Policy Brief for the EP Environment Committee
IP/A/ENVI/FWC/2005-35

Ban on Leaded Batteries:

Analysis of an Amendment to Article 4 in the Council Common Position For Adopting A Directive On Batteries And Accumulators And Waste Batteries And Accumulators And Repealing 91157/EEC

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1 EXECUTIVE SUMMARY

The Commission published a proposal to repeal the existing Directive on batteries and accumulators and waste batteries and accumulators (91/157) in November 2003[1]. The proposal has been through the first reading of European Parliament and Council, and the European Parliament Committee on the Environment, Public Health and Consumer Policy is scheduled to have its second reading in November 2005. In the latest report by Rapporteur Hans Blokland[2], parts of amendments to Article 4 from the first EP reading are re-introduced, such that *portable* batteries or accumulators, including those incorporated into appliances, that contain more than 40ppm[3] lead would be banned.

This study was commissioned to provide additional information to the Environment Committee to assist with the decision on whether to support a ban on portable batteries with a lead content over 40ppm. It includes data on the portable battery market, the lead content of the different types of battery, the types of batteries that would be affected by a ban, the availability of substitutes and whether there are grounds for exemptions. The main findings are summarised below.

1. The portable battery market represents around 15% of the overall EU battery market. Rechargeable batteries, comprising of different technologies, represent 14.3% of the total portable market; while the remainder of the market consists of alkaline batteries (54.3%), zinc carbon batteries (28.6%) and button cells (0.2%).
2. The amount of lead used by portable batteries is relatively small in comparison to other uses (eg automotive batteries).
3. The use of lead varies between battery types and ranges from below 40ppm (eg some alkaline technologies, lithium manganese and nickel oxyhydroxide) to 700,000ppm (lead-acid).
4. Battery technologies are often bespoke to an application, which means that it is not possible to present a *de facto* list of exactly what applications would be affected by a ban and those which would not.
5. Based on this analysis, the types of batteries that would be covered by a ban, their typical applications, and the availability of substitutes are provided in Table 1.
6. Alkaline manganese batteries (<40ppm types) and nickel oxyhydroxide batteries provide an alternative to zinc carbon batteries for a large number of uses. Lead free zinc carbon batteries will also soon be available on the market. Therefore there are alternatives to using traditional zinc carbon technologies.
7. Alkaline manganese batteries are around 3 times more expensive than zinc carbon, but have a longer lifetime. Though the consumer would not have 'cheap' options, the alkaline manganese battery represents better value, and has other resource advantages.

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[1] Proposal for a Directive of the European Parliament and of the Council on Batteries and Accumulators and Spent batteries and Accumulators, COM(2003)723, 21.11.2003

[2] Draft Recommendation for Second Reading on the Council common position for adopting a directive of the European Parliament and of the Council on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC (5694/5/2005 – C6-0268/2005 – 2003/0282 (COD); Committee on the Environment, Public Health and Food Safety, Hans Blokland.

[3] Note that in the amendment this referred to as 0.004%. As lead is expressed as ppm in the data received from producers, percentages have been converted to ppm throughout the report.

8. Substitutes for other lead-containing battery technologies are in development, but are not expected to be on the market in the short term. There are some selected exceptions to this, for example lithium ion button cells can be used in some applications.
9. If all batteries >40ppm lead were banned, there would be impacts on a number of sectors and users, based on the items listed in Table 1. This includes battery producers, consumers, product manufacturers, users of hearing aids, and those benefiting from the use of medical equipment. There could be a disproportionate impact on the EU-10 and lower income users if cheaper zinc carbon batteries are not available.
10. Based on the evidence available, exemptions would be justified for those battery technologies where no alternatives are expected to be available on the market in the short-term future (2-5yrs):
    - Zinc air, silver oxide, alkaline manganese and multi button cell technologies, given that it is not clear whether there are suitable alternatives available or near to the market. Button cells have many key specific functions, not least the use in hearing aids. They also represent a very small percentage of the portable battery market (0.2%).
    - Selected alkaline manganese batteries and alkaline manganese special applications multicells, given that their use is preferable to the zinc carbon alternatives (c100ppm lead versus c2000ppm).
    - Sealed lead acid batteries, given that most uses are industrial or professional (even though classified as portable); that many of applications are essential (eg use in medical equipment); that no suitable alternatives are available; and that collection and recycling infrastructures are already in place.

    In effect, a ban with these exemptions would only impact on the existing zinc carbon technologies, for which there are suitable alternatives.

A number of arguments in support and against the amendment are presented (see Table 2). It is noted, however, that there are a number of other issues that should be considered which were outside the scope of this study, such as the viability of other policy options in achieving the same policy objective, and considering the impacts of a ban in comparison with the impacts of the proposed collection and recovery systems. These issues could be addressed in an impact assessment. There is also a need for clarity from the scientific community on what the lead content threshold should be.

Table 1: Portable batteries with a >40ppm lead content, and typical applications

Batteries with a lead content >40pmm	Typical applications	Availability of substitutes
Zinc carbon standard sizes	Clocks, toys, torches	Yes – alkaline manganese and nickel oxyhydroxide available now; and lead free zinc carbon batteries will soon be available on the market.
Zinc carbon special applications multicell	Lanterns, traffic safety	Yes – alkaline manganese
Selected alkaline manganese batteries (LR14, LR20, 3LR12) (NB other alkaline manganese batteries are <40ppm)	Portable radios, toys, flash lights (3LR12- flat flash lights)	No
Alkaline manganese special applications multicells.	Halogen flashlights, recording equipment and photo equipment.	No
Silver oxide single button cells	Watches, small electronics	Lithium ion cells (<40ppm) can provide an alternative in some cases (eg watches). However, they are generally not suitable alternatives given that they have a different voltage, and are rechargeable, whereas the others are primary. At present, there do not appear to be substitutes for the zinc air button cells.
Alkaline manganese single button cells	Small electronics, cameras, medical devices	
Zinc air single button cells	Hearing aids	
Multi-button cell battery	Various flash lights, remote controls for garages.	
Sealed lead acid portable batteries	Tends to be in industrial or professional applications: mobile medical equipment (eg infusion pumps, defribrillators, mobile intensive care units, power supply to operating tables, cardiopulmonary support systems, emergency ambulance equipment etc), alarm systems, emergency lighting, and uninterruptible power supply for electronic equipment.	No

Table 2: Arguments for and against the amendment to Article 4 in relation to lead

Arguments for	Arguments against
→ The positive health and environmental effects of removing harmful substances from products. → The importance of phasing out the use of harmful substances where possible. → The trend to reduce lead content of products - it seems sensible to extend this to the batteries that would be used within them. → It would result in a market shift away from zinc carbon batteries to alkaline batteries. In addition to having a lower lead content, alkaline batteries are also more resource efficient. → There are substitutes available for zinc carbon batteries → It could drive more research and development into lead free technologies. → It rewards those companies who have already been innovative in developing alternatives. → Treatment costs are avoided for this specific waste stream. → Exemptions could be put in place to ensure that certain batteries would still be available, in particular button cells for hearing aids and batteries used for security and medical purposes.	→ A ban would only capture a small proportion of the total battery market. → Given the market share, the amount of lead that would be captured by the ban is relatively small. → The market is already moving away from zinc carbon batteries, and battery producers are researching alternatives to the use of lead. → A ban could change the whole balance of the portable battery market, including effects on imports and exports, impacts on production facilities (and employment) and consequences for recyclers. → Alternatives are not yet available for many of the batteries that would be banned. → Systems will still need to be in place for collection, recycling and disposal of spent batteries and accumulators. → The impacts would be disproportionate to those on a lower income, and the EU-10. → Consumers would have to replace battery-using devices if direct substitutes are not made available. → The positive attitude of industry towards collection and recovery could be capitalised on. → Other policy options could have the same effect, but have not been fully assessed.

2 INTRODUCTION AND BACKGROUND

The Commission published a proposal to repeal the existing Directive on batteries and accumulators and waste batteries and accumulators (91/157) in November 2003[4]. The proposal has been through the first reading of European Parliament and Council, and the European Parliament Committee on the Environment, Public Health and Consumer Policy is scheduled to have its second reading in November 2005. In the latest report by Rapporteur Hans Blokland[5], parts of amendments to Article 4 from the first EP reading are re-introduced, such that *portable* batteries or accumulators, including those incorporated into appliances, that contain more than 0.004% of lead by weight (or 40ppm) would be banned.

This study aims to provide a short evaluation of the suggested EP amendment, focussing on:

- The batteries and accumulators that would be caught by this ban;
- How much lead (percentage by weight) those batteries and accumulators contain;
- The availability of alternatives that exist on the market (taking into account differences in performance, capacity and price), or that could soon be put on the market; and
- Instances where portable batteries are incorporated into appliances used by vulnerable groups, such as hearing aids.

It should be noted that this report does not represent an impact assessment. Rather, it is intended to provide the EP Committee with independent guidance on whether the amendment would be justified.

To inform the study, IEEP has undertaken desk research and has spoken directly to battery associations, battery producers, recycling associations, regulatory authorities, scientists, independent advisers and representatives from European Parliament, the Council and Commission[6].

3 KEY QUESTIONS: POTENTIAL EFFECTS OF A LEAD BAN ON THE PORTABLE BATTERY MARKET

3.1 The portable battery market

The world battery market has grown in value by approximately 9% every year since 1989, driven by the growth linked to the development of new consumer electronic appliances. This trend is now slowing down but worldwide demand for batteries is still expected to grow by 5% per annum over the next few years[7]. The market for rechargeable batteries is expected to grow faster than that for primary (non rechargeable) batteries, caused in part by increased

[4] Proposal for a Directive of the European Parliament and of the Council on Batteries and Accumulators and Spent batteries and Accumulators, COM(2003)723, 21.11.2003

[5] Draft Recommendation for Second Reading on the Council common position for adopting a directive of the European Parliament and of the Council on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC (5694/5/2005 – C6-0268/2005 – 2003/0282 (COD); Committee on the Environment, Public Health and Food Safety, Hans Blokland.

[6] More than 25 interviews were undertaken. Details can be provided on request.

[7] The Freedonia Group ‘World Batteries’ report, October 2002; cited in COM(2003)723

demand for health care devices, wireless phones and digital cameras. In 2004, 1 175 000 tonnes of batteries (all types, ie portable, industrial and automotive) were placed on the market in the EU[8].

The battery market can generally be divided into two groups: 'portable' batteries, used by households or professional users and usually weighing less than 1kg; and the 'industrial and automotive' sector, which are above this threshold (see Box 1). It is the former group that is of interest for this study. The portable batteries and accumulators market itself can be split into three main categories, two of which are primary (non rechargeable) and one which is secondary (rechargeable) batteries:

Primary	(i) General purpose batteries and accumulators which are non-rechargeable (mainly zinc-carbon and alkaline manganese batteries);
	(ii) Button cells (mainly zinc air, silver oxide, manganese oxide, alkaline and lithium batteries); and
Secondary	(iii) Rechargeable batteries and accumulators (mainly nickel-cadmium, nickel-metal hydride, lithium ion[9] and sealed lead-acid batteries).

Box 1: Definitions[10]

Battery – means any source of electrical energy generated by direct conversion of chemical energy and consisting of one or more primary battery cells (non-rechargeable).

Accumulator – means any source of electrical energy generated by direct conversion of chemical energy and consisting of one or more secondary battery cells (rechargeable).

Portable battery or accumulator – a battery or accumulator used in household applications, cordless power tools, emergency lighting and electronic and electrical equipment or other applications by either consumers or professional users.

Button cell or accumulator – means a small round battery or accumulator whose diameter is greater than its height and which is used for special purposes such as hearing aids, watches and small portable equipment.

It should be noted that the definition of 'portable' is still under discussion, and the outcome will determine which batteries would be covered by a ban. In particular, it is not yet clear whether batteries weighing less than 1kg and used in industrial or professional capacities would be classed as 'portable', and therefore subject to this ban, or 'industrial', and subject to collection and recycling. For the purpose of this study we have taken the definition in the original proposal. Furthermore, although this definition does not include button cells, in the detail on 'portable batteries and accumulators' in the explanatory memorandum of the proposal, button cells are clearly included, and are therefore included in this study.

[8] Avicenne, 2004

[9] Lithium-ion (Li-ion): Lithium has the highest electrochemical potential. It is however, an unstable metal and thus this battery system is made from Lithium ions from chemicals. Because of its lightness and high energy density, Lithium-Ion batteries are ideal for portable devices such as laptop computers and can be recharged often

[10] COM(2003)723

The portable battery market forms approximately 15% by weight of the overall battery market (see Figure 1). In 2004, 175,000 tonnes of portable batteries, representing 5.5-6 billion cells, were placed on the EU market. Data provided by Avicenne[11] showed that in 2004, alkaline and zinc carbon batteries account for the majority of the portable battery market (see Table 3).

Figure 1: EU Battery Market, 2004[12]

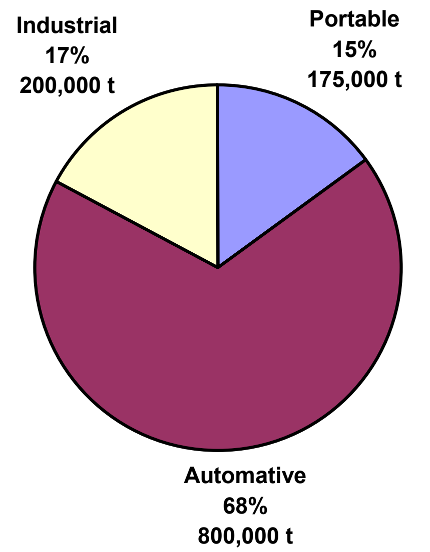

Table 3: Breakdown of the portable battery market, 2004

Battery type	Tonnes	Trend	Number of cells	Share, by weight, of		
				Primary market (1)	Total EU portable market (2)	Total EU battery market (3)
Alkaline	Almost 95000	Increasing 2% per year	> 3 billion	c.63.3%	54.3%	8.1%
Zinc carbon	Less than 50000	Decreasing 3% per year	>1.5 billion	c.33.3%	28.6%	4.3%
Button cells	Less than 400	-	0.4 billion	c.0.27%	0.2%	0.03%
Rechargeable (all)	25000	-	> 0.8 billion	- - -	14.3%	2.1%
Other	4600	-	-	--	2.6%	0.4%

(1) 150,000t; (2) 175,000t; (3) 1175,000 t

[11] Avicenne is an independent market research and consultancy organisation, specialising *inter alia* in the battery market. Contact Christophe Pillot, c.pillot@avicenne.com; www.avicenne.com

[12] *Avicenne (2004)*

Data from the European Portable Batteries Association (EPBA) for the year 2000 provides an indication of the breakdown of the rechargeable market (see Table 4). This is data for EPBA members only (80% of EU market) and is intended only as a guide. The proposal's explanatory memorandum puts the percentage of rechargeables in the portable market at 28% of the portable market (2002).

Table 4: Breakdown of the rechargeable battery market, 1999 [13]

Battery type	Tonnes	Share of portable market (1)
Sealed lead acid	15,000	10%
Lithium Ion (Li-Ion)	1,854	1%
Nickel Cadmium (NiCd)	12,844	8%
Nickel Metal Hydride	5,200	3%
Total	34,898	22%

Note that the EPBA data uses the total portable battery market for the year 2000 (156,939 tonnes), but data on rechargeables is from 1999 (CollectNiCad)

3.2 Lead content of portable batteries

The use of lead in batteries can have different purposes:

- In lead acid batteries the electrochemical system of the battery requires a certain ratio of lead and sulphuric acid. The amount of lead in the battery defines the power (voltage and capacity).
- In other batteries, it extends their performance and safety by acting as a gas inhibitor, thereby avoiding dead cells and leakage. This mainly concerns zinc batteries and button cells.
- Soldering of some multi-cell battery assemblies.
- Some alkaline manganese (large consumer size) batteries contain lead in the zinc gel.

The amount of lead contained in most portable batteries is small, especially when this is compared to the lead content of industrial and automotive batteries, which contain up to 73% (730,000ppm) lead or up to 8% (80,000ppm) cadmium[14]. Automotive lead-acid batteries, for example, are the largest use of lead in batteries and accumulators, and in 1997 it was reported that they used around 73% of the total global lead production. The extended impact assessment for the batteries proposal included data on the typical lead content of different battery systems. This showed that lead was present in zinc carbon batteries (1,500ppm – 50,000ppm[15]), alkaline batteries (400ppm - 20,000ppm[16]) and sealed lead-acid batteries (650,000 – 700,000ppm[17]). The EPBA has done its own detailed analysis of the lead content of portable batteries (see Table 5).

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[13] EPBA (Cegasa, Duracell, Energizer, Germanos, GP Batteries, Kodak, Leclanché, Mitsubishi, Moltech, Panasonic, Rayovac, Renata, Saft, Sanyo, Varta), from http://www.epbaeurope.net/Recycling.html - market weight in 2000. http://www.epbaeurope.net/Recycling.html

[14] SEC(2003)1343

[15] 0.15-5% by weight

[16] 0.040-2% by weight

[17] 65-70% by weight

Table 5: Lead content of portable batteries[18]

Battery Technology	Lead content (EPBA)	Lead content (producer opinion)
Primary batteries and button cells		
Zinc carbon standard sizes Eg. R20, R14, R6, R03, 3R12, 6F22	**>40ppm**	**Typical lead content c2000ppm**
Zinc carbon special applications multicell	**>40ppm**	
Alkaline manganese standard sizes Eg. LR20. LR14, LR6, LR03, 6LR61, 3LR12	<40ppm	
	>40ppm for LR14, LR20, 3LR12	**For these, the lead content is typically <100ppm**
Alkaline manganese special applications multicell	**>40ppm**	**Typical lead content c100ppm.**
Nickel Oxyhydroxide Eg. ZR6, ZR03	<40ppm	
Lithium Manganese Dioxide Majors Eg. CR123A, CRP2P, 2CRM5M	<40ppm	
Other Lithium primary batteries Eg. Lithium thionyl chloride, lithium sulphur dioxide	<40ppm	
Single button cells – silver oxide	**>40ppm; some cell types are < 40ppm**	Typical lead content <100ppm
Single button cells – alkaline manganese	**>40 ppm**	Typical lead content <100ppm
Single button cells – zinc air	**>40 ppm**	Typical lead content <200ppm
Single button cells – lithium manganese dioxide	<40 ppm	
Multi button cell battery Eg. 4SR44, 4LR44	**>40 ppm**	
Rechargeable batteries, packs and button cells		
Nickel cadmium Eg. R20 full cell, R14 Sub-C, 9V-block	<40ppm	
Nickel metal hydride Eg. R20 full cell, R14 Sub-C, 9V-block	<40ppm	
Rechargeable alkaline manganese	-	
Lithium ion Eg. R20 full cell, R14 Sub-C, 9V-block	<40ppm	
Lithium polymer	<40ppm	
Sealed lead acid	**c 600,000**	

Note: Those technologies in bold are those that would be affected by the proposed ban.

[18] Information provided to IEEP for this study

3.3 What batteries and accumulators would therefore be covered by a ban, and what applications are they used in?

From evidence provided in the Commission SEC document and from the EPBA, the types of batteries that would be affected by the ban, and the typical applications in which they are used, are provided in Table 6. The information on applications was provided by the EPBA. The complete table, showing typical applications for all batteries, can be found in

Annex 1.

Table 6: Batteries that would be banned and their typical applications

Batteries with a lead content >40pmm	Typical applications
Zinc carbon standard sizes	Clocks, toys, torches
Zinc carbon special applications multicell	Lanterns, traffic safety
Selected alkaline manganese batteries (LR14, LR20, 3LR12)	Portable radios, toys, flash lights (3LR12- flat flash lights)
Alkaline manganese special applications multicells.	Halogen flashlights, recording equipment and photo equipment.
Silver oxide single button cells	Watches, small electronics
Alkaline manganese single button cells	Small electronics, cameras, medical devices
Zinc air single button cells	Hearing aids
Multi-button cell battery	Flash lights, remote controls for garages.
Sealed lead acid portable batteries	Use tends to be in industrial/professional applications, rather than domestic: mobile medical equipment (eg infusion pumps, defribrillators, mobile intensive care units, power supply to operating tables, cardiopulmonary support systems, emergency ambulance equipment etc), alarm systems, emergency lighting, and uninterruptible power supply for electronic equipment.

3.4 Do substitute products exist for those that would be banned?

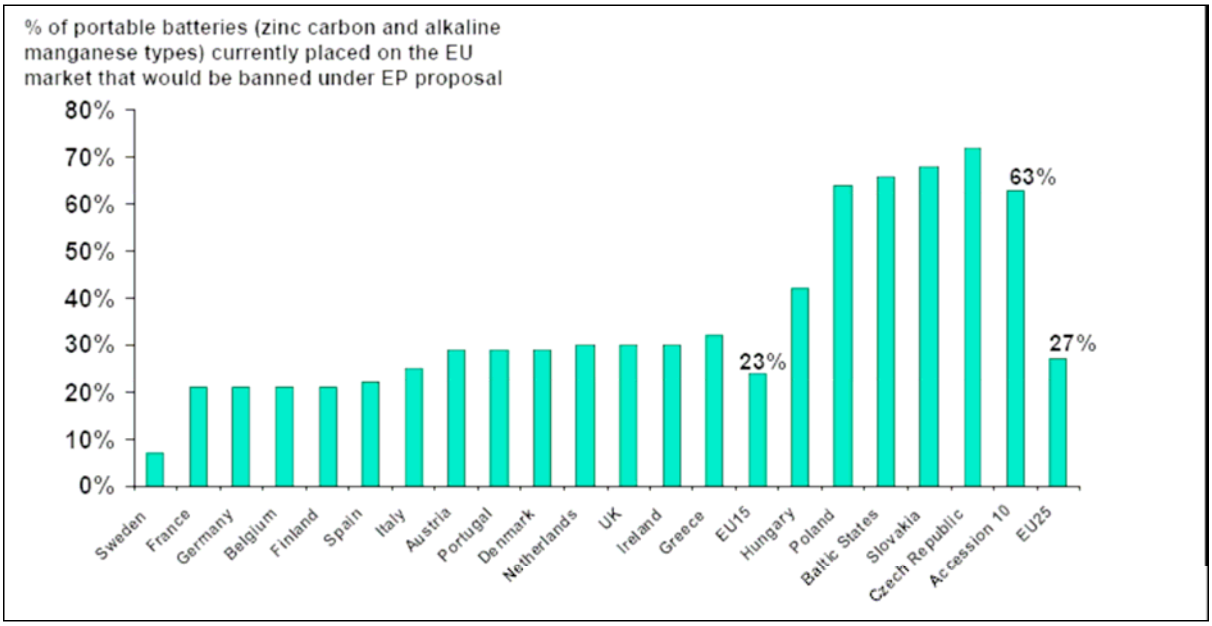
The difficulty of assessing whether substitutes are available for certain battery technologies is that the issue is not as black and white as it may appear. While some battery technologies could be substituted on a like-for-like basis (eg alkaline manganese replacing zinc carbon standard sizes), other technologies are more bespoke to the product in which it is being used (eg button cells). In theory, substitutes can either use the same battery technology with a lower lead content (possibly substituting lead for other properties that would perform the same function), or can be a completely different battery technology for the same application.

When considering substitutes, the performance of the replacement needs to be considered. This includes voltage, energy efficiency, cost, capacity, charging efficiency and reliability of the product over time (eg shelf life, performance under different climatic conditions, ability to prevent leakage). The environmental impact of the replacement is also important – switching the market to a different technology type should not result in the creation of new problems, for example, environmental externalities (heavy metal content etc), lack of treatment infrastructure, excessive cost or a decrease in resource efficiency. Consequently, substitutes need to undergo a full assessment before they can be brought to the market.

3.4.1 Zinc carbon batteries

The official position of the EPBA and individual national portable battery associations is that there are only substitutes available now to replace the zinc carbon standard size batteries and special applications multicell ie alkaline manganese batteries and also nickel oxyhydroxide in the case of standard sizes. However, the cost of alkaline batteries is up to 3 times higher than that of zinc carbon batteries; and nickel oxyhydroxide are up to 3.5 times more expensive (see Annex 2). This, the associations argue, would have a disproportionate effect on the EU-10, where the share of zinc carbon batteries in the portable battery market is higher (see Figure 2). One producer indicated, however, that the cost of producing zinc carbon and alkaline manganese batteries is not sufficiently different, and that the discrepancy is only in the retail cost. It is also argued that a ban on the cheaper zinc batteries would encourage illegal imports. The EU would then have the problem of having to deal with these batteries when they become waste, in a situation when no producers can be found, and there is limited capacity to handle these battery types (given that if they were banned in the EU there would be no supporting infrastructure for collection and recycling).

Figure 2: Impact of 40ppm lead restriction on portable batteries market (excluding button cells)[19]



A strong counter argument is provided by the fact that alkaline batteries last longer than zinc carbon batteries. Research by Oeko Test (see Annex 3) showed that the capacity of alkaline manganese batteries is in the order of three times that of zinc carbon batteries. Therefore, although consumers pay more, their battery expenditure in the long term may not be adversely affected. Switching to alkaline manganese batteries (those with < 40ppm lead) would consequently have consumer and environmental benefits, including overall resource savings as the number of cells for the same energy output is reduced, resulting in savings over the life cycle of the cell (production, packaging, transport etc) and a reduction in the number of spent cells that have to be collected, transported and treated.

The position of the portable battery associations is that alternatives to lead-containing zinc carbon batteries are in development, but that the stage that this is at varies across its member producers, and in the short term alternatives would not be available on the market. It is apparent however that some producers are at a more advanced stage, and that alternatives to some of the batteries that would be banned are nearer to the market. One major producer, for example, revealed that it would be ready to bring lead free zinc carbon batteries to the market

[19] EPBA, 2003.

in 2006, and to their knowledge one other major producer is in the same position. As a purchaser of batteries as well as a producer, the company will also be requiring the products it purchases (of this type) to be lead-free. The alternatives would replace the 'big 5' main battery types (R03, R6, R14, R20 and 9v), which account for 99% of the zinc carbon market. Indium can be used as a substitute for lead in these products, and provides the same characteristics as the lead-containing product. Although indium is more expensive, as the quantities used are small, it is considered that there would be no significant increase in cost to the consumer.

It therefore seems apparent that there are substitutes available for the current zinc carbon batteries: either by producing lead free alternatives; or switching to alkaline manganese or nickel oxyhydroxide batteries.

The picture is less clear for the other battery technologies that would be banned: selected alkaline manganese batteries and alkaline manganese special applications multicells; most types of button cells; and sealed lead acid portable batteries.

3.4.2 Selected alkaline manganese batteries and alkaline manganese special applications multicells

The use of lead in a number of alkaline manganese batteries is due to the need to provide a higher level of consistency and duration of performance over the product's life, and to prevent leakage when used in high value goods. At present, there appears to be no alternatives available. Though the lead content of these batteries is >40ppm, it is still substantially lower than the lead content of the zinc carbon batteries, for which they are a substitute.

3.4.3 Button cells

There are no major alternatives available at present for the button cells that would be affected by the ban, including zinc air button cells used in hearing aids. Research and development is ongoing. While it is considered technically possible to reduce the lead content of button cells, there is still a long way to go in terms of matching performance and reliability. One of the problems with finding alternatives to button cells is that they have to be small, in addition to meeting other performance requirements. Preventing leakage is particularly important given the health considerations for use in hearing aids, or the fact that they are used in high value goods (eg watches, cameras). Lithium ion cells (<40ppm) can provide an alternative in some cases. For example, it was reported by one producer that more watches are now coming to the market using lithium ion technology, as opposed to silver oxide cells. However, they are generally not suitable alternatives given that they have a different voltage, and are rechargeable, whereas other button cells are primary.

3.4.4 Sealed lead-acid portable batteries

Alternative rechargeable technologies for sealed lead-acid portable batteries are available, and the data provided by the EPBA shows they have a <40ppm lead content (see Table 5). However, the battery type used is specific to each application, and needs to provide the same level of performance (eg performance in a wide temperature range). Current alternatives do not appear to do this, nor compare on cost. In some cases the alternatives have other disadvantages. For example, nickel-cadmium is an alternative for some applications, but at present these would be banned in the revised Directive given their cadmium content. Summary details of the advantages and disadvantages of alternatives to lead acid are provided in Annex 4. If no alternatives are available for lead acid portable batteries, there is at least some existing collection and recycling infrastructure in place. As most uses of lead acid batteries are industrial or professional, rather than domestic, spent batteries are already collected and recycled. The high lead content (c60%) provides a market incentive to do this, and collection levels are currently close to 100%[20]. In comparison, collection rates for portable batteries as a whole are estimated to be 18% across the EU, of which around 90% is estimated to be recycled. Collection is well developed in some Member States (eg Austria, Belgium, Finland, Germany, Netherlands and Sweden) and less so in others[21].

It should also be noted that if the ban on batteries containing greater than 0.002% cadmium is passed (as in the Council's Common Position), portable NiCad batteries and valve regulated lead acid batteries would not be available. This limits the potential to substitute the use of lead acid batteries[22].

3.5 Taking account of substitutes available, would a ban have serious impacts on any sector, use, or user group?

If the aforementioned technologies were banned from the EU market (assuming no exemptions), a number of sectors and users would be affected. It should be noted that due to the bespoke nature of some battery technologies, it is not possible to have a *de facto* list of the applications that would be affected and those that would not. The following provides some indication:

- Producers of the banned batteries, but in particular the producers of zinc carbon batteries, given that these technologies would be phased out, and they currently represent a large proportion of the portable battery market. According to our research, a direct switch to producing other battery technologies is not possible. Therefore if plants producing only zinc carbon batteries cannot adapt (eg to producing lead free or alternative technologies) they may face closure. This study has not assessed the socio-economic impacts of this, nor the distributional impacts. It is known from the EPBA that in Europe these manufacturers are based in Poland and Greece.
- Banning the existing zinc carbon technologies would force consumers to purchase the higher price alkaline manganese batteries. This would have a disproportionate impact on those on a lower income, and on the EU-10 where sales of zinc carbon batteries are currently higher than the EU-25 average.
- The power source for *inter alia* critical medical and emergency equipment would not be available if portable lead acid batteries were banned. This would impact on human lives.
- Manufacturers whose products use the banned battery technologies, including: watch manufacturers; producers of small electronics; cameras; medical devices; mobile

[20] Questions and Answers on the Commission proposal (CEC)

[21] Bio Intelligence Services, Impact Assessment on selected policy options for the revision of the battery Directive (July 2003), DG Environment.

[22] Based on the heavy metal data provided in SEC(2003)1343. Note that a thorough analysis of the effect of a NiCad ban has not been undertaken for this study.

medical equipment; alarm systems; emergency lighting; and producers of miscellaneous applications using existing zinc carbon technology or alkaline manganese technologies (>40ppm types) where use of alternatives is not feasible (eg toys, radios, flash lights, clocks, game consoles).

- If zinc air button cells were banned, users and manufacturers of hearing aids would not be able to source replacement batteries.
- Consumers would not be able to source replacement batteries for some products, and would therefore, over time, need to replace the battery using devices. This may cut short the life of otherwise perfectly functioning devices, creating waste and a cost burden to consumers.

3.6 Should there be any exemptions?

Based on the evidence available, exemptions would be justified for those battery technologies where no alternatives are expected to be available on the market in the short-term future (2-5yrs):

- Selected alkaline manganese batteries and alkaline manganese special applications multicells, given that their use is preferable to the zinc carbon alternatives.
- Zinc air, silver oxide, alkaline manganese and multi button cell technologies, given that it is not clear whether there are suitable alternatives available and near to the market. Button cells have many key specific functions, not least the use in hearing aids. They also represent a very small percentage of the portable battery market (0.2%).
- Sealed lead acid batteries, given that most uses are industrial or professional; that many of the applications are essential (eg use in medical equipment); that no suitable alternatives are available; and that collection and recycling infrastructures are already in place.

It should be noted that if there were too many exemptions from a ban, the benefits would diminish. Collection and recycling systems would still need to be put in place for those excluded (as a component of all batteries on the market[23]), and the marginal costs of treating the lead-containing batteries could be higher. The environmental gain needs to be balanced against this, and the cost to producers, manufacturers and consumers.

4 CONCLUSIONS

This study provides substantial further information to the Environment, Public Health and Consumer Policy Committee, and will hopefully assist it in reaching a decision on whether to support a ban on portable batteries with a lead content over 40ppm. It is not intended to recommend a vote in one direction or another. Rather, based on the evidence, we can present a number of advantages and disadvantages to the proposed Article 4 amendment. These arguments are presented below.

[23] The proposal to amend Directive 91/157 would cover all spent batteries.

Arguments in favour of the amendment to Article 4 in relation to lead:

- The positive health and environmental effects of removing harmful substances from products.
- It is important to take action in phasing out the use of harmful substances where it is possible, irrespective of the amounts covered.
- Given the trend to reduce lead content of products, it seems sensible to extend this to the batteries that would be used in the products.
- It would result in a market shift away from zinc carbon batteries to alkaline batteries. In addition to having a lower lead content, alkaline batteries are also more resource efficient.
- It could drive more research and development into lead free technologies for batteries currently excluded from the ban (eg lower threshold of lead content or technologies exempted).
- It rewards those companies who have already been innovative in developing alternatives.
- Avoided treatment (recycling/recovery/disposal) costs for this specific waste stream.
- There are substitutes available for zinc carbon batteries.
- Exemptions could be put in place to ensure that certain batteries would still be available, in particular button cells for hearing aids and batteries used for security and medical purposes.

Arguments against the amendment to Article 4 in relation to lead:

- The ban would only capture a small proportion of the total battery market, given that portable batteries represent 15% of the total market. Some of the battery technologies that would be banned represent smaller percentages again: Zinc carbon batteries, though almost one third of the portable battery market, are only around 4% of the total battery market; button cells are only 0.2% of the portable battery market.
- Given the market, the amount of lead that would be captured by the ban is relatively small when compared to industrial and automotive batteries.
- The market is already moving away from zinc carbon batteries, and battery producers are researching alternatives to the use of lead. Therefore would a ban add any value?
- A ban could change the whole balance of the portable battery market, including effects on imports and exports, impacts on production facilities (and employment) and consequences for recyclers. Would such a large change be worthwhile for the gains in terms of reduced lead entering the environment?
- Alternatives are not available for many of the batteries that would be banned.
- Systems will still need to be in place for collection, recycling and disposal of spent batteries and accumulators.
- The impacts would be disproportionate to those on a lower income, and the EU-10.
- Consumers may have to replace battery-using devices if direct substitutes are not made available.
- The positive attitude of the industry towards collection and recovery, as the alternative to a ban, could be capitalised on, leading to positive effects on the whole recycling industry.
- Other options, for example the use of time-limited exemptions as in the ELV Directive, could have the same effect on the market, but have not been fully assessed.

One of the main arguments by those objecting to the amendment is that it has not been subject to a full impact assessment, and therefore there is not sufficient evidence on which to base such a decision. While this study seeks to provide evidence in the context of the terms of reference, it should not be seen as a full impact assessment.

In addition, there appears to be no consensus on the level of lead that would be considered acceptable. It seems that the threshold is driven by what is technically feasible in some cases, rather than on environmental risk. Some have suggested that a level set at 100-200ppm would be more suitable. However, this would serve only to ban existing zinc carbon and sealed lead acid technologies. Scientific justification for the 40ppm would need to be provided. It could be requested that the Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE) looks at the issue, as was done in relation to the health impacts of lead in candles in 2003[24].

The arguments for and against introducing a ban on certain batteries also need to be considered against the relative merits of the alternative policy options. That analysis is beyond the scope of this particular study, but it is recommended that further research be undertaken. Some of the potential areas to cover include *inter alia*:

- The potential of reducing heavy metal content over time by strengthening Article 5 of the Commission proposal regarding the promotion of research and development into reducing the environmental impact of batteries over their life cycle, including heavy metal content, and developing recycling technologies.
- The potential of encouraging innovation in the market by including a review clause in the Directive, which states that the issue of lead content will be reviewed more closely in the next revision of the Directive.
- The potential of having longer phase out periods for different types of technology in order to allow the battery market to bring substitutes to the market place, and the battery using devices to be replaced.
- The potential of focusing on product manufacturers, so that the use of certain battery technologies is discouraged at the design stage, thereby encouraging research and development into alternatives and a market switch in favour of lead free technologies.
- The viability of other policy options, eg addressing heavy metal content through standardisation[25], voluntary agreements, or the principle of best available technology (BAT).
- Considering whether without a ban the same level of environmental protection could be achieved through collection and recovery, given the proposed collection rate and the recycling efficiencies (and whether this refers explicitly to extracting lead content).
- Consideration of the costs of implementing a ban in comparison to collection and recovery costs (bearing in mind that collection and recovery needs to be in place for other spent batteries).
- The impact of a ban on other industries, including product manufacturers and the lead industry (batteries account for c70% of lead consumption).

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24 http://europa.eu.int/comm/food/fs/sc/sct/out176_en.pdf

25 The leading global organization for the preparation and publication of international standards for batteries (as well as all other electrical, electronic and related technologies) is The International Electrotechnical Commission (IEC). The IEC standards serve as a basis for national standardization, promotes global interoperability and serves as references when drafting international tenders and contracts. The IEC objectives also include contributing to improvement of human health and safety and protection of the environment.

- The impact of a ban on different Member States, noting how usage and manufacture of portable battery technologies varies.
- The impact of a ban on consumers, given the lifetime of existing battery using products and the need to replace these if certain batteries are no longer available.
- The impact of illegal imports (including sales over the internet).

ANNEX 1: LEAD CONTENT, USES & AVAILABILTY OF SUBSTITUES (EPBA)

	Pb Content	Substitutes with <40 ppm lead and without loss of performance	Cost differential of substitute	2004 Sales No. of Pieces million	Typical applications
PRIMARY BATTERIES AND BUTTON CELLS					
Zinc Carbon standard sizes e.g. R20, R14, R6, R03, 3R12, 6F22	> 40 ppm	Alkaline manganese and Nickel oxyhydroxide	x 3 x 3.5	1499	Clocks, toys, torches,
Zinc Carbon special applications multicell	> 40 ppm	Alkaline manganese	x 3	6	Lanterns, traffic safety
Alkaline Manganese standard sizes e.g. LR20, LR14, LR6, LR03, 6LR61, 3LR12	<40 ppm >40ppm LR14, LR20, 3LR12			3850	Electronic, photo-flash, game consols.
Alkaline Manganese special applications multicell	> 40 ppm	None			Halogen flashlights, recording equipment and photo equipment.
Nickel Oxyhydroxide e.g. ZR6, ZR03	<40 ppm				
Lithium Manganese Dioxide Majors e.g. CR123A, CRP2P, 2CRM5M, 2CR1/3N, CR2	<40 ppm			36	Photographic
Other Lithium Primary Batteries e.g. Lithium thionyl chloride, Lithium sulphur dioxide	<40 ppm			2.25	
Single Button Cells - Silver Oxide	> 40 ppm; some cell types are < 40 ppm	None		134	Watches Small electronics
Single Button Cells - Alkaline Manganese	> 40 ppm	None		32	Small electronics, cameras, medical devices
Single Button Cells - Zinc Air	> 40 ppm	None		220	Hearing aids
Single Button Cells - Lithium Manganese Dioxide	< 40 ppm			60	Photographic
Multi-Button Cell Battery e.g. 4SR44, 4LR44	> 40 ppm	None		Included with single button cells	
RECHARGEABLE BATTERIES, PACKS AND BUTTON CELLS					
Nickel Cadmium e.g. R20 Full cell, R14 Sub-C, 9V-Block	< 40 ppm				
Nickel Metal Hydride e.g. R20 Full cell, R14 Sub-C, 9V-Block	< 40 ppm				
Rechargeabke Alkaline Manganese					
Lithium Ion e.g. R20 Full cell, R14 Sub-C, 9V-Block	< 40 ppm				
Lithium Polymer	< 40 ppm				
Sealed Laed Acid	About 60%				Mobile medical equipment, alarm systems, emergency lighting, uninterruptible power supply for electronic equipment.

ANNEX 2: OVERVIEW OF AVERAGE PRICES: ZINC CARBON AND ALKALINE BATTERIES[26]

	ZINC CARBON		ALKALINE	
	Type	Average price	Type	Average price
Belgium	AA	€0,55	AA	€1,30
	D	€1,34	D	€2.40
Czech Republic	AA	€0,2	AA	€0,6
	D	€0,5	D	€1,7
Denmark	AA	€1,7	AA	€4,7
	D	€2	D	€5,4
Finland	AA	€1,5	AA	€4
	D	€2	D	€5
Greece	AA	€0,46	AA	€0,83
	D	€0,83	D	€1,96
Hungary	AA	€0,2	AA	€0,8
	D	€0,6	D	€1,7
Italy	AA	€1,2	AA	€3
	D	€1,3	D	€3,5
Poland	AA	€0,2	AA	€0,8
	D	€0,7	D	€1,5
Slovakia	AA	€0,2	AA	€0,6
	D	€0,5	D	€1,8
Spain	AA	€0,13	AA	€0,64
	D	€0,35	D	€1,35
Sweden	AA	€0,4	AA	€0,8
	D	€1,1	D	€2,2
Turkey	AA	€0,92	AA	€2,83
	D	€1,18	D	€3,61

[26] EPBA

ANNEX 3: PERFORMANCE OF SELECTED ZINC CARBON AND ALKALINE MANGANESE BATTERIES[27]

Battery name	**Energizer High-Tech Formula**	**GP Super Alkaline**	**Kodak Photolife**	**Panasonic Power Alkaline**	**Philipps Power Life**	**Tornac Alkaline**	**AccuCell AC 1000**	**Big, the rechargeable Alkaline**
Supplier/vendor	Ralston Energy Systems	Gold Peak Group	Kodak	Panasonic	Philips	Woolworth	AccuCell	Big
Price per piece (DM)	**1.87**	**1.98**	**2.00**	**1.48**	**2.25**	**1.50**	**6.95**	**5.00**
Type/ model	LR 6, Alkali-mangan	LR 6, Alkali-Mangan	LR 6, Alkali-Mangan	LR 6, Alkali-Mangan	LR 6, Alkali-Mangan	LR 6, Alkali-Mangan	LR 6, Alkali-Mangan, rechargeable	LR 6, Alkali-Mangan, rechargeable
Lead in mg/kg (ppm)	no	no	no	no	no	no	50	30
Cadmium in mg/kg	no	no	no	no	no	no	no	no
Mercury in mg/kg	no	no	no	no	no	no	no	no
PVC/PVDC/chlorinated synthetic materials in the battery	no	no	no	no	no	no	no	no
Capacity in mAh	**2039**	**1898**	**1996**	**2089**	**2021**	**2054**	**1507**	**1355**
Did the battery leak while being deloaded/ used	no	no	no	no	no	no	no	no
Test result for batteries	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Limited recommendable	Limited recommendable
PVC/PVDC/chlorinated synthetic materials in the packaging	no	no	no	no	no	no	no	no
Test result for packaging	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable
Comment	1)							3) 4)
Overall result	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Limited recommendable	Limited recommendable

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Battery name	**Daimon Alkaline**	**Duracell Power Check**	**Mars**	**Rocket Ultra Green**	**Sony New Ultra**	**Ucar Super Life**	**Varta Alkaline Extra Longlife**	**Boomerang Regenerable Alkaline**	**Power Metal Jacket Batteries**
Supplier/vendor	Duracell	Duracell	Penny	Rocket (Wollworth)	Sony	Ralston Energy Systems	Varta	Leclanché	Conrad Electronic
Price per piece (DM)	**0.99**	**1.74**	**0.75**	**0.50**	**1.00**	**1.12**	**1.75**	**3.99**	**0.21**
Type/ model	LR 6, Alkali-mangan	LR 6, Alkali-Mangan	LR 6, Alkali-Mangan	R 6, Zinc-carbon	R 6, Zinc-carbon	R 6, Zinc-carbon	LR 6, Alkali-Mangan	LR 6, Alkali-Mangan, rechargeable	R 6, Zinc-carbon
Lead in mg/kg	no	no	100	500	950	700	100	35	1400
Cadmium in mg/kg	no	no	no	no	no	no	no	no	130
Mercury in mg/kg	no	no	no	no	no	no	no	no	200
PVC/PVDC/chlorinated synthetic materials in the battery	yes	yes	no	no	no	no	no	yes	No
Capacity in mAh	**1913**	**2036**	**1929**	**479**	**547**	**537**	**1906**	**1521**	**157**
Did the battery leak while being deloaded/ used	no	no	no	no	no	no	no	no	Yes
Test result for batteries	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Less recommendable	Not recommendable
PVC/PVDC/chlorinated synthetic materials in the packaging	no	no	no	no	no	no	no	no	Yes
Test result for packaging	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Recommendable	Limited recommendable
Comment	2)	1) 2)					3)	2)	
Overall result	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Limited recommendable	Less recommendable	Not recommendable

Comments: 1) liquid level indicator. 2) PVC/PVDC/Chlorinated synthetic materials are only part of the glue of the outside cover. 3) According to the supllier Varta and Big those batteries are currently changed to lead-free systems. 4) Battery contains 0.4% nickel, though promoted to have \"0% Nickel\". According to the supplier Big the Nickel is not part of the content of the battery but comes from the nickel-plated steel cover. **Explanation:** the depreciation of one step is due to the following failings/ deficiencies: a) lead in the battery, b) Cadmium in the battery, c) mercury in the battery; d) PVC/PVDC/ chlorinated synthetic materials in the battery; e) capacity is a third less than other similar types/ models' capacity; f) Battery was leaking in standard tests; g) PVC/PVDC/chlorinated synthetic materials in the packaging of the battery. Batteries and packaging were first ranted separately, the ratings were then averaged and where appropriate rounded up in favour of the product. However, the overall result can not be better than the rating of the battery.

ANNEX 4: ADVANTAGES & DISADVANATAGES OF SUBSTITUTES[28]

Replacing	Existing Alternatives	Advantages	Disadvantages
Lead-acid (Rechargeable)	Nickel-cadmium	These batteries are more compact than lead-acid, their chemistry is reliable, can operate in a range of temperatures, tolerates abuse well, performs well after long periods of storage, and can be recharged a large number of times. The lead content is <40ppm.	These batteries are more expensive than lead-acid ones; in addition cadmium is another toxic element and the recycling infrastructure for nickel-cadmium batteries is very limited. NiCad batteries may be banned in the new batteries Directive.
	Lithium-ion	It has a high specific energy (the number of hours of operation for a given weight) making it a huge success for mobile applications such as phones and notebook computers. Lead content is <40ppm.	More expensive than lead. The cost differential though is not as apparent with small batteries for phones and computers. Nevertheless, currently there is no established system for recycling large lithium-ion batteries. In addition Lithium is a very reactive element, which can lead to explosive consequences, ruptured cells may cause fire and spent batteries should be stored with care.
	Nickel-metal hydride	They are a new generation that can replace NiCad batteries and have a higher energy density and longer life cycle, it is reliable and lightweight, They do not contain the most dangerous heavy metals so are more environmental friendly than NiCad and Lead acid batteries.	The metals in the battery are 25 times more expensive than lead, and cannot be recharged as many times as NiCad. Nickel has been identified as a carcinogen. No significant recycling capability exists.
	Nickel-zinc	They are claimed to provide the lowest impact to the environment of any standard rechargeable battery technology mainly because of the absence of contamination from the dangerous heavy metals. They have lower cost than NiMH, are	It is expensive and its life cycle, while improved during the past few years, is still merely adequate. So there has been no breakthrough in this chemistry.

[28] http://www.batterycouncil.org
http://www.envirogreen.co.uk/disposal-and-recycling-services-waste-battery.htm#1

		lighter and better performers than lead acid, have a high capacity per cycle and high cycle life and they also have low maintenance requirement	
	Sodium-sulphur	This chemistry is about as efficient as lead-acid, but has three to four times more specific energy (the number of hours of operation for a given weight).	27 years of research has yielded only one commercial application – load levelling by electric utilities in Japan.
Zinc carbon	Alkaline manganese	Alkaline batteries have a higher capacity than zinc carbon, and most of the main battery types have less than 40ppm lead content.	The cost of alkaline batteries is up to 3 times higher than that of zinc carbon batteries;
	Nickel oxyhydroxide	Lead content is less than 40ppm.	Nickel oxyhydroxide are up to 3.5 times more expensive than zinc carbon.
Button cells	Mercury oxide (1)	Mercury-oxide cells have a high energy density and flat voltage profile resembling the energy density and voltage profile of silver-oxide cells. These mercury-oxide cells are also ideal for producing specialty batteries.	The component, mercury, is relatively expensive and its disposal creates environmental problems. These batteries are banned in the EU.
	Silver oxide (1)	Silver-oxide cells have a moderately high energy density and a relatively flat voltage profile. As a result, they can be readily used to create specialty batteries. Silver-oxide cells can provide higher currents for longer periods than most other specialty batteries, such as those designed from metal-air technology.	Due to the high cost of silver, silver-oxide technology is currently limited to use in specialty batteries. Though some silver oxide cells are <40ppm lead, other have a higher lead content.
	Lithium (1)	Are becoming popular for use in computer memory back-up, in calculators, and in watches. In applications such as these, where changing the battery is difficult, the longer lifetime of the lithium battery makes it a desirable choice. The lead content is <40ppm.	Higher cost

(1) National Law Enforcement And Corrections Technology Center (Nlectc) website: Http://Www.Nlectc.Org/Txtfiles/Batteryguide/Ba-Type.Htm

ANNEX 5: SUMMARY DETAILS OF THE BATTERIES PROPOSAL

The Commission released a proposal to amend the 1991 batteries and accumulators Directive (91/157/EEC) in November 2003. The proposed Directive would, *inter alia*, require the collection and treatment of spent batteries, from both industrial and domestic users, and set targets for recovery and recycling. The proposed Directive would cover all types of batteries and accumulators, regardless of their shape, volume, weight, material composition or use (*Article 2*). Directive 91/157 only covers circa 7% of all portable batteries on the EU market annually. As experience with the current Directive has shown that consumers have difficulties distinguishing between portable batteries containing cadmium, mercury and lead covered by this Directive and other portable batteries (e.g. alkaline manganese and zinc-carbon batteries), it is considered necessary to extend the scope of the proposed policy/proposal to all portable batteries.

Member States are to set up collection facilities for spent portable batteries and accumulators (*Article 9*). A uniform target for the collection of all spent portable batteries and accumulators, at a level of 160g per inhabitant is to be achieved four years after the Directive's transposition. There is a separate collection rate for NiCad batteries, set at 80% (*Article 13*).

By twelve months after transposition, all *collected* portable batteries and accumulators (unless they have become damaged during collection, for which up to a maximum 10% exemption is proposed) and all industrial and automotive batteries should 'enter a recycling facility' (*Article 18*), and minimum recycling efficiencies are to be achieved no later than three years after transposition, as follows (*Article 19*):

- NiCad batteries - all the cadmium and a minimum of 75% of the average weight are to be recycled;
- Lead-acidic batteries - all the lead and a minimum of 65% by average weight are to be recycled; and
- Other batteries and accumulators - a minimum recycling efficiency of 55% by average weight is proposed.

These levels are to be evaluated regularly and adapted to technical progress.

The proposed Directive would set minimum requirements for the treatment of spent batteries and accumulators, requiring that Member States ensure that producers or third parties set up treatment facilities which use the best available recycling techniques (as with WEEE for example) (*Article 15*).

As with the current legislation, producers must mark their products with a symbol showing that the spent battery is not to be placed in the bin, and those containing mercury (>0.0005%), lead (>0.4% by weight) or cadmium (>0.025%) must be marked with a chemicals symbol (*Article 27*). Consumers are to be informed of the meaning of these symbols, and of the potential effects of those substances on the environment and human health; the requirement not to dispose of spent batteries as unsorted municipal waste and to collect such waste separately; collection and recycling schemes available to them; and their role in contributing to recycling (*Article 25*).

Member States would be required to promote research into the possibility of increasing the overall environmental performance of batteries and accumulators throughout their entire life cycle, and the marketing of B&A which contain smaller quantities of dangerous substances or which contain less polluting substances, in particular as substitutes for mercury, cadmium and lead (*Article 5*). They would also be required to promote the development of new recycling and treatment technologies, and research into environmentally friendly and cost-effective recycling methods for all types of batteries and accumulators (*Article 17*).

The only Article relating to prevention is *Article 4*, which states that:

1. Member States shall prohibit the marketing of all batteries or accumulators whether or not incorporated into appliances, which contain more than 0.0005% of mercury by weight.
2. Button cells and batteries made up of button cells with a mercury content of no more that 2% by weight shall be exempt from the prohibition referred to in paragraph 1.

ANNEX 6: WHAT JUSTIFICATION IS PRESENTED FOR A BAN?

The reports of rapportuer Johannes Blokland present the justification for a ban on the use of batteries containing more than 40ppm lead. This includes two factors: (i) the health and environmental impacts of lead; and (ii) the trend in policy to restrict the use of harmful substances, so preventing impacts at source. Summary information on both of these aspects is provided below for reference.

Health and Environmental Impacts of Lead[29]

Lead is classified under Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances[30] as:

- Repr.Cat.1, R61 – substance toxic to reproduction category 1 (substance known to cause developmental toxicity in humans) / May cause harm to the unborn child;
- Repr.Cat.3, R62 – Substance toxic to reproduction category 3 (substance which cause concern for humans owing to possible developmental toxic effects) / Possible risk of impaired fertility;
- Xn; R20/22 – Harmful by inhalation and if swallowed;
- R33 – Danger of cumulative effects; and
- N; R50-53 – Dangerous for the environment / very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Above certain concentrations, lead is toxic to humans, and continued or acute over exposure can cause severe and cumulative health problems. According to research, lead affects the major organs (the kidney in particular), as well as the central nervous system and circulatory systems. Long-term exposure to lead in a work environment has resulted in decreased performance of the nervous system, and weakness in fingers, wrists, or ankles. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people. Exposure may also cause anaemia and, in men, damage the reproductive system. At high levels of exposure, lead can severely damage the brain and kidneys.[31] Exposure is most serious for young children, because they absorb lead more easily than adults and are more susceptible to its harmful effects. Lead can also affect the unborn child, especially in the third trimester of pregnancy.

Lead can have adverse effects on ecosystems, including interference with growth and productivity of marine life, toxicity in fish and mammals and negative effects in photosynthesis and growth of plants[32].

Under the existing batteries and accumulators Directive (91/157) measurable and verifiable instruments preventing uncontrolled disposal of batteries and accumulators containing lead are not prescribed. Consequently, there are different approaches across Member States, and the overall collection efficiency of spent batteries and accumulators is low. Thus, many batteries and accumulators are still landfilled or incinerated, rather than being collected and recycled. In 2002, for example, 45.5% of portable batteries and accumulators sold in the EU-15 went to landfill or incineration, amounting to circa 72155 tonnes[33]. The main environmental concern associated with

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29 Adapted from SEC(2003)1343, Extended Impact Assessment, 24.11.2003

30 OJ L196, 16.8.1967

31 DRAFT TOXICOLOGICAL PROFILE FOR LEAD, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, September 2005

32 Risks to Health and the Environment related to the use of lead in products, TNO report STB-01-39 (Finals)

33 Bio Intelligence 2003, Impact Assessment on Selected Policy Options for Revision of the Battery Directive.

landfilling batteries containing lead are related to the generation and eventual discharge of leachate, in particular the potential contamination of drinking water supplies. The Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE) acknowledges that there is a lack of methodology to assess the long-term risks of leachate from landfills. The main alternative disposal route, incineration, also has negative environmental externalities, in particular the emissions of heavy metals to air. Directive 2000/76/EC on the incineration of waste sets stringent emission limit values. However, an additional issue is that metals such as lead, mercury, cadmium, zinc, nickel, lithium and manganese are found in the bottom-ashes and fly ashes of incinerators, for which a safe disposal route is required. In addition to the impacts of batteries once they become waste, the impacts of the whole life cycle also needs to be considered. (see Table 7).

Table 7: Emissions of lead during production, consumption and disposal of all batteries in the EU-15 (kilotonnes Pb unless stated otherwise)

Year	Production	Consumption			Waste treatment						
	Air emission	Inflow of Pb	Outflow of Pb	Emission	Remains in environment	Recycling	Landfill	Incineration	Emission from incineration to air	Stock on landfill	Emission from landfill to soil
						90-95%	8/7%or 4/3.5%	2/3% or 1/1.5%			0.23 %leakage 0.008% corrosion
1965											
1970	p.m.	446	0	0	0	0	0	0	p.m.	0	0.000
1975	p.m.	476	410	0	0	390	16	4	p.m.	103	0.002
1980	p.m.	573	474	0	0	453	18	4	p.m.	212	0.004
1985	p.m.	694	568	0	0	541	21	5	p.m.	345	0.006
1990	p.m.	800	682	0	0	650	26	6	p.m.	505	0.009
1995	p.m.	869	793	0	0	755	30	7	p.m.	692	0.013
2000	0.21	919	863	0	0	823	32	8	0.03	894	0.016
2005	0.21	947	915	0	0	873	33	9	0.03	1108	0.020
2010	0.22	975	945	0	0	901	34	10	0.03	1328	0.024
2015	0.22	1005	973	0	0	928	34	11	0.04	1555	0.029
2020	0.23	1035	1002	0	0	956	34	13	0.04	1789	0.033
2025	0.24	1066	1032	0	0	984	34	14	0.05	2029	0.037
2030	0.25	1098	1063	0	0	1014	35	15	0.05	2277	0.042

Note: The emission during production is based on the air emissions from industry of 358 tonnes in 1998 (EMEP, 2001) attributed to batteries proportional to the consumption of lead in products in the EU15. The air emission of waste incinerators is based on the emission of 124 tonnes in 1998 (EMEP, 2001) attributed to the different products proportional to the estimated waste streams from discarded products. Pmm = data not analysed. Recycling refers to lead extracted through recycling.[34]

How lead is covered in other EU legislation[35]

Over the last decade EU waste policy has moved away from traditional 'end-of-pipe' solutions, to reducing both the amount and toxicity of waste at source[36]. This approach has been taken in relation to several waste streams, such as end of life vehicles and waste electronic and electrical equipment.

WEEE/ROHS - Batteries incorporated in WEEE will be collected on the basis of the WEEE Directive. For those batteries, battery producers will only become responsible after those batteries are removed from the collected WEEE. Meanwhile, ROHS restricts the use of heavy metals in electrical and electronic equipment, but does not apply to batteries.

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34 Risks to Health and the Environment related to the Use of Lead, TNO-Report STB-01-39,September 2001

35 SEC (2003)1343

36 Insert Efiea reference – check 'decade'

End of Life Vehicles Directive - A similar situation applies to batteries incorporated into end of life vehicles. Those batteries will be collected on the basis of requirements in the ELV Directive. In addition, Article 4(2) of the ELV Directive requires the substitution of mercury, lead, hexavalent chromium and cadmium in vehicles by 1 July 2003. The ELV Directive applies to automotive lead-acid batteries and NiCd batteries used in electrical vehicles. However, there is a list of exemptions from this substitution requirement in Annex II to the Directive: Entry 5 of Annex II provides for an exemption for the use of lead in car batteries without time limitation; and Entry 21 of Annex II provides for a temporary exemption for the use of nickel-cadmium batteries in electrical vehicles until 31 December 2005. The latter was extended to 1 July 2008 in a Decision published in September 2005. Decision 2005/673 also extended by one year to July 2006 allowable uses of lead in valve sets and in vulcanising agents and stabilisers in certain applications, and made a number of other amendments in relation to heavy metal content.

The recent batteries proposal applies without prejudice to the ELV Directive. This means that the substance ban of Article 4(2) of the ELV Directive continues to apply to batteries and accumulators used in vehicles.

Integrated Product Policy (IPP) - The IPP Communication sets as its objective the reduction of environmental impacts from products throughout their life-cycle, harnessing, where possible, a market driven approach, within which competitiveness concerns are integrated. The Commission proposal for a Battery Directive is in line with IPP in the sense that it requires Member States to promote research to increase the overall environmental performance of batteries throughout their entire life-cycle.

Thematic Strategy on the Sustainable Use of Natural Resources - The recycling requirements of the proposed Directive aim to avoid negative impacts of natural resource use. This should be consistent with the approach of the Thematic Strategy (not yet published), which is expected to take into account the impacts during the life cycle of harmful substances. It cites lead as an example: Lead is mined at various locations under very different technical and environmental conditions and then transformed by a multitude of technologies into products such as batteries. Throughout this life cycle some of the lead re-enters the environment where its toxicity may harm biological systems and human health.

Thematic Strategy on the Prevention and Recycling of Waste - The creation of a closed-loop system (to re-incorporate waste in the economic cycle) and the prevention of hazardous waste are important elements of a comprehensive approach to resource management.

Waste incineration - Directive 2000/76/EC on waste incineration sets emission standards for new and existing installations. In the case of incineration of batteries containing lead, lead will be found in the incineration residues and would thereby contribute to emissions of heavy metals to air and reduces the quality of the residues.