteries processed for recycling of spent Portable Ni-Cd Batteries: Data of the year 2000

Countries	gr/inhabitant/year	Tonnes/Year Collected	Population
Austria	6,5	53	8,1
Belgium	11,4	115,2	10,1
Denmark	11,2	59,2	5,3
Finland	2,0	10	5,1
France	2,3	135,1	60
Germany	11,6	950	82
Greece	0,1	1	10,6
Italy	0,6	32,5	56,8
Luxembourg	12,5	5	0,4
Portugal	0,1	1	9,9
Ireland	3,1	11,3	3,6
Spain	0,8	29,5	39,1
Sweden	16,9	147	8,7
The Netherlands	13,5	210,3	15,6
UK	1,3	77,8	61,2
Norway	2,2	9,7	4,4
Switzerland	26,9	194	7,2
Total		2041,6	388,1

It must be mentioned that the reprocessing of the Ni-Cd is a difficult and complex procedure and that there are only three available industrial units dealing with this process in Europe. The following table presents these plants.

Table 10. Ni-Cd Batteries Recycling Capacity of Processing Plants Located In Europe

Companies	Recycling Plant in operation from	Location	Capacity in Tonnes / Year
ACCUREC GmbH	1995	Germany	2500
SAFT AB	1978	Sweden	2000
SNAM	1977	France	5500

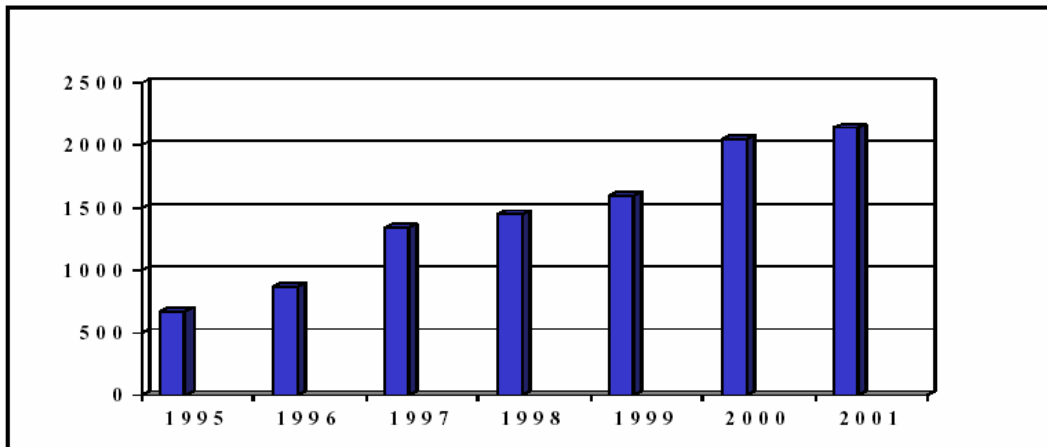



Figure 2. Total amounts of Ni-Cd batteries collected by Accurec GmbH, SAFT AB, SNAM since 1995 (source CollectNiCad)

The most characteristic recycling systems in Europe and other countries are shown below in the next chapters.

5.2.1 Recycling system: Sweden


Country	Sweden
Recycling system	SAFT. Organized formal recycling system for industrial Nickel-Cadmium Batteries
Type of batteries	industrial Nickel-Cadmium Batteries
Recycling rates	More than 96-97% of the industrial Ni-Cds disposed of in Sweden are collected and treated by SAFT. The treatment is performed in SAFT recycling plant at Oskarshamn. Cadmium recovered from industrial as well as sealed Ni-Cds is used for the production of new industrial Ni-Cd cells. The operation is closely integrated into the production of industrial pocket plate batteries, corresponding to approximately 500 tonnes of nickel and 350 tonnes of cadmium. The recycling plant produces approximately one-third of the cadmium needed for production of industrial batteries at the Oskarshamn factory.
National Legislation	Ordinance 1997:645 Valid10.99
Legal status of the organization	Free market
Activities	Batteries are supplied to and received from the whole world. With respect to the Swedish market, 93-95% of the Oskarshamn products is used by customers with known battery collection systems. The remainder, i.e. 5-7%, is supplied to users that return their batteries directly to the Oskarshamn plant or via a scrap dealer. The existing SAFT process for Ni-Cd batteries was developed from 1978. The cadmium process reached industrial scale in 1986. A minor modification had made it possible to also handle sealed Ni-Cds, but with somewhat lower efficiency.
Financial data : income – outcome	Levy: Ni-Cd SEK 300/kg
Dissemination activities	Not available

5.2.2 United Kingdom

Country	UK	
Recycling system		<p>REBAT: Rebat stands for REcycling BAtteries.</p> <p>The collection scheme was created to enable the British Government to satisfy the requirements of directive 91/157.</p>
Type of batteries	<p>The rechargeable battery types that REBAT collects are Nickel Cadmium, Nickel Metal Hydride and Lithium-Ion Batteries</p>	
Recycling rates	Not available	
National Legislation	<p>Statutory Instrument 232, 2/2/94.</p>	
Legal status of the organization	<p>REBAT is an initiative managed by the British Battery Manufacturers Association (BBMA) to encourage collection of nickel cadmium batteries in the UK, as required under European legislation. The support of industry was requested, and the International Cadmium Association (ICdA) acted as secretariat.</p> <p>The main requirements of the UK/EC battery legislation include:</p> <ul style="list-style-type: none"> ▪ Take appropriate steps to ensure that spent NiCd's are collected separately with a view to their recovery or disposal - gradual reduction, in household waste ▪ Ensure that NiCd's and, where appropriate, appliances into which they are incorporated are marked in the appropriate manner. The marking must include indications as to the following points: separate collection; where appropriate, recycling; the heavy-metal content ▪ NiCd's cannot be incorporated into appliances unless they can be readily removed, when spent, by the consumer. 	
Activities	<p>Collection: A number of waste management companies collect NiCd in the UK. Following a competitive tendering process in the UK REBAT selected G&P Batteries as its recommended operator to manage the collection of batteries.</p> <p>G&P Batteries is the largest collector of waste non-lead acid batteries in the UK. The company is fully licensed to handle all types of non lead acid batteries, both rechargeable and single-use. The company is also able to supply collection bins, collect, consolidate and transport batteries to the recyclers.</p> <p>There is a range of individual collection schemes in the UK. When someone in the UK wants to dispose a NiCd battery responsibly, can seek guidance either from the distributor where the battery was purchased, or the battery manufacturer or the appliance manufacturer.</p> <p>Recycling: There are no UK recycling facilities for portable rechargeable batteries. The batteries collected in the UK are shipped to France for recycling by S.N.A.M</p>	

	<p>Loddon holdings Ltd is the handling agent for S.N.A.M. The company is licensed for the transportation of a range of battery types including - Nickel Cadmium (Ni-Cd), Nickel Metalhydride (Ni-Mh), Lithium Ion (Li-Io) and Lead Acid batteries, that S.N.A.M. is specialized for processing. The company holds the following licenses:</p> <ul style="list-style-type: none"> ▪ Special Waste Transfer Station Licence No: EH111/111a. ▪ Special Waste Carriers Licence No: HAM408362.
Financial data : income – outcome	<p>There is a free market base approach established in the UK. REBAT is activated as an administrative authority, setting in fact the rules and the competences of the market. A payment of a nominal sum is required for the membership to the group (REBAT) in order to cover the cost of meetings, administration, etc. The collection / delivery charges are based on the gross weight of the consignment. Charges vary depending on the cost of recovering the metals against the actual quantities recovered.</p>
Dissemination activities	<p>REBAT has advised its collection targets to the UK's Department of Trade & Industry who then communicated these to the European Commission.</p>

5.2.3 Germany

Country	Germany
Recycling system	 <p>GRS – Batterien. Gemeinsames Rücknahmesystem Batterien is a foundation guaranteeing the uniform and nation-wide collection of spent batteries in Germany. It was established in May 1998 by leading battery manufacturers and the German Electrical and Electronic Manufacturers' Association (ZVEI). The foundation is financed by contributions from its users. These manufacturers and importers pay disposal contributions to the foundation for the services rendered, through a Trustee (KPMG Deutsche Treuhandgesellschaft in Bielefeld, Germany) and in accordance with the quantity and type of batteries sold in Germany.</p>
Type of batteries	All batteries except car batteries
Recycling rates	<p>Collection: Since 1998 the quantity of batteries collected increased continuously. In 2001 10,564 tons batteries were collected, an increase of approximately 13% compared with 2000 (9,322 tons batteries). In 2001, an average of 129 g per inhabitant was collected.</p> <p>Recycling: In 2001, the recycling rate was 54 % (% of the collected batteries recycled). In the future with the minimization of mercury content in batteries, it is expected to be between 70 and 80 %.</p>
National Legislation	Battery Decree 27/3/1998
Legal status	<p>GRS Batterien was established under the <i>National Battery Decree</i>. According to this Decree manufacturers and importers are now responsible for the professional disposal of the batteries distributed by them on the German market. As a result of this, Duracell, Panasonic, Philips, Energizer, Saft, Sanyo, Sony, Varta and the German Electrical and Electronic Manufacturers' Association established a foundation – the Common Battery Collection System, GRS Batterien, as a non-profit-organisation.</p> <p>Consumers may no longer dispose their spent batteries with their household waste but must return them. Dealers are required to take back spent batteries regardless of whether these were purchased in their store. The disposal and recycling requirement does not apply to municipalities, therefore they do have to take back batteries. It is under the competence of GRS Batterien to guarantee manufacturers and importers the uniform and national disposal of batteries. Additionally, GRS Batterien handles any documents required by the monitoring authorities.</p>
Activities	The service provided by GRS is equally available to all manufacturers and importers. The users of GRS pay a contribution towards waste disposal costs for the batteries marketed by them in Germany, according to weight and system. The foundation provides distributors and

municipalities as well as commercial and industrial users with appropriate collection and transportation containers free of charge, and organises sorting and disposal in accordance with the German Battery Decree. Until 2001, more than 470 manufacturers and importers of portable batteries have joined GRS. These users put approximately 30,000 tons of portable batteries into circulation in 2001.

There are now approximately 150,000 points of collection/transportation Germany wide, 130,000 of which alone are trade outlets. Numerous commercial users and nearly all public waste disposal services use the GRS.

Regardless of their electrochemical system and hazardous substance content, used batteries may no longer be disposed of in domestic waste. The end-user is the first in the collection chain: he must return used batteries to the trade or the municipalities. Industrial users can hand over their used batteries directly to the collection system. Second in the collection chain are the distributors and municipalities, who have a duty to collect batteries free of charge and regardless of the brand or system.

Manufacturers and importers are, for their part, obliged to provide distributors, industrial users and municipalities with suitable collection boxes and must take back the collected portable batteries free of charge.

The manufacturers sign a contract with GRS in order to become a user of the system.

The user contract states that the volume and the number of batteries distributed by the user have to be reported to the trustee. GRS Batterien receives the volume and weight sold by all the users only in aggregated form.

There is no requirement for a marking system on the batteries or the packaging with the GRS logo. The use of GRS Batterien logo is on the manufacturers will. According to the Battery Decree, only the batteries that contain dangerous substances must be marked.

The collection of the batteries is assigned to mail order companies. GRS Batterien is required to submit annual documentation to the Land authorities on:

1. the batteries distributed,
2. the batteries taken back,
3. the quantitative and qualitative recycling and disposal results as well as the funding costs.


Sorting

After the batteries have been collected, GRS Batterien organises the sorting of the batteries into the various electrochemical fractions and their subsequent disposal. After sorting the batteries are distributed to the authorized recycling facilities for reprocessing. Until now, There is a problem with reprocessing of alkaline / manganese batteries containing mercury.


Financial data : The battery-recycling programme is free of charge for trade, commercial users, public waste disposal centres and income -

outcome	consumers. The costs of the containers, for collection, transport, sorting, recycling or environmentally-compatible disposal of spent batteries are borne by the users of Gemeinsames Rücknahmesystem Batterien. These are battery manufacturers and importers who have entered into a user contract with GRS Batterien. They pay disposal contributions to GRS Batterien for the services stated above, in accordance with the quantity, type and system of batteries sold in Germany.
Dissemination activities	Through communications, projects, TV commercials, information material and other campaigns, GRS frequently call upon users to return even more batteries.

5.2.4 Belgium

Country	Belgium
Recycling system	 Bebat : non-profit Association (Battery Collection Fund)
Type of batteries	All batteries
Recycling rates	Not Available
National Legislation	Royal Order F96-989
Legal status of the organization	<p>Bebat is a non-profit Association (Battery Collection Fund) that was set up in 1995 within the framework of the Belgian Law on "Ecotaxes". The Association aims to collect all kinds of used dry batteries and accumulators for their subsequent recycling. It operates under the aegis of the Federal State and the three Regions, maintaining close and constant links with these bodies, as is demonstrated by the protocol agreement with the Regions.</p> <p>Any company which is liable for ecotax on batteries may become a member of the Bebat system. Today more than 380 companies are making an active contribution towards developing the on-site collection programme.</p>
Activities	The Association collects all kinds of used dry batteries and accumulators for their subsequent recycling.
Financial data : income - outcome	<p>The law of 7.3.96 establishes that if a deposit or return payment system or -in the case of the Bebat Association- if a collection and recycling system for used batteries is set up, the latter are exempt from ecotax (EUR 0,50 + VAT per battery). In this particular case, exemption depends on achieving the collection objectives determined. In the same way, the system must be financed by means of a collection and recycling contribution (CRC) payable by the consumer, amounting to EUR 0,13 + VAT per battery. Similarly, all batteries collected must be processed in a manner which conforms to regional legislation and the protocol agreement dated 17.6.97.</p> <p>Non-compliance with such legal requirements may give rise to various sanctions, leading to stoppage of the voluntary collection system in question.</p>
Dissemination activities	Not available

5.2.5 The Netherlands

Country	The Netherlands	
Recycling system		<p><i>Stichting Batterijen (STIBAT)</i> was formed to enable Dutch battery manufacturers and importers to fulfil their legal obligation to collect and recycle spent batteries.</p>
Recycling rates	<p>The collection rate for 2001 is up to 70%. This rate seems to be stabilized in this level during the last years.</p>	
Type of batteries	<p>Small batteries (responsible for collecting and recycling batteries that weigh up to one kilogram)</p>	
National Legislation	<p>Battery Decree 1993/1995</p>	
Legal status of the organization	<p>Stibat executes a joint collection and processing plan on behalf of battery manufacturers and importers. When companies join the Stibat Plan, they comply thereby with the Batteries Disposal Decree of January 31, 1995, which holds them responsible for recovering batteries they market once they are spent. After the first Stibat Plan (1995-1998), the Stibat Implementation Plan II (1998-2003) was approved by the minister of Housing, Spatial Planning and the Environment in 1999. The approval of that plan stipulates that 90% of all spent batteries must be collected separately in 2003.</p> <p>A new method for estimating the collection rate has also been approved. This method was developed co-operatively by Stibat, the National Institute for Public Health and the Environment (RIVM) and the Ministry of Housing, Spatial Planning and the Environment.</p>	
Activities	<p>Collection. The collection is performed by municipalities, schools, and outside of the city limits. More specifically, Dutch municipalities are responsible for separate collection of small chemical waste (scw), including batteries. There are several different collection systems in place, according to reports from the municipalities. In some towns, inhabitants can use a "green box", others have a "chemocar", and in others, the inhabitants bring their batteries to the municipal scw depot. Stibat also provides extra collection sites within town limits, to supplement municipal scw systems.</p> <p>Retail is also a significant supplementary collection channel for spent batteries in the Netherlands. At many supermarkets, photo shops, toy stores, department stores, telephone and electronics stores, do-it-yourself stores and household appliance stores, customers can drop off their spent batteries. Also, many elementary schools collect batteries. Even recreation facilities, such as campgrounds and bungalow parks, are becoming more and more environmentally conscious and are offering their guests places where they can drop off spent batteries. The batteries are picked up by Stibat approved contractors. These collectors pick up spent batteries from all Dutch municipalities, and store them temporarily in their depots. They conduct a preliminary inspection, pack the batteries in special plastic bins, and bring them to the central national depot which is also Stibat's sorting station.</p> <p>Sorting. All batteries that are collected by the municipalities are brought to Stibat's national depot, where the total Dutch battery intake</p>	

weight is measured and recorded, and the batteries are pre-sorted based on their type and size to facilitate further processing. Sorting divides the batteries into several streams, the largest of which (about 60% of all batteries collected) is cylindrical consumer batteries (AAA's, AA's, C's and D's). These cylindrical batteries are further sorted by chemical type, such as: alkaline batteries, alkaline UV (lead-free), zinc carbon batteries, nickel cadmium /nickel metal hydride batteries, and mercury oxide batteries. These separate, pure battery streams meet the acceptance criteria of the specialized processors. The remaining battery streams are car batteries, electric fence batteries, batteries with soldered connections, rechargeable packs, batteries from Polaroid-type cameras, button cells in blister packs, battery-containing objects, and batteries that are contaminated. All these batteries are sorted visually according to their chemical composition so they can be transferred to specialized (mainly foreign) processing facilities where they are recycled.

Transportation to processing facilities. All the batteries that were sorted at the sorting station are eventually shipped to specialized processing facilities in Western Europe, which recover the metals from the batteries.

Recovering raw materials. All the collected spent batteries are recycled at a number of different processing plants in Western Europe. For example, zinc carbon batteries are processed by Nedstaal in the Netherlands. Lead-containing batteries go to the Belgian company Campine in Beerse. The nickel metal hydride, nickel cadmium and lithium ion batteries (which are all rechargeable batteries), are processed at the French company SNAM in Lyon. Button cells are processed by the Swiss company Batrec. The following metals are recovered through recycling: zinc, steel, nickel, cadmium, lead and manganese. The remaining slag is used in asphalt road construction.

Financial data: income - outcome


Income. Stibat's income originates from the disposal fees paid by each participant. The fee is a set amount for each battery type. Strict monitoring is used to ensure that the fees are sufficient, and that a balance between costs and income is achieved.

Expenses. The expenses Stibat incurs in efficient implementation of the Stibat Plan consist mainly of transport, sorting, and processing costs. Another source of expense is the public awareness campaigns that aim to increase the collection rate.

Dissemination activities


"Empty batteries? Bring them in!" is the motto for the national campaign that Stibat conducts year-round. The goal of the campaign is to continually motivate the public to drop off their spent batteries, both because this reminder is needed, and in order to inform people about where they can bring-in their batteries. Television and radio commercials have been run, text advertisements have been placed in many newspapers, magazines and newsletters, and posters have been hung in tram and bus stops, subway and train stations. Additionally Stibat develops a variety of community programs, such as recreation, school, retail and public awareness programs.

5.2.6 Luxembourg

Country	Luxembourg
Recycling system	 <p>The collection and recycling battery industry in Luxembourg is held by SuperDrecksKëscht.</p>
Recycling rates	<p>In 2002, SuperDrecksKëscht collected 70,7 tonnes of batteries from private households, plus 22,8 tonnes of batteries from commercial sources in Luxembourg. Additionally the enterprise Lamesch collected another 20 tonnes. So a total of 113,5 tonnes are collected in Luxembourg in 2002. This is about 258 gr per head and year (Lux population is 440.000). Since the exact import and export rates are not available, it's difficult to estimate the collecting quota, but it is estimated to be between 70 to 80 %.</p> <p>The recycling ratio (recycling/collection) reaches a total of 94%.</p>
Type of batteries	All
National Legislation	Regulations of 23/5/95
Legal status of the organization	<p>The SuperDrecksKëscht is a so called project of the Luxembourg state (ministry for environment) and the communities (Luxembourg has 118 communities). In charge of the SuperDrecksKëscht is a private firm, but the firm exclusively is run under the guidelines of the Ministry of Environment.</p>
Activities	<p>Collection. The project SuperDrecksKëscht fir Biirger is collecting all toxic and problematic waste from private households. This structure is entirely financed by the state. The organization is collecting problematic waste under three separate collecting systems:</p> <ol style="list-style-type: none"> 1. Mobile containers - they are placed up to 3 times a year in central places all over Luxembourg. 2. Recycling centres of communities or associations of communities (in 12 recycling centres in Luxembourg problematic waste is collected), 3. House-to-house-collection. <p>In addition to these systems SuperDrecksKëscht cooperates intensively with commercial enterprises: in supermarkets, big electronic shops, markets for home-workers etc. a special collection box is used. Partially, the supermarket chains transport the batteries to their central storage centre, from where SuperDrecksKëscht then take the batteries back. These boxes are placed also in schools or administrations where many people pass by.</p> <p>Recycling. All the dry batteries are collected. Then the dry batteries are sorted and Ni-Cad (around 2 %) and Ni-MH accumulators as well as the button cells containing quicksilver</p>

	<p>and lithium batteries are separated. These products are shipped by authorized companies for recycling. In these companies, the heavy metals quicksilver and cadmium are retrieved with a high purity level and then re-used for the production of new products. Nickel and iron metals are used in the iron industry. The remaining dry batteries (zinc carbon and alkali manganese batteries) are shredded and the iron from the coating as well as paper and the plastic materials are separated. The remaining shredded components are dissolved in an acid mixture; the mud containing quicksilver is separated and shipped on to a specialized company for refining. The metals (zinc, copper, manganese) react with the acid mixture and form sulphate salts which are used in the manure industry. The non-solvent carbons as well as paper and plastic materials undergo heat treatment</p>
Financial data : income - outcome	<p>Fee included in Municipal Waste Mgt. This system is at the moment entirely financed by the Luxembourg state, the battery industry and the market doesn't pay anything. Their only contribution is the cooperation and partially transports to a central place.</p>
Dissemination activities	<p>The dissemination campaign includes among other the distribution of brochures and leaflets containing information on the recycling programme and recommendations.</p>

5.2.7 Switzerland

Country	Switzerland
Recycling system	 <p>INOBAT is a private organization that is responsible for the collection and recycling of batteries since 2001, under the ordinance of the Federal Authorities.</p> <p>History. In 1992 an advanced disposal charge (VEG) was introduced in Switzerland to finance battery recycling. This solution was initiated at the time by the importers, manufacturers and the trade unions. These bodies joined forces in the BESO (Battery Disposal Self-Help Organization) cooperative. BESO (1992 to 2001) was based on a voluntary participation of the involved actors.</p> <p>Since April 2001, a compulsory system has been in place and the specific implementation of the text of the ordinance is in the responsibility of INOBAT which is a private organization, successoring body to BESO.</p>
Types of batteries	All types of batteries
Recycling rates	Until 2002 the collection rate for the system was over 60%.
National Legislation	Bat Ordi 1998
Legal status of the organization	<p>Since 2001 in Switzerland there has been established a compulsory battery collection and recycling system, INOBAT which is a private organization.</p> <p>With the new legislation (ordinance), the responsibility of Federal authorities concerning the recycling of batteries has been shifted to the private organization, that is responsible for the implementation of the recycling system. The Federal authorities are entitled to give instructions to INOBAT. Compulsory VEG is based on the ordinance that stipulates that the State is not itself responsible for implementation but that a suitable private organization handles this task. Because this is a Federal mission on a substantial scale, the award of the tender was based on the provisions of the public procurement system. INOBAT was chosen as the successful bidder. The basis for the cooperation is a comprehensive contract between the environmental authority and INOBAT, which has been concluded for a five-year period. In relation to the parties who are required to pay the VEG, INOBAT has a right of disposition, which enables it to implement the task for which it has taken over responsibility from the Federal authorities even if the parties concerned refuse.</p> <p>The wish to make membership of INOBAT compulsory with a continuing basis in the law on cooperatives, proved impossible to implement for legal reasons. However, an overwhelming number of VEG payers do in fact belong to INOBAT because the idea still prevails that the branch must look after its own interests.</p>
Activities	<p>Collection. INOBAT is responsible for the battery collection. Weight is the basis for collection. INOBAT pays for recycling and transport according to weight in both cases.</p>

A little "battery bag" is supplied to facilitate collection in the household. The bag has a printed logo, which the consumer will encounter again at the collection centre where collection boxes are set up and the battery bag can be emptied. Finally, the free collection service from the collection centre rounds off the collection process which is designed to be as convenient as possible. The ordinance requires consumers to return used batteries to a collection centre. By law, collection centres are all the points of sale at which batteries are offered for sale, i.e. some 10,000 different outlets. There is accordingly an obligation to take these batteries back and also an obligation to return them. Further collection centres have been set up in various local authorities and increasingly also in companies. Via the free collection service, and sometimes also through transport boxes sent by mail – these boxes are available from INOBAT – the used batteries reach the processing works where raw materials for other products are in turn produced.

Transportation to processing facilities

INOBAT concludes agreements with an identical wording under which transporters undertake to pick up batteries free of charge on request from the collection centres. In return for this service, the partners to the agreement receive a uniform sum for every tonne of batteries delivered by them to **Batrec**. However, the proportion of this sum which goes to a sub-contractor or supplier is a matter for the company which has concluded the agreement with INOBAT. Clearly, INOBAT pays only for the batteries which are delivered by the partner working under an agreement to the processing company.

In practice the carriers make big collection containers available to the collection centres so as to avoid as far as possible the carriage of small quantities. The service provided by the transporters to the collector is an integral part of the competition among our partners who are tied by agreements.

Battery Reprocessing. Exports of used batteries are allowed only in exceptional cases. Only one factory in Switzerland is able to recycle batteries, **Batrec Industrie AG of Wimmis**. This plant therefore effectively enjoys a monopoly position.

Financial data : income - outcome	VEG is determined by ordinance, although INOBAT is consulted beforehand. The present price is CHF 4.80 per kg (against CHF 3.20 in the days of the voluntary solution). The processing price has been fixed by the environmental authority at CHF 5,40 per kg.
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Dissemination activities	The VEG finances information campaigns. A campaign of that kind is in progress at present (4 RD Q 2002). TV and cinema spots, posters and information brochures are designed to enhance the motivation of consumers (generally households) to deliver batteries to a collection centre. The campaign message is that the return of batteries must be self-evident.
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5.2.8 Denmark

Country	Denmark
Recycling system	Denmark operates from 1992, a collection program dedicated to Ni-Cd batteries. The initial program was run on a Voluntary basis by Industry. Afterwards, the program responsibility was transferred to the Danish Environmental Protection Agency (DEPA) in 1996. The consumer has to support this charge which is discriminatory vis à vis of other batteries systems. A fraction of the fee collected is used to refund collectors but there is not incentive given to the end-user for taking back batteries. Concerning the Region of North Denmark (Jutland), the collection of all types of batteries is organised by an association of communities managing both the private household and industrial waste of this region populated by 160'000 inhabitants (70'000 households).
Recycling rates	Not available
National Legislation	Order 13/12/93 –BEK 1061 (Pb)
Legal status of the organization	Not available
Activities	Not available
Financial data : income - outcome	<p>Levy Ni-Cd: DKK6/cell; DKK36/pack</p> <p>Initially (between 1992 and 1995), the recycling fee was fixed at an average value of 2.0 €/kg when the program was operated by Industry. It was raised to 16.0 € / kg by Danish EPA and has to be paid by importers of batteries or appliances equipped with Ni-Cd batteries.</p> <p>Especially in the region of North Denmark, the collection cost supplied by the operator for dedicated collection of spent portable batteries (among which portable Ni-Cd) is of 1.7 €/kg. which is ten times less costly than the fee fixed by the Danish EPA.</p>
Dissemination activities	Not available

5.2.9 Finland

Country	Finland
Recycling system	Free market: An official recycling system has not been established yet according to the Association of Finish Technical Traders
Recycling rates	Not available
National Legislation	Govt Decision 105/95
Legal status of the organization	
Activities	
Financial data : income - outcome	
Dissemination activities	

5.2.10 Norway

Country	Norway
Recycling system	 REBATT System. The system is operated by BATTERIRETUR. Norway's program addresses the collection of nickel-cadmium and mercuric oxide batteries.
Recycling rates	Between 1998 and 2000, the collected quantities have reached between 9.0 and 12.0 Tonnes for Portable Ni-Cd batteries.
National Legislation	Reg. 17/07/90 and 13/09/94
Legal status of the organization	Not available
Activities	Not available
Financial data : income - outcome	The collection of Ni-Cd batteries is dedicated and operated on the basis of approximately 1.0 €/kg.
Dissemination activities	Not available

5.2.11 France

Country	France
Recycling system	The responsible organization for the management of the battery recycling National program in France is SCRELEC - Société de Collecte et de Recyclage des Equipments Electriques et Electroniques . In a parallel network with SCRELEC, several large retail chains have also set up their own independent collection schemes in collaboration with French recycling companies to meet their obligations under French law. Supplementary, for Ni-Cd batteries, the association ECO-VOLT has been active for many years on an independent basis established by major Cordless Power Tools OEMs.
Recycling rates	
National Legislation	Decree 99-374
Legal status of the organization	The legal obligation to collect separately all batteries for recycling came into effect from the beginning of 2001. since then it was established SCRELEC, the managing organization of the National Program on battery recycling.
Activities	The SCRELEC collection program is based on the distribution of Collection boxes of various types to the various collection points including: stores, business or industrial sites and municipal waste facilities and forward them to a sorting facility.
Financial data : income - outcome	A fee of approximately 0.8 €/kg of primary batteries is perceived from the producers and importers (VAT not included). The fee is perceived at sales time when the battery is sold to the end user. For the rechargeable batteries a fee of 1.7 € / kg is perceived to cover the collection and recycling costs (VAT not included).
Dissemination activities	Not available


5.2.12 Austria

Country	Austria
Recycling system	UFB -Umweltforum Batterien. This is an organization established by the manufacturers and the importers.
Recycling rates	There were collected over 80 tonnes of Ni-Cd batteries during 2001.
National Legislation	Ordinance 514/1990
Legal status of the organization	Austrian law requires retailers and wholesalers to take back used batteries from consumers free of charge. Municipalities are also obliged to accept used batteries from private citizens. Battery manufacturers and importers have established UFB in order to administer the scheme for collection which operates under the coverage of Austrian Ordinances 514 (1990) and 495 (1999).
Activities	It can handle, sorting and disposal or recycling of batteries.
Financial data : income - outcome	Levy Ni-Cd: DKK6/cell; DKK36/pack. The basic fee is ranging between 0.2 to 10. ATS / cell or 6.25 to 40 ATS / kg with an average of 2.0 €/kg.
Dissemination activities	Not available


5.2.13 Taiwan

Country	Taiwan
Recycling system	ROC. The Recycling Management Foundation of the Environmental Protection Administration, Taiwan.
Recycling rates	The volume collected in 2001 is 586 tons for dry batteries of various types, and 36,316 tons for lead acid batteries. Despite the legislation, the collection rate achieved is low for dry batteries. This can be attributed to the relatively small size of dry batteries, which are often disposed together with general garbage.
National Legislation	Not available
Legal status of the organization	<p>The Waste Disposal Act was introduced in 1988 in Taiwan and it was implemented the first Extended Producer Responsibility (EPR) legislation to collect and recycle various municipal wastes. In 1990, mercury-containing batteries and lead acid batteries were listed as products subject to the EPR scheme. Manufacturers, importers and sellers of listed products were required to achieve the collection and recycling rates set by the Environmental Protection Administration (EPA).</p> <p>In March 1997, the new amendments to the Waste Disposal Act changed the EPR scheme to require the responsible manufacturers or importers to pay recycling fees instead of fulfilling the mandatory collection and recycling targets. Labelling requirement is applied to batteries containing mercury or cadmium. The retailers, on the other hand, are obliged to take back the used dry batteries from consumers. In 1998, Ni-Cd batteries for general consumer uses are added to the EPR product list. From November 1999, the EPR regime was expanded to cover all kinds of dry battery types.</p>
Activities	<p>ROC is responsible for the collection and recycling of batteries among other waste streams in Taiwan.</p> <p>According to the law the retailers are obliged to take back the used dry batteries from consumers.</p> <p>Dry battery collectors take a subsidy for the collection of batteries.</p>
Financial data : income - outcome	There is a subsidy rate given to dry battery collectors.
Dissemination activities	EPA initiated a nation-wide school education program in late 2001, in order to raise public awareness of dry battery recycling.

5.2.14 Japan

Country	Japan	
Recycling system		<p>The Battery Association of Japan BAJ promotes the collection of used batteries for recycling as well recycling efforts, based on "Laws Concerning the Use of Recycled Materials" and "Laws Concerning Waste Material Processing." It also undertakes advertising activities for the promotion of Lead -acid and Ni-Cd battery collection and recycling. The Association also promotes recycling technology for used primary dry batteries. Internationally, the Association participates in the Tripartite Working Group (TWG), related conferences in Europe and America, the OECD working group and other groups in order to exchange information and promote international cooperation and unity`.</p> <p>BAJ has established a nation-wide collection program. At the present time, there are four recyclers in Japan. Total capacity for recycling is about 7,000 tonnes. Because the recycling capacity is adequate, it is most important to develop a system to collect Ni-Cd batteries.</p>
Recycling rates	Not available for the last 5 years, only 1992-1996	
National Legislation	Not available	
Legal status of the organization	<p>In June 1993, sealed Ni-Cd batteries and products powered by these batteries were designated by the "Law for Promotion of Utilization of Recyclable Resources". The Ni-Cd battery was specified as a "second category product" the same as PET bottles and steel or aluminium cans.</p> <p>Products powered by Ni-Cd batteries were specified as "first category products". This category includes 16 products such as power tools, cordless telephones, shavers, vacuum cleaners, etc.</p> <p>In compliance with the relevant laws, the Battery Association of Japan (formerly JSBA, BAJ hereafter), consisting of 26 members, has actively started to promote the collection and recycling of used Ni-Cd batteries</p>	
Activities	Not available	
Financial data : income - outcome	<p>BAJ members bear the expenses according to their share in Ni-Cd batteries production. BAJ is still considering how the cost of collecting other portable rechargeable batteries such as Ni-MH, Li-ion and sealed small lead-acid batteries will be borne. (1999)</p>	
Dissemination activities	<p>BAJ established a PR/education committee for Ni-Cd batteries collection. The committee has developed plans based on the Ni-Cd batteries collection program.</p>	

5.2.15 USA

Country	USA
Recycling system	 <p>The recycling programme is being implemented by the <i>Rechargeable Battery Recycling Corporation – RBRC</i>. It is a non-profit organisation whose mission is to promote and implement the separate collection of Ni-Cd batteries, removing these heavy-metal products from the municipal waste stream.</p>
Recycling rates	Not available
National Legislation	Not available. Varies from state to state
Legal status of the organization	<p>Before the establishment of RBRC, rechargeable batteries and rechargeable consumer products were regulated under a complex system of state, federal and international laws. These laws were designed to promote safety and the environmentally sound recycling or proper disposal of rechargeable batteries and battery-powered products.</p> <p>The enactment of the Mercury-Containing and Rechargeable Battery Management Act, most commonly referred to as the Battery Recycling Act, initiates a new federal approach to the recycling of a ubiquitous consumer product - Ni-Cd batteries. The act does not impose a collection obligation on industry or establish rates and dates that must be met. Instead, it facilitates a largely private-sector collection programme, supported by a substantial industry-funded public awareness campaign to encourage consumers to recycle.</p> <p>The programme contains several key elements which are specified in the US EPA regulation, various United States state laws governing Ni-Cd battery recycling, and the Mercury-Containing and Rechargeable Battery Management Act.</p> <p>These include the following provisions:</p> <ul style="list-style-type: none"> ▪ uniform battery labelling requirements; ▪ removability of batteries from products; ▪ national network of collection systems; ▪ regulatory relief to facilitate Ni-Cd battery collection for recycling; ▪ widespread publicity to encourage public participation; ▪ development of a funding mechanism for the programme. <p>The Charge Up to Recycle! programme offers various Ni-Cd battery recycling plans for retailers, communities, businesses and public agencies. These include the Retail Recycling Plan (20,000 plus participants), the Community Recycling Plan (300 enlisted), and the Business and Public Agency Recycling Plan (1000 enrolled). These activities ensure that the maximum return of the small consumer Ni-Cd batteries will be accomplished.</p>
Activities	<p>The plans under the programme are briefly described below:</p> <ul style="list-style-type: none"> • Retail Recycling Plan: In conjunction with the United Parcel Service (UPS), RBRC has developed a recycling plan for retailers who sell Ni-Cd batteries and battery-powered products. Participation is free of charge. RBRC provides containers for

retailers to collect and ship used Ni-Cd batteries, as well as pre-addressed, pre-paid shipping labels for the containers, shipping instructions, safety instructions, point-of-sale notices, and information about the programme. RBRC pays the cost of recycling the batteries; all the retailer must do is sign up.

- **Community Recycling Plan:** RBRC provides counties and municipalities with information on how to set up and operate a household battery collection programme. RBRC pays the cost of shipping the Ni-Cd batteries under the terms of the programme and the cost of recycling them. Counties will be asked to consolidate batteries at one consolidation point and ensure that they are properly segregated.

- **Business & Public Agency Recycling Plan:** RBRC provides business and government agencies with information on how to set up and operate a battery collection programme. It offers a streamlined and blanket rate for Ni-Cd batteries shipped to its recycling facility under the terms of the programme. Shippers pay only transportation costs. RBRC pays the recycling costs.

The Ni-Cd batteries collected under the **Charge Up to Recycle!** programme are recycled at the International Metals Reclamation Company (INMETCO) in western Pennsylvania. A subsidiary of INCO, one of the world's largest mining and metals companies, INMETCO is a leading recycling facility of metal-bearing wastes in North America.

INMETCO uses a state-of-the-art, high-temperature metal recovery process to recover the nickel, iron and cadmium content of the batteries. The process is recognised by the US EPA to be the "best demonstrated available technology" for recycling Ni-Cd batteries.

Financial data : income - outcome

The rechargeable power industry funds the Charge Up to Recycle! programme through the licensing of RBRC's battery recycling seal. License fees paid by rechargeable battery and battery-powered product manufacturers allow them to place the seal on their rechargeable products. Presently, the most world-renowned companies in the industry have entered into a License Agreement with RBRC, committing themselves to display the RBRC seal on the Ni-Cd batteries and packaging they market in the United States. Consumers can support these pro-environment companies by shopping for RBRC's battery recycling seal.

The display of the RBRC seal clearly distinguishes those manufacturers which are participating in the programme and those which are not. For batteries exported from the United States, rebates will be issued. The programme also provides an incentive for Ni-Cd battery users (licensees) to utilise their own distribution infrastructure to collect batteries and recycle them in a manner similar to that of commercial/institutional generators. Licensees can receive a rebate of up to 75% of their original licensing fee, based on the weight of batteries collected for recycling.

Dissemination activities

RBRC is conducting public education programmes to inform consumers, retailers and manufacturers about battery recycling efforts under the **Charge Up to Recycle!** program.

The cornerstone of the public education campaign is RBRC's

information system, which includes an interactive web site (www.rbrc.org), a fax-back system, and a toll-free helpline, 1-800-8-BATTERY. The web site and helpline refer consumers to the Ni-Cd collection point nearest them and provide additional information on RBRC activities. For example, callers with household batteries will be asked to enter their zip code or surrounding zip code areas. The system will then refer the caller to an RBRC designated battery collection site, such as a municipal household hazardous waste programme or retail store.

Retailers or public agencies interested in joining the programme can utilise the web site or the fax-back system to obtain information on specific RBRC activities. To access the fax-back system, they call from the handset of their fax machine and choose from a menu of information. Retailers, for example, can register to participate in the Retail Recycling Plan or request additional collection containers. Businesses or municipalities can also have pertinent information sent via fax, including applicable regulations, pilot programme approvals in their state, and RBRC's insurance policies. The programme provides for the establishment of various recycling plans for collecting used Ni-Cd batteries from many sources, including consumers, retailers, distributors, generators, county recycling facilities, county household hazardous waste collection sites, consolidation points and manufacturer-designated battery collection facilities.

Furthermore, to get the word out about the Charge Up to Recycle! program, RBRC is conducting a public education campaign which includes the promotion of Charge Up to Recycle! This promotion is performed through a variety of media events:

- TV's *Home Improvement*.
- Three filmed Public Service Announcements (PSAs), recruitment messages for RBRC target audiences
- Educational video for RBRC's school curriculum plan.
- National media such as *Entertainment Tonight* and *Live with Regis & Kathie Lee* are also promoting the programme.
- RBRC ran two full-page advertisements in *USA Today* to educate consumers about Ni-Cd battery recycling and to recognise the RBRC Licensee companies for supporting the environment through their funding of the Charge Up to Recycle! program.
- RBRC marketing activities include the distribution of RBRC's *Charge Up to Recycle!* quarterly newsletter. The newsletter proves a useful vehicle to disseminate information to participants in the programme. With features including Spotlight on a Licensee, Message from the President, the Latest from Canada and a Public Relations Update, newsletter recipients are kept-to-date with RBRC news.

RBRC's Charge Up to Recycle! PSAs was distributed in May through October 1996. RBRC distributed a holiday PSA encouraging consumers to Shop for the Seal during the holidays, which was broadcast nearly 2000 times in a one-month period.

6. REFERENCES

6.1 INTERNET LINKS:

INTERNATIONAL BATTERY ASSOCIATIONS

Rechargeable Battery Recycling Company

www.rbrc.org

Portable Rechargeable Battery Association

www.prba.org

National Electrical Manufacturers Association

www.nema.org

Battery Association of Japan

www.baj.or.jp/e/index.html

Battery Council International

www.batterycouncil.org

EUROBAT. Association of European Storage Battery Manufacturers

www.eurobat.org

CollectNiCad

www.collectnicad.org

Independent Battery Manufacturers Association (IBMA)

www.thebatteryman.com

China Industrial association of Power Sources

www.chinabatteryonline.com

Electricity Storage Association

<http://www.energystorage.org/>

International Lead and Zinc Study Group

<http://www.ilzsg.org/>

NATIONAL BATTERY ASSOCIATIONS

Belgium

<http://www.bebat.be/>

Germany

<http://www.umweltbundesamt.de/>

Austria

<http://www.batteriensammeln.at/>

Sweden

<http://www.batteriforeningen.a.se/>

Denmark:

<http://www.batteri.dk/>

Norway

<http://www.batteriretur.com/>

United Kingdom

<http://www.bbma.co.uk/>

Luxemburg

<http://www.superdreckskescht.lu>

The Netherlands

<http://www.stibat.nl/>

Switzerland

<http://www.inobat.ch/>

France

<http://www.screlec.fr/>

Italy

www.cobat.it

Japan

<http://www.baj.or.jp/e/index.html>

Taiwan

http://recycle.epa.gov.tw/index_eng/index.htm

USA

www.rbrc.org

OTHER NATIONAL INTERNET LINKS**Greece:**

<http://www.germanos.gr/>

<http://www.nikon.gr/html/varta.html>

<http://www.interland.gr/zembatteries/index2.htm>

http://www.cc.ece.ntua.gr/~achan/Kataskeues/UnDead_Batteries.htm

<http://www.recycling.gr/>

<http://www.dissios.gr/>

United Kingdom:

<http://www.g-pbatt.co.uk/>

<http://www.bristol-city.gov.uk/>

<http://www.loddonholdings.co.uk/>

<http://www.wasteonline.org.uk/resources/InformationSheets/HouseholderRecyclingInformationSheet.htm>

<http://www.reuze.co.uk/batteries.shtml>

<http://www.worktwice.co.uk/rabbitt/>

<http://www.wastewatch.org.uk/>

<http://www.rebat.com/>

Norway:

<http://www.rebatt.no/>

Denmark:

<http://www.returbat.dk/>

Germany:

<http://www.de.bosch.com>

The Netherlands:

<http://www.nhhwf.org.uk/case-studies.htm>

France:

<http://www.ecovolt.fr/>

USA:

EPA: <http://www.epa.gov/epaoswer/non-hw/reduce/epr/products/bresources.html>

NYC: <http://www.batteryparkcity.org/>

Stanford Un.: http://www.stanford.edu/dept/EHS/prod/enviro/battery_recycling.html

BATTERY REPROCESSING COMPANIES

SAFT:

<http://www.saftbatteries.com/>

SNAM:

<http://www.snam.com/>

GENERAL INTEREST WEBSITES:

<http://www.recycle.net/battery/>

<http://www.batteryrecycling.com//>

<http://www.nesllc.com/batteryrecycling.htm>

<http://www.ibpstl.com/brcomm.htm>

<http://www.eurobatteries.com/>

<http://www.ibpstl.com/>

<http://www.informinc.org/>

<http://www.deq.state.la.us/assistance/recycling/home/battery.htm>

<http://www.ehso.com/battery.php>

<http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml>

6.2 PERSONAL CONTACTS

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