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Study on "Elements for an impact assessment on proposed options for capacity labelling of portable primary batteries in the context of the Batteries Directive 2006/66/EC"

Final report

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ABBREVIATIONS

Ah Ampere-hours

BAU Business as Usual

EEE Electrical and Electronic Equipment

EFTA European Free Trade Association

EPBA European Primary Battery Association

EU European Union

FAQ Frequently Asked Questions

GWP Global Warming Potential

IBGE Brussels Administration of the Environment and Energy

IEC International Electrotechnical Commission

LCA Life-cycle Analysis

MAD Minimum Average Duration

mAh Mili-Ampere-hours

MJ Mega Joule

MS Member State

NiCd Nickel cadmium

NiMH Nickel Metal Hydride

UNESAP United Nations Economic & Social Commission for Asia and the

Pacific



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EXECUTIVE SUMMARY

The data on the European Union market for portable primary batteries shows that approximately 160,000 tonnes of portable batteries every year are produced and ultimately deposed of. Although portable primary batteries do not necessarily cause serious damaging environmental impacts during their use phase, these batteries contain metals, which can pollute the environment at the end of their life-cycle. Mercury, lead and cadmium are the most dangerous substances present in batteries.

The new version of the Batteries Directive covering batteries and accumulators and waste batteries and accumulators (Directive 2006/66/EC), officially repealing the 1991 Batteries Directive, was adopted on 6 September 2006 by the European Parliament and the Council. The Directive takes into account the European legislative requirements to decrease the use of hazardous substances and the management of hazardous waste. The primary objective of this Directive is to minimise the negative environmental impact of batteries and accumulators and of waste batteries and accumulators on the human health and the environment, in order to contribute to its protection.

Article 21(2) of the Directive requires that all portable and automotive batteries and accumulators be marked with a capacity label in visible, legible, and indelible form. The capacity label aims at providing useful, easily understandable and comparable information for end-users when purchasing portable and automotive batteries and accumulators. The objective of the capacity label therefore is to communicate to the end-users the information about the appropriate battery type which may lead to reduction in battery waste by achieving market transformation towards higher capacity batteries and accumulators.

First study on capacity labelling of batteries

In 2008, BIO Intelligence Service conducted a study on "Establishing harmonised methods to determine the capacity of all portable and automotive batteries and rules for the use of a label indicating the capacity of batteries" for the European Commission. This first study provided the technical analysis of existing capacity determination methods (i.e. International/European standards and common industry practices). The study further clarified the technical meaning of capacity for each battery type, developed harmonised measurement methods, and proposed several labelling options based on these methods.

Labelling options for each category of battery were developed based on the measurement methods investigated. The first study on capacity labelling of batteries proposed a capacity labelling option for portable primary (non-rechargeable) batteries. A "two-level" method for the capacity/performance labelling was proposed:



- First Level includes basic labelling options which display information derived directly from the existing test standards;
- Second Level focuses on more elaborate labelling options which necessitate further research before it is possible to implement them.

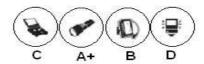
In Figure 1, a first level labelling option is shown. The label includes 4 application tests corresponding to the 1-4 most popular end-use devices of the battery geometry considered.

Figure 1: Basic labelling option ("first level" labelling option)



In Figure 2, a second level labelling approach is shown. The principle of a second level labelling approach is to translate the technical data on performance (e.g. in "service-hours"/ number of "flashes"), which is not always evocative for the end-user, into a letter scale, as is already the case in the European Energy Labelling scheme. The performance data is then replaced by a range of letters associated to the different "Performance classes", i.e. from A to G (from more efficient to less efficient). As a result, there is no need for colour printing.

Figure 2: Letter grading label ("second level" labelling option)



Based on the results of the first study, an informative capacity labelling for portable secondary (rechargeable) and automotive batteries for end-users has been proposed. However, Member States and stakeholders requested additional information, particularly on consumer response to a capacity label for primary batteries, and the feasibility of establishing an implementing measure for the capacity labelling of portable primary batteries. The following issues were raised by various stakeholders regarding:

- Life-cycle data
- Consumer behaviour information
- Possible impacts and implementation issues

Therefore, this present study aims to provide further additional information on the issues listed above. This study in the context of the Batteries Directive 2006/66/EC, seeks to improve the environmental impacts of the portable batteries in use in the European Union by examining the feasibility of labelling options for portable batteries to encourage industry action by providing guidance on their social, environmental and



economic impacts. This study also recommends an optimised capacity labelling option for portable primary batteries and evaluates the impacts of the label to ensure proper implementation of the new requirements in light of the administrative, environmental, and economic impacts created.

The approach and methodology adopted for the work has included detailed and comprehensive reviews of existing literature and legislative sources with targeted and constructive stakeholder input for added value.

Environmental performance of primary versus secondary batteries

The environmental impact of portable batteries in the context of the material and energy flows can be estimated using Life Cycle Analysis. The Life Cycle Analysis approach allows for identification and comparison of environmental impacts from a lifecycle stage to another, between different scenarios for a single system, or between two different systems. The results of a Life Cycle Analysis study are generally presented through several indicators of environmental impacts. These indicators based on full life cycle could provide useful information for capacity labelling of both portable primary and secondary batteries. However, they are not expected to provide any general statement on the relative performance of portable secondary batteries vs. portable primary batteries as a wide range of system configurations are possible (e.g. a primary battery can be alkaline, zinc-carbon or zinc-chloride whereas a battery-operated device can be an alarm clock, a digital camera, a flash light, etc.) which will not allow conclusions valid for both battery types (primary and secondary) at EU level and in all situations.

Only a few existing literature on former Life Cycle Analysis studies on portable batteries quantify the environmental benefits of portable secondary batteries over portable primary batteries using a life-cycle approach. They provide some useful insights on the relative performance of primary batteries vs. secondary batteries but none of these studies cover extensively the overall scope of such a comparison. These studies base themselves on many critical assumptions, which in turn can vary with each study. The results and main conclusions of the most relevant Life Cycle Analysis studies (David Parson, 2007- Study 1, Uniross, 2007-Study 2, and Lankey & McMichael, 2000-Study 5) on portable batteries reviewed above are summarised in Table 1.

Results of these reviewed studies show that for secondary batteries, significant factors in the environmental impact were the production of batteries themselves, the electricity used for wholesaling and retailing, the transport to landfill and the copper, and other components of the battery charger. Conversely, in the case of portable primary batteries (e.g. non-rechargeable batteries), the dominant impacts came from the electrical energy used for wholesaling and retailing the batteries, followed by the production of the batteries.



Table 1: Factor of improvement for portable secondary batteries over portable primary batteries¹

Environmental impact indicators	Study (Box 1)	Environmental impact indicators	Study (Box 2)	Environmental impact indicators	Study (Box 5)
Acidification/Eutrophi cation	108	Non-renewable natural resources use	19	Lead and zinc use	6
Respiratory organics	57	Climate change	29	Water use	81
Respiratory inorganics	90	Photochemical oxidation	32	Coal use	56
Fossil fuels	115	Air acidification	9	Iron use	190
Carcinogens	42	Sedimentary ecotoxicity	12	Electricity	33
Ecotoxicity	60			Copper use	14
Land use	110			SO ₂ release	23
Minerals	10			NO ₂ release	46
Climate change	131			GWP	50

The findings indicate that a harmonised labelling option for portable primary and secondary batteries is not feasible at this stage due to the lack of Life Cycle Analysis studies that provide comparable quantified environmental impacts of portable primary and secondary batteries. Furthermore, the life cycle scenarios covered in the literature reviewed generally focus on one particular type of battery application and neglect others therefore they are not representative of the whole portable battery market. Finally, the Life Cycle Analysis studies cover different geographical scopes, making it difficult to generalise their results and recommendations in the context of the EU (i.e. some of the crucial environmental indicators like Global Warming Potential are heavily impacted by the local energy policies of electricity generation and hence could have different values for different countries).

Consumer behaviour regarding capacity label

In order to more fully understand consumer response to a battery capacity label, so as to develop the most optimised labelling option, information on consumer behaviour was collected through a questionnaire sent to relevant stakeholders (Member States and industry). This was complimented by an in-depth literature review of existing information on consumer behaviour. Overall, 21 questionnaires responses were received from primary battery manufacturers. Due to limited time and resources, primary battery consumers could not be directly consulted for this study, therefore existing literature sources and stakeholders' opinion through targeted questionnaires and interviews were taken into account, which allows for some general observations about consumer response to battery labels.

The numbers in the "boxes 1, 2 and 3" represent the ratio of damage caused by portable primary batteries to that caused by portable secondary batteries on a range of characteristics (environmental indicators) of the damage



Understanding how portable primary batteries are marketed and the purchasing behaviour of consumers is important in order to identify aspects that should be taken into account in order to design a meaningful capacity label for consumers. The analysis on consumer behaviour investigated how consumers purchase portable primary batteries; interpret environmental and technical information related to the product, and how this might influence consumer purchasing decision of portable primary batteries. The analysis also seeks to determine the most effective way to communicate primary battery capacity/performance information so that it is end-user friendly, and determine whether the location and the size of the label strongly influences the end-user's interest in the information displayed, as well as the types of supports that would be most appropriate to ensure maximum impact on the end-user's purchasing decision. Based on literature review and stakeholder views, several observations can be made on the consumer behaviour related to portable primary batteries:

- Portable primary batteries are often spontaneously and impulsively purchased items, therefore labels need to be as effective as possible in conveying the most important information needed to influence the purchasing decision.
- The existence of a primary battery capacity label would allow consumers to compare battery performance across different brands, which could create a competitive advantage by encouraging less recognised brands to produce higher-level performance batteries.
- According to a recent Eurobarometer survey, around 3 in 10 EU citizens answered that the best way for retailers to promote environmentally-friendly products is to provide better information to consumers². The same survey indicated that approximately half of EU citizens thought that retailers should promote environmentally-friendly products in their stores by increasing the visibility of these products on store shelves or by having a green corner dedicated to such products². Almost a fifth of interviewees felt that regular promotions focusing on environmentally-friendly products would be the best way to promote green purchasing.
- Different marketing strategies can also be used to promote the awareness and understanding of a possible battery capacity label through the use of additional in-store information provision such as displays and targeting information campaigns on the battery capacity label during high peak battery sales periods.
- Due to the complex nature of batteries, additional information should be provided to consumers, particularly through the manufacturer's website. This service is currently being provided by many manufacturers who communicate additional product information through their website. Other support such as brochures and in-store information would also be helpful.

² Eurobarometer, 2009, Europeans' attitudes towards the issue of sustainable consumption and production Analytical report for the European Commission; [Available online: ec.europa.eu/public_opinion/flash/fl_256_en.pdf]



- Labels that present the efficiency of a product on a comparative scale such as stars, letters or numbers, or a colour coding system are vastly more preferred and are more easily understood and motivating than those that present technical information only.
- Selection of labelling options³

Eight labelling schemes were analysed and compared based on label design, legibility on information included on the label, technical completeness of the label and consumer comprehensions. The comparison can be seen in Table 2:

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Please note: The labelling option 3 was proposed by the stakeholders after the first study (ecc.europa.eu/environment/waste/batteries/pdf/battery_report.pdf). However, this labelling scheme (option 3c) is thoroughly examined and analysed in the present study.



Table 2: Comparison of the different primary battery labelling options

Labelling option	Example of label	e of label Size of the label ⁴ Legibility Technical completeness of label		Consumer comprehension	
Option 1	XX h XX h XX pulses	Large (horizontal label: 537.5 mm2, vertical label: 530 mm2)	Accurate but complex design	Complete information possible on "lifetime" of the battery and means of comparison among products.	Relatively difficult for the consumer to understand the alpha numeric information presented in this label.
Option 2a		Medium (horizontal label same as vertical label: 430 mm2)	Relatively simpler(than Option 2c) design	Qualitative information on battery performance. Colour coding system provides an indication of the level of performance of the battery in comparison to the average European products.	The colour coding is relatively easier for consumer to understand than option 1.
Option 2b	C A+ B D	Large (same as Option 1)	Relatively simpler (than Option 2c) design	Complete (but less qualitative than Option 2a) information on battery performance. Letter grading system provides an indication of the level of performance of the battery in comparison to the average European products.	The textual information is relatively easier for consumer to understand than option 2a.
Option 2c	XX pulses XX h XX h XX h	Large (same as Option 1)	Accurate design and simpler than Option 1	Most complete information possible on "lifetime" of the battery. Colour coding system provides an indication of the level of performance of the battery in comparison to the average European products.	Alpha numeric information coupled with colour coding makes it easier to comprehend than option 1.
Option 3a	Zinc Carbon Zinc Chloride Alkaline	Small (horizontal label same as vertical label: 102 mm2)	Simple design	Provides relative performance for a product across different battery chemistries.	The star icons used in this label are relatively easier to understand (than option 2b).

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⁴ The reference to size of label (large, medium and small) is done in a relative context to the size of all the labels considered here



Option 3b	∑	★ ★ ★	* Alkaline	Small (same as Option 3a)	Simple design	Provides comparative relative performance for a product across different battery chemistries.	This labelling option using a star ranking system would allow consumers to easily compare and rank the battery performance out of 3 stars making it easier to understand than option 3a.
Option 3c	★ Zinc Carbon	★ ★ Zinc Chloride	★ ★ ★ Alkaline	Small (same as Option 3a)	Simple design	More elaborate form of Option 3a using colour coding.	The colouring of star icons in this label would provide an additional element to convey battery capacity information, however, the use of colours in addition to the star ranking system may be confusing to consumers and harder to interpret than option 3b.
Option 3d	₹ Żinc Carbon	☆ ★ ★ Zinc Chloride	Alkaline	Small (same as Option 3a)	Simple design	Provides means to compare relative performance for a product across different battery chemistries. The use of stars and a colour code runs the risk of confusing consumers as consumers may not necessarily associate specific colours to a specific performance.	The comparative manner of using star icons in this label would provide an additional element to convey battery capacity information, however, the use of colours in addition to the star ranking system may be confusing to consumers and harder to interpret than option 3b.

The eight labelling options are however based only on three different approaches⁵. The most representative labelling option was selected from each of the three different labelling approaches. The following three most promising options are therefore selected out of the overall seven labelling schemes (representative of each of the three different approaches) for analysis:

⁵ The three approaches are first level labelling, second level labelling based on the end use application device and the labelling option based on the battery chemistries



Table 3: Selected labelling options for analysis

Option 1: First level labelling	Option 1: First level labelling Option 2b: Letter grading for popular end- use applications Option 3b: Comparative black and white star ra system based on battery chemistry			_
XX h XX h XX pulses	C A+ B D	∑ Zinc Carbon	★ ★ Zinc Chloride	★ ★ ★



Analysis of proposed capacity labelling options

An analysis was carried out on the environmental, social and economic impacts of the different labelling options suggested for portable primary batteries. These impacts were analysed by taking into account different stakeholders' perspectives. Questionnaires were sent out to primary battery manufacturers and to authoritative bodies responsible for implementing the Batteries Directive in Member States. Overall, 9 responses were received from the Member States (and 21 received from the manufacturers, industry associations and other stakeholders.

In order to express the costs and benefits, and other impacts of the proposed capacity labelling options for portable primary batteries, a number of indicators are used to assess the possible impacts related to the use of a label. Indicators include for example:

- Environmental indicators: battery waste, climate change, energy use, packaging waste
- Social indicators: consumer information, employment generation, time required to implement policy
- Economic indicators: implementation cost (industry), enforcement cost (Member States), control and monitoring

These indicators are mainly estimated on a qualitative basis, except where robust data was available (either through literature review or stakeholder consultation).

The labelling options analysed include:

- Business as Usual (BaU)⁶
- First level labelling (Option 1)
- Second level labelling based on application device for the battery (Option 2b)
- Second level labelling based on battery chemistry (Option 3b)

Business as Usual

The BaU scenario includes the current scope of the Battery Directive with no development of a capacity labelling option for portable primary batteries. This option serves as the baseline for comparison of costs and benefits with the policy options on capacity labelling. The impact of implementation of these labelling options is weighed against BaU option.

At present, in order to help consumers select the battery for their best intended application, some manufacturers display on the blister (packaging) pictograms/icons which aim to inform the applications for which a particular battery type is recommended. Such pictograms however do not indicate the performance level the consumers may expect since that depends on several environmental and usage factors

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Business as Usual scenario assumes that no labelling option will be implemented for the portable primary batteries.



(such as temperature, humidity, continuous or intermittent power demand, etc over which the manufacturers have no control). As no performance level is indicated for these pictograms/icons, for the purpose of control and monitoring of the legibility of these icons, a complex performance testing is not required but simple battery chemistry verification (electrolyte test) will suffice, which costs approximately € 100 per battery⁷. One of the Member States indicated (in the response to the questionnaire) that the enforcement of the Batteries Directive currently costs them approximately € 200 000 per year. This sum may vary depending on how the Batteries Directive is implemented in each Member States. For example, enforcement and monitoring costs can vary from one region to another within a Member States due to differences in several aspects such as geographic area covered, population density, regional organisation, authorities, etc.

Battery producers use these icons and pictograms as a marketing strategy in order to better sell their batteries. Therefore the initiative to display these pictograms and icons on the blisters is carried out by only some manufacturers for a select few of the portable primary batteries produced by them. Therefore, this should be seen more as a marketing strategy than a voluntary labelling initiative with very limited product coverage. In addition, these pictograms and icons were introduced on the blisters of the battery packaging with other major design changes (marketing aspects) on the blister and therefore it is difficult to put numbers (cost estimate) on the design change requirements on the blister specific to these pictograms/icons.

As the icons/pictograms used in the BaU scenario do not provide any information on the performance level of the batteries, it is reasonable to assume that they do not have an effect on the environmental indicators (viz. reduction in primary battery production, climate change and reduction in energy usage). The implementation of the BaU scenario will not have any impact on employment generation (due to very low requirements on testing).

Option 1: First level labelling

Although the design of this label provides the most complete information (on capacity and possible device applications) to the consumer, it is highly technical in nature (the label contains alpha-numeric symbols representing capacity which are also subject to language barriers across Member States).

The icons, and the textual expression used in this labelling scheme, provide a good understanding of the "lifetime" of the battery, and means of comparison between products (end-use-devices). However, the delivered capacity of the primary batteries varies with the operating conditions in which they are used, therefore, the capacity number indicated in this label (corresponding to a value obtained under certain conditions as defined by the IEC standards) could be misleading for the consumer and

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Source: This value reflects EPBA members' estimate of the cost associated with the electrolyte testing requirements



prone to variations. This would therefore risk a low level of accuracy in terms of consumer interpretation of information.

Overall, compared to the BaU scenario, implementation of this labelling option may contribute to the effectiveness of making an informed choice on primary batteries. However, this contribution would not be significant compared to the BaU scenario (given that a high percentage of consumers are characterised as non-battery experts).

o Economic impacts

The survey (carried out using a questionnaire) of portable primary battery manufactures and industry organisations forms the basis of the estimate of average costs provided in this section (one time-costs only) associated with the implementation of labelling option 1. As per the feedback received in this survey, the majority of participants agreed upon a common value for the cost per manufacturer to implement this labelling scheme. The cost breakdown and values agreed upon them are presented in Table 4.

Table 4: Cost breakdown for the implementation of labelling option 18

Implementation stage (per manufacturer)	Average cost (in €)
Testing	37 000
Design changes	423 000
Overhead costs (includes new printing tools)	90 000
Total cost	550 000

The implementation of labelling option 1 would cost the industry approximately five times more compared to the implementation of labelling option 3b. According to some stakeholders, the additional cost of each label in order to make the necessary changes (testing, design and new tools for label printing) and implement it at the product level may cost up to 20% more of the current cost of producing a single unit of portable primary battery.

A questionnaire survey was sent to the authorities responsible at the Member State level for the enforcement and monitoring of any potential future primary battery

The cost estimates values provided in this table are based on a survey of EPBA members.

Source: responses received from manufacturers and industry organisations to the questionnaire survey carried out by BIO (see Annex 2).

Please note:

The cost associated with the design and testing requirements for labeling option 1 and option 2b presented here are only an average number per producer (based on the feedback received from the EPBA members) and the split of cost (between testing and design changes) is a very rough estimation (since not all members have given a split between design and testing costs).

The calculation of cost associated with testing is based on the costs for an external independent testing laboratory

The cost calculation for the design change requirements base itself on the fact that the large size of the labelling option 1 and 2b will have a significant impact on the entire blister card and the way the already present information will have to be reshuffled

The overhead cost among other points include changing numbers and SAP systems



labelling scheme (in the context of Batteries Directive). According to the majority of participants of this survey, costs related to administrative burden and obstacles to overcome non-compliance with the labelling scheme were regarded as the main barriers to the introduction of a possible labelling scheme for portable primary batteries. Agreement on a harmonised primary battery label however was regarded by most of the participants to be a less critical issue for the introduction of such a labelling scheme.

In the opinion of Member States (who responded to the questionnaire), an additional body for monitoring is not required. They suggested that it will most likely be handled by an already existing competent body which monitors the regular marking on batteries. Only 9 Member States responded to the questionnaire, but their response can very well be assumed to be representative (in this context) of all the 27 Member States in the EU as the Batteries Directive applies equally to all the 27 Member States and it already requires each one of them to regularly monitor the batteries for restricted substances (as also expressed by all the 9 Member States who responded to the questionnaire). To accomplish this, each one of these Member States is expected to already have competent bodies, which can also handle the capacity labelling on the portable primary batteries. Two of the Member States indicated (in the response to the questionnaire) that the enforcement of Batteries Directive currently costs them approximately € 200 000 per year.

The costs associated with the control requirements will add to the overall implementation burden of the Member States. The costs associated with the performance testing (as per IEC standards) for labelling option 1 are significant as shown in Table 5⁹. The control requirement for the implementation of option 1 will cost more (approximately 10 times more) than that for the labelling option 3b due to specific requirements on testing ¹⁰.

Table 5: Costs associated with the performance tests required for labelling option 1¹¹

Primary battery type	Cost (in €) per brand tested
AAA	1200
AA	1200
С	1200
D	1200
9V	900

Four application tests for AAA, AA, C and D and 3 application test for 9V portable primary batteries

Four application tests for AAA, AA, C and D and 3 application test for 9V portable primary batteries
 Source: These values reflect EPBA members' estimate of the cost associated with the testing requirements (as per IEC standards) for labelling Option 1 and Option 2b



Social impacts

The implementation of this labelling scheme (option 1) will have a substantial positive contribution towards generation of new employment due to the testing, design and printing requirements in the industry. Time required for the deployment of this labelling scheme at the Member States level would be substantially higher than labelling Option 3b due to the testing requirements. It is estimated that labelling option 1 would require around 18 months for deployment whereas only 12 months will be sufficient in case of labelling option 3b¹².

Environmental impacts

This labelling option would provide consumers with the possibility to compare different portable primary batteries (cost/efficiency). As a result, consumers may purchase batteries with a longer lifetime, corresponding to the most relevant devices and so less overall waste is "produced". It is therefore assumed that this labelling option may result in a slight improvement concerning the choice of the most appropriate battery according to end-application. This, in turn, results in a slight reduction in the overall production of primary batteries, which would also lead to a slight reduction in the consumption of natural resources. Similarly, this labelling option may also result in slight beneficial effects toward climate change and reduction of energy use over their life cycle due to the decrease in CO₂ emissions and energy savings arising from the slight reduction in demand for battery production. In terms of the impact on packaging waste, the slight advantage provided by this labelling scheme (slight reduction in number of batteries produced in turn, resulting in slight reduction in packaging demand) is being compensated for by the additional space requirements on the blister, as this labelling option is quite space intensive (requires 530 mm²), therefore resulting in an overall neutral impact.

Option 2b: Second level labelling based on application device for the battery

Labelling option 2b is a more elaborate version of labelling option 1. This labelling scheme provides complete information, however, not as precise as the labelling option 1. It uses a grading system accompanying the visuals (instead of providing technical information using alpha numeric data as is the case for labelling option 1) which makes it relatively easier for the consumer to interpret the information communicated through this label. One interesting aspect of this option is that the letters provides an indication of the level of performance of the battery in comparison to the average European products. In addition, as the analysis on consumer behaviour has shown, labels that present the efficiency of a product on a comparative scale such as stars, letters or numbers are substantially more preferred, easily understood, and more motivating than those labels that present technical information only The icons and the textual expression of the performance provide a good understanding of the "lifetime" (relative to the "lifetime" of the European average product of such a battery type) of

Source: The estimate on time requirements reflect the opinion of EPBA members' for labeling option 1, option 2b and option 3b



the battery, and means of comparison between products. The design of the label is simple and straightforward, which is important, as overloading the label with excessive or complicated technical information limits both comprehension and engagement with the label.

Comparison of labelling option 2b with BaU scenario

When compared with the BaU scenario (pictograms/icons), the nature of the message conveyed by this labelling scheme (option 2b) is not as easy for the consumer to understand (although it provides elaborate information on the performance level of the battery whereas BaU scenario does not) due to the technical nature of the information conveyed by this labelling scheme (option 2b).

In contrast to the BaU scenario (assuming only a few manufacturers use pictograms/icons on the blister for some of their portable primary batteries), it will cost substantially more to the industry to implement this labelling scheme (option 2b) due to the extra costs associated with the performance testing and design change requirements (€460 000 more per manufacture as compared to BaU scenario).

Similar to option 1, the control and monitoring costs associated with this labelling scheme 2b will add to the overall implementation burden of the Member States compared to the BaU scenario. The costs associated with the performance testing (as per IEC standards) for labelling option 2b will roughly be €1200 (for each battery cell) which is approximately 10 times more than in case control was required in the BaU scenario (electrolyte verification costing only ≤ 100 per test)¹³.

The implementation of this labelling scheme (option 2b) therefore has a slight positive impact on employment generation due to the (testing and design) requirements as compared to the BaU scenario. In the context of BaU scenario, this labelling scheme (option 2b) will require 18 months (substantially high) for implementation.

On top of the end-use application suitability information (also presented by BaU scenario) this labelling scheme (option 2b) includes information on the performance level of the batteries and therefore is advantageous compared to the BaU scenario. The additional information on performance level provided in this labelling scheme (compared to pictograms/icons of BaU scenario) may have substantial contribution to the overall reduction in primary battery production. Similarly, it may also result in substantial beneficial effects toward climate change and a reduction of energy use over their life cycle due to the decrease in CO₂ emissions and energy savings arising from substantial reduction in demand for battery production.

Economic impacts

The implementation (for portable primary battery manufacturers), enforcement and controlling (for Member States) costs based on the feedback received to questionnaire

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Source: These values reflect EPBA members' estimate of the cost associated with the testing requirements (as per IEC standards) and the electrolyte verification test for portable primary batteries



from Member States and other stakeholders are the same as that for the labelling option 1.

Social impacts

The textual nature of information presented in this labelling option makes it less complicated than the labelling option 1 and therefore relatively easier for the consumer to comprehend which results to a slight positive effect to the consumer information impact indicator. The implementation of this labelling option has a slight positive impact on employment generation due to the similar (testing, design and printing) requirements as the option 1. For the same reasons, the time required for the deployment of this labelling scheme will also be substantially high (18 months) when compared to option 3b (only 12 months)¹⁴.

Environmental impacts

This label communicates information to the consumer similar to labelling option 1 but does so more effectively by presenting the technical details corresponding to end-use-device by grades (textual) approach. This labelling option therefore is advantageous compared to option 1 in terms of end-user interpretation. A better consumer interpretation of this labelling option (compared to first level labelling scheme) may have a substantial contribution to the overall reduction in primary battery production, therefore a substantial beneficial effect towards reduction in the consumption of natural resources. Similarly, it may also result in substantial beneficial effects toward climate change and a reduction of energy use over their life cycle due to the decrease in CO_2 emissions and energy savings arising from substantial reduction in demand for battery production. This labelling scheme is as much space intensive as the labelling option 1 (both 530 mm²) but more than the labelling schemes based on battery chemistry (option 3b requires 102 mm²) and hence would have the same impact on packaging waste as in case of labelling option 1.

Option 3b: Comparative black and white star ranking system based on battery chemistry

In light of space constraints on the blister, this labelling scheme requires a relatively smaller area than labelling option 1 and option 2b (Option 1 and Option 2b require approximately 420% more labelling area as compared to labelling Option 3b). It provides the comparative information on the relative performance of a battery in the simplest and effective manner using the "star" icons. The filled (in black colour) "star" icons provide a good means of comparison between various possibilities of chemistries (zinc carbon, zinc chloride and alkaline) for primary batteries. Labels that present the efficiency of a product on a comparative scale such as stars, colour codes, letters or numbers are substantially more preferred, easily understood, and more motivating to consumers than those labels that present technical information only.

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Source: The estimate on time requirements reflect the opinion of EPBA members' for labeling option 1, option 2b and option 3c



Further, due to the easy visual system of star ranking, the vast majority of consumers throughout the EU and European Free Trade Association (EFTA) countries would be able to easily comprehend the ranking scheme, which is based on the classic hierarchy of battery chemistries (i.e. 1 star coloured in "black" for zinc carbon, 2 stars coloured in "black" for zinc chloride and 3 stars coloured in "black" for alkaline primary batteries provides a comparison between the relative performance of these batteries). It is a simple scheme which replicates the differentiation achieved by labelling options 1 and 2b (which base themselves on specific measurement tests).

This labelling successfully communicates qualitatively the information with regard to "lifetime" of the battery. Even though this labelling option does not explicitly indicate the potential end-use application devices for the battery, it is implicitly taken into account in the label, which assigns a performance level (stars) to a particular battery chemistry type based on performance test carried out over a wide range of potential end-use applications (using MAD values). The issue of end-use application devices can however also be addressed by providing complimentary information on display counters in the retail stores, using, brochures, or even through informing salespersons who could communicate this information to consumers.

o Comparison of labelling option 3b with BaU scenario

This labelling scheme (option 3b) is relatively as easy to understand for consumers as the pictograms/icons used in the BaU scenario. However the BaU scenario does not provide any information concerning performance level of the batteries. This labelling scheme (option 3b) therefore is more advantageous for the consumer than the icons/pictograms used in the BaU scenario as it qualitatively (using star icons) provides information regarding the performance level (MAD values) of the battery tested over a wide range of suitable end-use application devices.

The costs associated with the implementation of this labelling scheme (option 3b) for the industry (€90 000) are quite comparable with those required for the implementation of icons/pictograms used in the BaU scenario. This is true for the costs incurred for the implementation by the Member States as well. It is so because similar to the BaU scenario this labelling scheme (option 3b) only requires simple chemistry verification for control and monitoring by the Member States (electrolyte test which costs approximately € 100 per battery).

The implementation of this labelling scheme (option 3b) therefore will not have any impact on employment generation as compared to the BaU scenario (due to similar requirements on testing). In the context of BaU scenario, this labelling scheme (option 3b) will require 12 months for implementation.

The performance level information provided in this labelling scheme (compared to pictograms/icons of BaU scenario) may have slight contribution to the overall reduction in primary battery production. Similarly, it may also result in slight beneficial effects toward climate change and a reduction of energy use over their life cycle due to



the decrease in CO₂ emissions and energy savings arising from slight reduction in demand for battery production.

o Economic impacts

This labelling scheme (option 3b) would reduce (cost approximately 90% less) the overall implementation burden for Member States in comparison to labelling option 1 or option 2b. The enforcement costs for Member States resulting from the requirement of market surveillance (for labelling option 3b) will be fairly low (as no new competent body required at the Member State level due to their current activity in the context of Batteries Directive in the BaU scenario). One of the Member States indicated (in the response to the questionnaire) that the enforcement of battery Directive currently costs them approximately € 200 000 per year. The control and monitoring by the authorities of the labelling option 3b would also not require any complex performance testing because this labelling can easily be verified on the basis of the battery electrolyte test which costs approximately € 100 per battery¹⁵. On top of a very low cost, such a testing can be done very quickly i.e. within a matter of hours.

The labelling option 3b requires approximately only 1% of the overall space on the blister¹⁶. It is therefore assumed that this labelling scheme (option 3b) will not require any design changes due to its very low space requirement which will have insignificant impact on the entire blister card as it can be easily adapted to the blister in its current format (as the already present information on the blister need not be reshuffled).

The majority of stakeholders (primary battery manufacturers and industry associations) believe that the implementation of this labelling scheme would cost 85% – 90% less than the other labelling schemes (option 1 or option 2b) as it does not require any extra testing. An estimate of average costs of implementation per manufacturer (as per the feedback received from industry and industry organisation) is €90 000 (overhead costs only), which is much lower (costs €460 000 less per manufacturer) as compared to Option 1 and Option 2b alike. This labelling option is therefore considerate towards the implementation costs for battery producers and Member States.

Implementation of this labelling scheme presents very low enforcement cost burden for the Member States. This is so because this labelling scheme is easily verifiable since it is based on the chemistry of the battery and no testing needs to be done¹⁷. It is relatively easy to monitor and control this labelling scheme (option 3b). This is so due to the control being only on the battery chemistry (simple electrolyte test needed) while in other cases, the battery performance validation under certain set conditions taking into account consumer use pattern, weather conditions (temperature) and

Source: This value reflect EPBA members' estimate of the cost associated with the testing requirements for labeling option 3b

Please note: Labelling option 3b requires 102 mm² area and the overall area of the blister (see section 5.3.2.1) is 9600 mm²

As for labelling option 3b only a simple electrolyte test is required (€100 per test) which is approximately 90% lower when compared to the control requirements for labelling option 1 or option 2b (€1200 per test)



different drainage rates (low, medium and high) situations (based on appliance they are used in) also needs to be tested.

Social impacts

This labelling scheme has the true advantage of being relatively easier for the consumer to interpret due to its simplicity. This may in-turn reflect in the substantial time savings (gain) to the consumers in terms of making the purchase decision of portable primary batteries. The administrative efforts required for the implementation, enforcement and monitoring of this labelling option are far less than the other labelling options and therefore it may not have a beneficial impact on the generation of employment compared to other labelling options. On the contrary, for the same reasons, this labelling scheme also will be the quickest (only 12 months required for its implementation which is approximately 33% less as compared to option 1 or option 2b) to deploy at the Member State level and therefore would result in a very beneficial impact on time savings for its deployment.

Environmental impacts

Given the simplicity of this labelling option, it may assist consumers in selecting a higher energy content battery. This labelling option however presents the risk of consumers not making the most informed choice possible due to the limited amount of information provided. Thus, this labelling option (like the first level labelling option) may only result in a slight positive contribution towards reduction of energy consumption and damage to climate (CO_2 emissions) over the life cycle of the batteries. Similarly, it also contributes to a slight reduction in battery waste due to the reduction in demand of battery production.

This labelling option takes into account the limited amount of space available on battery packaging. The corresponding space requirements on the blister is lowest for this option when compared to other labelling options and therefore has least impact in terms of the contribution towards packaging waste. The implementation of this labelling option may therefore also have slight beneficial impact towards packaging waste reduction.

Summary of Analysis

Table 6 summarises the possible environmental, economic, social and administrative impact for implementation of the labelling options at the MS and industry level. In each cell of the matrix a qualitative score is given, hence, forming the basis for identifying the most workable approach in an efficient and effective manner.

To compare each of the labelling options assessed, a semi-quantitative score matrix approach is adopted. If there are external influencing factors, a range has been used, for example "0 to -" or even "- to +". Such scores are clarified by an additional note to the matrix. The level of detail in the analysis depends on the amount of information gathered as well as their quality.



Table 6: Impact assessment matrix of various labelling options for primary batteries

Impact Indica	Labelling Option	Option 1	Option 2b	Option 3b
	Economic impact indicate	ors:		
Implementat	ion costs (industry)	High	High	Low
		(€550 000)	(€550 000)	(€90 000)
Enforcement	cost (MS)	Low	Low	Low
Control and r	monitoring cost (MS)	High	High	Low
	Social impact indicators:			
Consumer in	formation	+	++	++
Employment	generation	++	+	0
Duration req	uired for implementation	-	-	+
	Environmental impact inc			
Battery wast	e	+	++	+
Climate chan	ge	+	++	+
Packaging wa	aste	0	0	+
Energy use		+	++	+
Other criteria:				
Degree of un	certainty/risk	+	++	-
Technical fea	asibility			+++

The objective of Table 6 is to compare the impacts (environmental, social and economic) of the three labelling options in light of the current situation so as to come up with the proposal of the optimised labelling option (the BaU scenario is therefore not considered in this table).

Optimised capacity labelling option for portable primary batteries

Based on results of the analysis, **option 3b: comparative black and white star ranking system based on battery chemistry** is the recommended labelling option.

Labelling options 1 and 2b are more technically capable of delivering similar or even better results on reducing environmental impacts, compared to labelling option 3b. However, the cost-effectiveness of implementing these labelling options is also questionable when compared to that for labelling option 3b. This is because options 1 and 2b would entail significant costs (on an average €550 000 implementation costs



each per manufacturer) for the industry. There exists a plethora of battery-using devices that are constantly evolving, therefore it would be expensive (on an average overall €460 000 design and testing costs each per manufacturer) and time consuming as it would require frequent updating, to select a group of products for each battery type. These options therefore present the risk of generating a label with unclear or confusing information to the consumer, at a higher price (on an average overall €460 000 more per each manufacturer when compared to Option 3b).

Labelling option 3b can achieve reduction in environmental damage caused by portable primary batteries, fulfilling a major aim of the Battery Directive, and would involve less administrative burden reflecting in the costs (€460 000 less per manufacturer when compared to Option 1 and Option 2b alike) for manufacturers. As such, the enforcement burden for the Member States in case of Option 3b is significantly reduced (approximately 90% less) relative to options 1 or 2b. This labelling scheme (option 3b) would require a relatively smaller area (approximately 80% less area per label on the packaging when compared to Option 1 and Option 2b). Furthermore, option 3b is based on the battery chemistry (simple electrolyte testing) rather than specific testing requirements (based on end-use applications) when compared to option 1 and option 2b and therefore can be implemented in the short term. Labelling option 3b also has strong stakeholder (involving portable primary battery manufacturers, industry associations, consumer associations, portable primary battery retailers and their associations) support. On the other hand, majority of the Member States (6 out of 9 Member States who responded to the questionnaire) had no preference for any particular labelling, 2 supported the Option 2b and one was in favour of Option 1. Therefore, it is difficult to make a general conclusion regarding Member States' preference for a particular option.

Although Option 3b does not provide detailed quantitative information on primary battery capacity, the star ranking scheme would present primary battery capacity information in a way that is easier to understand by consumers. This labelling option allows consumers to *compare* the capacity of portable primary batteries, which is an important element of an effective labelling scheme. In this labelling option, the label shows 1, 2, or 3 filled in stars out of 3 to give the consumer indication of the battery's capacity ranking. Furthermore, the provision of complementary information such as display counters in stores (shops), brochures, manufacturers' websites, or even through informing salespersons could provide additional information to consumers. Some primary battery manufacturers already provide such complementary materials in their marketing strategies through the use of attractive in store retail displays and through their websites. Nonetheless, it is not guaranteed that complementary information would be read by every consumer at the time of purchasing, nor available in every point of sale locations.

Therefore, based on the analysis of consumer behaviour literature, option 3b, which uses a comparative system based on stars, is deemed to be the most easily interpreted by consumers. Nevertheless, it should be noted that a consumer behaviour survey was



not carried out specifically for this study; therefore the findings on consumer behaviour were not a direct outcome of such a consumer questionnaire. Finally, it is important to note that the discussion on capacity labelling for primary batteries is a new issue for consumers, which requires sufficient understanding on how they perceive and understand this information. As consumers were not directly consulted during the study, an additional consumer survey to compliment the analysis carried out in this study would be useful.

In terms of a policy recommendation based on this study, extensive analysis has not yielded a labelling option that is simple and implementable, can give a clear recommendation to consumers as to which battery type (capacity) to buy for the application needed, and can be certain to yield significant environmental benefits. Moreover, it has been impossible so far to estimate the total and quantified benefits and costs for the options analysed as concerns portable non-rechargeable batteries. It may therefore be recommendable for the Commission to fulfil the requirements of Article 21 of the Batteries Directive (2006/66/EC) by requiring the capacity label adopted for portable rechargeable batteries only, and by granting an exemption from the capacity labelling requirement for all portable non-rechargeable batteries.



1. INTRODUCTION

This document is the final report of the study on "Elements for an impact assessment on proposed options for capacity labelling of portable primary batteries in the context of the Batteries Directive 2006/66/EC" (Service Contract ENV.G.4/FRA/2007/0067). The purpose of this report is to present the current status of the study to propose and carry out the assessment of impacts of capacity labelling of portable primary batteries (taking into account life-cycle environmental impacts and consumer behaviour) in the context of the Batteries Directive (2006/66/EC)¹⁸. Providing these information needs will allow for an optimised proposal for a portable primary battery capacity label. The capacity label aims at providing useful, easily understandable and comparable information for end-users when purchasing portable primary batteries. Such information helps in reducing battery waste by achieving market transformation towards higher capacity batteries.

1.1. REPORT STRUCTURE

Chapter 1 introduces the document structure, objectives, and the adopted approach.

Chapter 2 provides a brief introduction to the previous (first) study¹⁹ on establishing harmonised methods to determine the capacity of all portable and automotive batteries in order to describe the context of the present study.

Chapter 3 assesses the overall environmental performance of portable primary vs. secondary batteries to determine the feasibility of a single labelling scheme for both primary and secondary portable batteries.

Chapter 4 analyses end-user interpretation of different aspects of performance/capacity labelling options through a targeted stakeholder questionnaire survey, complimented by an in-depth literature review.

Chapter 5 assesses the environmental, social and economic impacts of the different options of the labels suggested for primary batteries and the ones already existing (first and second level).

Chapter 6 proposes an optimised labelling technique for portable primary battery, which is based on the evaluation of different labelling options for their technical completeness and their effectiveness from visual communication point of view.

Chapter 7 providers final conclusions of the report.

Finally the Annex includes supporting information for the report.

 $^{^{18}}$ OJ L 266, 26.9.2006, p. 1. Directive as last amended by Directive 2008/103/EC (OJ L 327, 5.12.2008, p. 7–8).

¹⁹ The study can be found at: ec.europa.eu/environment/waste/batteries/pdf/battery_report.pdf



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BACKGROUND & OBJECTIVES 2.

2.1. **BACKGROUND**

The European Union (EU) market for batteries and accumulators is estimated to be about 800,000 tonnes of automotive batteries, 190,000 tonnes of industrial batteries, and 160,000 tonnes of portable batteries every year. These batteries and accumulators contain metals, which might pollute the environment at the end of their life-cycle. Mercury, lead and cadmium are the most dangerous substances present in batteries.

Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators was meant to promote a less-polluted environment by minimising the quantities of harmful substances in batteries and accumulators. The Directive aims also at developing harmonised capacity labelling requirements to ensure the smooth functioning of the internal market and avoid distortion of competition within the EU.

Article 21(2) of the Directive requires that all the portable and automotive batteries and accumulators be marked with a capacity label in visible, legible, and indelible form. The capacity label aims at providing useful, easily understandable and comparable information for end-users when purchasing portable and automotive batteries and accumulators. The objective of the capacity label therefore is communicating to the end-users the information about the appropriate battery type which may lead to reduction of battery waste and market transformation towards higher capacity batteries and accumulators.

2.2. **BATTERIES DIRECTIVE (2006/66/EC)**

The new Batteries Directive (Directive 2006/66/EC), repealing the 1991 Batteries Directive, was adopted on 6th September 2006 by the European Parliament and the Council. It entered into force on 26th September 2006²⁰. Taking into account the European legislative requirements to decrease the use of hazardous substances and the management of hazardous waste, the primary objective of this Directive is to minimise the negative environmental impact of batteries and accumulators and of waste batteries and accumulators on the human health and the environment, in order to contribute to its protection.

This Directive covers all types of batteries and accumulators, regardless of their shape, volume, weight, material composition, or use. However, when used for the purpose of maintaining Member States' (MS) security or when intended to be sent into space,

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the further details on Directive. please visit the European Commission's website: ec.europa.eu/environment/waste/batteries/index.htm



such batteries and accumulators are excluded from the scope of this Directive. Some key definitions used in the Directive which are relevant for the current study are explained below:

- "Battery" or "accumulator": these terms refer to any source of electrical energy generated by direct conversion of chemical energy and consisting of one or more primary battery cells (which are non-rechargeable) or consisting of one or more secondary battery cells (which are rechargeable);
- "Portable battery or accumulator"21: means any battery, button cells, battery
 pack or accumulator that is sealed and can be hand-carried, and is neither
 industrial battery or accumulator nor automotive battery or accumulator.

2.3. FIRST STUDY ON CAPACITY LABELLING OF BATTERIES

In 2008, BIO Intelligence service (BIO) completed a study on "Establishing harmonised methods to determine the capacity of all portable and automotive batteries and rules for the use of a label indicating the capacity of batteries" for the European Commission. This study will henceforth be referred to as the first study. This first study provided the technical analysis of existing capacity determination methods (i.e. International/European standards and common industry practice). The study further clarified the technical meaning²² of capacity for each battery type, developed harmonised measurement methods, and proposed several labelling options based on these methods.

2.3.1. Scope

The following three categories of batteries and accumulators were investigated:

- Portable primary (non-rechargeable) batteries Alkaline, manganese, zinc carbon, lithium, zinc air, silver oxide, nickel oxyhydroxide, and lithium iron
- Portable secondary (rechargeable) batteries and accumulators Nickel cadmium, nickel metal hydride, lithium ion, lithium polymer and lead-acid
- Automotive batteries and accumulators Lead-acid

2.3.2. TECHNICAL MEANING OF "CAPACITY"

The technical meaning of the capacity of a battery is a measure of the energy contained within a battery under set conditions expressed in "Ampere—hours" (Ah). This "technical capacity" is not the only information used by battery manufacturers to

Please note: For the purpose of this study, the word "battery" is used to signify both a "battery" and an "accumulator".

The technical meaning of capacity for a battery is a measure of the energy contained within a battery under set conditions expressed in "Ampere-hours" (Ah)



communicate on the capability of their products. Therefore, the first study distinguished between "rated" and "delivered" capacity varying across the type of batteries:

- "Rated" capacity is the measure of energy contained within a battery under set conditions. This is a theoretical value and is measured in "Ampere-hours" (Ah);
- "Delivered" capacity is also measured in "Ampere-hours" (Ah) but reflects the actual energy available to the end-user in the specific circumstances in which the batteries are used. This value is highly dependent on factors such as: the device, operating temperature, minimum operating voltage of device, continuous or intermittent use of device by the end user and battery age. The information is usually provided in terms of "performance" expressed in "service-hours" which refers to duration of the discharge or a number of "pulses" (i.e. a number of flashes a battery can deliver when used in a camera).

For portable secondary batteries and accumulators, the frequency of use by the endusers does not influence the delivered capacity to a great extent. Therefore, for both portable secondary and automotive batteries and accumulators the "delivered" capacity is not greatly dependant on the device and it can be easily measured through the existing test²³. On the contrary, in the case of portable primary batteries, the "delivered" capacity is highly dependent on the drain rate²⁴ (load) of a device and how frequently an end-user uses a device. As such, for portable primary batteries, there is no single battery capacity marking that would be appropriate or representative of the battery's performance for all electrical devices because of the nature of these batteries. This is further reflected in the existing test standard for primary batteries.

Based on the existing test standards²⁵, the first study defined a unit for displaying the capacity/performance for each type of battery as per following:

- Portable secondary batteries and accumulators: "Ampere-hours" (Ah) or "mili-Ampere-hours" (mAh)
- Automotive batteries and accumulators: "Ampere-hours" (Ah) for the capacity and "Amperes" for the cranking current
- Portable primary batteries: "service-hours" or "pulses".

2.3.3. CAPACITY LABELLING

Labelling options for each category of battery were developed based on the measurement methods investigated. These were either based on a display of a single "rated" capacity for portable secondary batteries and accumulators, or on display of up

²³ IEC/EN 60622; IEC/EN 61951; IEC/EN 61960; IEC/EN 61056

The drain rate refers to how fast energy is taken from the battery – higher the demand the lower the capacity and performance.

²⁵ IEC/EN 60086 for portable primary batteries, IEC/EN 60622; IEC/EN 61951; IEC/EN 61960; IEC/EN 61056 for portable secondary batteries, and IEC/EN 60095 for automotive batteries



to four performance results (in "service hours") related to specific application for portable primary batteries.

Based on the results of the first study, an implementing measure establishing the capacity labelling rules for portable secondary (rechargeable) and automotive batteries and accumulators has been developed.

The first study also investigated the possibility of harmonising the labelling options between primary and secondary batteries but concluded that a global approach based on life-cycle analysis is required to serve as a basic tool for rating and comparing portable primary and secondary batteries.

The first study on capacity labelling of batteries proposed a capacity labelling option for portable primary (non-rechargeable) batteries. A "two-level" method for the capacity/performance labelling was proposed:

- First Level includes basic labelling options which display information derived directly from the existing test standards;
- Second Level focuses on more elaborate labelling options which necessitate further research before it is possible to implement them.

In Figure 3, a first level labelling option is shown. The label includes 4 application tests corresponding to the 1-4 most popular end-use devices of the battery geometry considered. The result is an integrated format label with up to 4 pictograms inserted in a circle (i.e. the icon), depicting the selected applications and their associated number of "service hours" or "pulses". The unit is indicated by its abbreviation, e.g. "h" instead of "hours", except for "pulses" which should be written without any abbreviation. For an easier understanding of the labelling information, the term "pulses" could be envisaged to be replaced by "flashes".

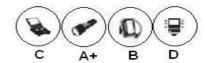
Figure 3: Basic labelling option ("first level" labelling option)



In Figure 4, a second level labelling approach is shown. The principle of a second level labelling approach is to translate the technical data on performance (e.g. in "service-hours"/ number of "flashes"), which is not always evocative for the end-user, into a letter scale, as is already the case in the European Energy Labelling scheme. The performance data is then replaced by a range of letters associated to the different "Performance classes", i.e. from A to G (from more efficient to less efficient respectively). As a result, there is no need for colour printing.



Figure 4: Letter grading label ("second level" labelling option)



The other alternative options proposed could investigate ways to simplify the label either by analysing the possibility to aggregate the 4 performance indicators into a single letter or using another performance indicator based on chemistry rather than based on the number of service hours.

Based on the results of the first study, an informative capacity labelling for portable secondary (rechargeable) and automotive batteries for end-users has been proposed. However, Member States and stakeholders requested additional information, particularly on consumer response to a capacity label for primary batteries, and the feasibility of establishing an implementing measure for the capacity labelling of portable primary batteries. **This issue is the focus of the current study.**

For portable primary batteries, the labelling options proposed during the first study suggested to display up to four performance data in order to be representative of the diverse usage and behaviour of the battery. Despite being representative of the battery's performance across the majority of the possible various end-use appliances in which a battery can operate, and despite providing the information to support the comparison between different primary batteries of the same geometry, some issues were raised by various stakeholders regarding the limited number of four performance data, which does not cover the full range of possible uses and the challenge in communicating information on a multi-indicator label (i.e. four performance data). The following issues were raised by various stakeholders regarding:

- **Life-cycle data:** a comparison of the performance of portable secondary and primary batteries is needed in order to determine the feasibility of establishing a single capacity label for both battery types.
- Consumer information: The limited number of four performance data does not
 cover the full range of possible uses. Further, a label that conveys multiindicators could be challenging for consumers to interpret. The industry also
 raised their concern that the real life performance of the battery might deviate
 from the measured performance under testing conditions due to
 environmental and use factors and this could be confusing for the end-user.
- Implementation issues: (both for industry and Member States), i.e. practical and economic consideration related to the possible impacts (social, economic and environmental), proper implementation, monitoring and enforcement of the labelling options.

Therefore, MS and stakeholders requested additional information not covered in the first study being able to establish an implementing measure for the capacity labelling of portable primary batteries.



2.4. STUDY OBJECTIVES

The main objective of this study is to provide further additional information on the lifecycle comparison of portable secondary and primary batteries, consumer interpretation of battery labels, and possible impacts of the new capacity labelling requirements for portable primary batteries from an administrative, economic and environmental point of view. This study in the context of the Batteries Directive 2006/66/EC, seeks to improve the environmental impacts of the portable batteries in use in the EU by examining the feasibility of labelling options for portable batteries to encourage industry action by providing guidance on their social, environmental and economic impacts.

This study will recommend an optimised capacity labelling option for portable primary batteries and evaluate impacts of the label to ensure proper implementation of the new requirements in light of the administrative, environmental, and economic impacts created.

2.5. APPROACH

The approach followed for this study is built around the result of the first study and complements the data in relation to:

- Environmental impacts caused by primary vs. secondary batteries over the lifecycle
- Consumer interpretation of delivered and rated performances data and other capacity/performance information
- Possible administrative, economic, and environmental impacts of the new labelling requirements.

This approach enables an effective and scientifically valid assessment of developing a list of labelling options for portable primary batteries. It aims to incorporate detailed and comprehensive in-depth reviews of existing literature and legislative sources with constructive and targeted stakeholder input to bring added value. The stakeholder consultations were carried out to collect data by organising stakeholder meetings, interviews, and via electronic questionnaires. This therefore ensures delivery of robust and well founded conclusions and recommendations.



3. ENVIRONMENTAL PERFORMANCE OF PRIMARY VS. SECONDARY BATTERIES

This chapter aims to collect data on the overall environmental performance of portable primary vs. secondary batteries. In theory, a comparative Life Cycle Assessment (LCA) could technically serve as the best tool for rating and providing the necessary information. The environmental impact of portable batteries in the context of the material and energy flows can be estimated using LCA. The various phases in the complete life-cycle of a portable battery are shown in Figure 5. The LCA approach allows for identification and comparison of environmental impacts from a lifecycle stage to another, between different scenarios for a single system, or between two different systems. The LCA can thus be used within a "design for the environment" approach, at the time of decision-making as well as for comparative analysis of alternative product systems.

The LCA is a multi-criterion approach in which no global environmental mark is given. Nonetheless, the results of a LCA study are generally presented through several indicators of environmental impacts. These indicators based on full life cycle could provide useful information for capacity labelling of both portable primary and secondary batteries. However, they are not expected to provide any general statement on the relative performance of portable secondary batteries vs. portable primary batteries²⁶ as a wide range of system configurations are possible (e.g. a primary battery can be alkaline, zinc-carbon, lithium whereas a battery-operated device can be an alarm clock, a digital camera, a flash light, etc.) which will not allow establishing conclusions valid at EU level and in all situations.

Please Note: Henceforth, portable secondary batteries and portable primary batteries are referred to as secondary and primary batteries respectively throughout this report.



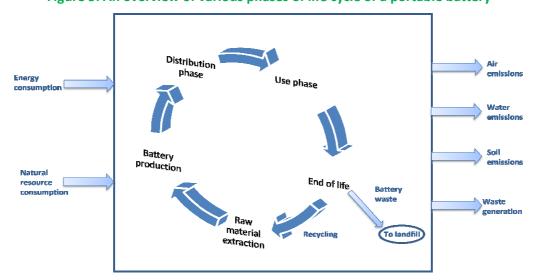


Figure 5: An overview of various phases of life cycle of a portable battery

3.1. LITERATIVE REVIEW OF LCA STUDIES

The analysis presented in this section is based on literature review and information gathering from experts. The literature on former LCA studies on portable batteries is reviewed in the templates below. However, only a few studies have quantified the environmental benefits of portable secondary batteries over portable primary batteries using a life-cycle approach. They provide some useful insights on the relative performance of primary batteries vs. secondary batteries but none of these studies cover extensively the overall scope of such a comparison. These studies base themselves on many critical assumptions, which in turn can vary with each study. This is a matter of concern, which was also raised by some stakeholders (for example, members of the EPBA – European Portable Battery Association²⁷). The stakeholders recommended carrying out a dedicated LCA study, covering thoroughly the scope of primary and secondary batteries available in the market to come up with meaningful conclusions based on a more realistic comparison.

David Parson (2007) reported a comparative study on environmental impacts of primary and secondary batteries in the context of Australian portable battery market (see Box 1). Very similar studies were conducted by Uniross (conducted by BIO for Uniross in 2007, see Box 2) and Lankey and McMichael (2000, see Box 5) based on input-output data for the EU and the USA respectively. All these studies compared the environmental impacts of secondary AA batteries (both NiCd- Nickel cadmium and NiMH - Nickel Metal Hydride for David Parson, NiMH for Uniross and NiCd for Lankey and McMichael)²⁸ against primary AA (alkaline) batteries. The assumption made regarding the possibility to recharge secondary batteries varied across these studies

²⁷ European Portable Battery Association; (www.epbaeurope.net)

Please Note: NiCd stands for Nickel Cadmium battery and NiMH represents Nickel Metal Hydride Battery



being either 400 or 50 times (two scenarios, most optimistic and least optimistic respectively) for David Parson (2007), 330 times for Uniross (2007) and 200 times for Lankey and McMichael (2000). These studies take into account various life cycle stages including production, distribution, use and end of life phase. From a system perspective, all these studies take into consideration the battery charger used (David Parson (2007) study also includes partial recycling and disposal to landfill these batteries). The systems being compared includes:

- The battery + charger+ recharging process: for the secondary battery
- The number of primary batteries required to produce energy equivalent to that provided by the overall use phase of the secondary battery: for the primary battery

The evaluation of these studies was overwhelmingly in favour of the secondary battery option. This was reflected in every impact criteria studied and even for less than optimistic scenarios of battery use such as significant shelf life or high discharge rates (David Parson, 2007).



Box 1: Literature review of study 1

STUDY TITLE	THE ENVIRONMENTAL IMPACT OF DISPOSABLE ²⁹ VERSUS RE-CHARGEABLE		
	BATTERIES FOR CONSUMER USE		
Goal of study	Validate that portable secondary batteries have a lower impact on the environment		
	when compared to the portable primary batteries.		
Publication year	2007		
Authors	David Parsons (Int J LCA 12 (3) 197–203)		
Geographical	Australia		
coverage			
Website/source	www.springerlink.com/content/r104g3640u736674/fulltext.pdf		
Environmental indicators	Impact on human health; Ecosystem quality and Resource consumption		
	Acceptable and address and a state of wide Class Day		
Data sources	Australian databases associated with SimaPro		
Functional unit ³⁰	Delivery of 1 kWh of energy to an electronic device		
Assumptions	Rechargeable batteries can be used either 400 or 50 times		
Drainage rate	Both slow and fast drainage rates analysed		
Methodology	The life cycle inventory of each of the alternatives takes into account:		
· .	 Charger for rechargeable batteries including discharge & recharging process 		
	 Recharging efficiencies of batteries and energy efficiencies of charger. 		
	 Energy use in wholesale and retail parts are also accounted for 		
Product scope	Three alternative battery system scenarios are considered:		
	 Portable secondary battery: NiMH (AA cells) of nominal capacity 1200 mAh 		
	Portable secondary battery: NiCd (AA cells) of nominal capacity 800 mAh		
	Portable primary battery: Alkaline (AA cells) of nominal capacity 800 mAh		
Results	NiMH batteries use compared to NiCd batteries, considering only the recycled case,		
	results in a significant benefit (18%) to human health, and (13%) to ecosystem quality plus a lesser (4%) benefit to resources. (for 400 cycles)		
	NiMH batteries compared to alkaline batteries cause about 96 times less damage to		
	each of the three damage criteria (for 400 cycles).		
	Substantial contribution to the impact of rechargeable batteries comes from the		
	production phase, electricity used for wholesaling and retailing, transport to landfill		
	and the copper and other components in the battery charger.		
	The dominant impacts for the disposable batteries came from the electrical energy		
	used for wholesaling and retailing the batteries, followed by the production phase.		
	Damage caused by the generation of electricity for recharging the batteries is also		
	significant, amounting to about 10% for the NiMH batteries		
	In a less optimistic scenario (50 cycles for NiMH batteries), the factors of advantage over alkaline cells ranged from 30 to 42 for the three damage categories		
	In a less than optimistic scenario (50 cycles and long shelf life for the NiMH		
	batteries and a high discharge rate for the alkaline batteries), the factors of		
	advantage range from 27 to 36 for the same three damage categories.		
Conclusions	The evaluation carried out in the study strongly supports rechargeable battery over		
	disposable batteries. The conclusion is backed by the environmental impact of each		
	of the criteria studied even for less than optimistic scenarios of battery use such as significant shelf life or high discharge rates.		
	7		
Comments	Study results and conclusions are very informative and based on thorough analysis		
	of portable batteries market.		

²⁹ Please note: The term "disposable battery" is used to signify a "portable primary battery" here

In order to facilitate the comparison of different options (use of secondary batteries, recharge cycles, use of primary batteries) a common reference needs to be defined. Such a reference is called a "functional unit" and is a measure of the function of the studied system. It provides a reference to which the inputs and outputs of an LCA can be related.



Box 2: Literature review of study 2

STUDY TITLE	UNIROSS STUDY ON THE ENVIRONMENTAL IMPACT OF BATTERIES			
Goal of study	Assess the environmental impact of the portable primary and secondary batteries throughout their life cycle including production, sale, use phase and end of life.			
Publication year	2007			
Authors	BIO Intelligence Services (FR), Fraunhofer Institute IZM (DE) for critical review			
Geographical	EU – 25			
coverage				
Website/source	www.rechargeonslaplanete.net/_docs/UNIROSS_Study			
	Environmental impact of	<u>batteries.pdf</u>		
Environmental indicators	Consumption of natural resources; Global warming; Ozone pollution; Air acidification and Water pollution			
Data sources	European Environment Agency for waste packaging data, Uniross, end-of-life			
		ery Directive and WEEE Directive respectively.		
Functional unit	1 kWh of delivered energy to an electronic device			
Assumptions	25% of all batteries are recycled and rest are collected in household waste The hatter selection and after each of the control of the c			
	 The battery charger is unplugged after each use Rechargeable batteries provide 90% of their nominal power with each use 			
	 Rechargeable batteries provide 90% of their nominal power with each use Life expectancy for a rechargeable battery: 0.9 kWh of energy supplied 			
	throughout all charge/discharge cycles,			
Drainage rate	Frequent use and little self-discharge (daily use in a MP3 player)			
Methodology	Based on the comparative Life Cycle Analysis (LCA) method for a portable secondary (rechargeable) battery and its equivalent in portable primary (disposable) battery.			
Product scope	The study compares two all	ternative battery system scenarios:		
	 Portable secondary battery: Uniross 2500 mAh NiMH rechargeable batteries 			
	(size AA) accompanied with Uniross 1h Sprint charger.			
Danilla		itter: 2500 mAh alkaline batteries (size AA)		
Results	For 1 kWh of energy produced, portable	Up to 32 times less impact on the environment Up to 23 times less impact on non-renewable natural		
	secondary rechargeable	resources		
	batteries as compared to	Up to 28 times less impact on global warming		
	portable primary disposable batteries are:	Up to 30 times less impact on ozone pollution		
		Up to 9 times less impact on air acidification		
		Up to 12 times less impact on water pollution		
Conclusions		ary (NiMH) batteries is better for the environment than		
	the use of portable primary (alkaline) batteries. Irrespective of the capacity of the battery or the end-of-life route (municipal solid waste or recycling), NiMH batter generate significantly less environmental impacts than alkaline batteries.			
Comments	Limitations of the study:	invironmental impacts than alkaline batteries.		
Comments	•	other possible chemistries of rechargeable and		
	disposable batteries, therefore, not representative of the overall portable			
	battery market.			
	 Does not consider the scenario of slow drainage rate or infrequent use, 			
	therefore, not accounting the possibility to be used in the devices with such			
	characteristics.			



Box 3: Literature review of study 3

STUDY TITLE	BATTERY WASTE MANAGEMENT LIFE CYCLE ASSESSMENT		
Goal of study	To determine the environmental impacts associated with collection and recycling targets and to estimate the financial cost of alternative scenarios for implementing the requirements in the Directive on Batteries and Accumulators.		
Publication year	2006		
Authors	Environmental Resources Management		
Geographical	United Kingdom: collection of batteries		
coverage	United Kingdom and Europe: battery recycling		
Website/source	www.defra.gov.uk/environment/waste/topics/batteries/pdf/erm-lcareport0610.pdf		
Environmental indicators	Abiotic depletion; Global warming; Ozone layer depletion; Human toxicity; Fresh water aquatic ecotoxicity; Terrestrial ecotoxicity; Acidification and Eutrophication.		
Data sources	Material and energy consumption data for collection, sorting and recycling provided by stakeholders form the European battery waste management industry. Published life cycle inventory (secondary) data used to describe the production of these material and energy inputs.		
Functional unit	Management of portable battery waste arising in the UK between 2006 and 2030.		
Assumptions	Assessment includes the collection, sorting, recycling and residual waste management of the battery		
Drainage rate	Not Applicable (N.A.)		
Methodology	Nine implementation scenarios for portable battery waste management combining three different collection mixes and three different recycling mixes were assessed for the period 2006 to 2030. These were compared with a tenth baseline scenario which assumes all batteries are managed as residual waste.		
Product scope	The study covers the waste management of following consumer portable batteries (including both rechargeable and disposable batteries): PRIMARY: Silver Oxide (AgO), Zinc Air (ZnO), Lithium Manganese (LiMn), Lithium (Li), Zinc carbon (ZnC), Alakaline Manganese (AlMn) SECONDARY: Lithium Ion (Li-ion), Nickel cadmium (NiCd), Nickel Metal Hydride (NiMH), Lead Acid (PbA).		
Results	Not Applicable (N.A.)		
Conclusions	Increasing recycling of batteries is beneficial to the environment. However, it is achieved at significant financial cost when compared with disposal.		
Comments	 Limitations of the study: No environmental impacts comparison, at the end of life, of primary and secondary batteries. The manufacturing and use phase of the batteries are not considered 		



Box 4: Literature review of study 4

STUDY TITLE	ENVIRONMENTAL ASSESSMENT OF BATTERY SYSTEMS		
Goal of study	Evaluate the environmental impact of recycling rechargeable NiCd batteries		
Publication year	2003		
Authors	Carl Johan Rydh		
Geographical	Sweden		
coverage			
Website/source	homepage.te.hik.se/personal/tryca/battery/Rydh_2003_Battery_metal_flows.pdf		
Environmental indicators	Resource usage, water pollution, primary energy use		
Data sources	LCA databases, literature review, interviews, questionnaires and reports on NiCd batteries		
Functional unit	A battery with an energy storage capacity of 1 Wh of electrical energy		
Assumptions	 Modelling of cadmium and nickel as closed-loop recycling 		
	Metal emissions during battery manufacturing		
	Load factor of trucks and transport distances		
Drainage rate	Not Applicable (N.A.)		
Methodology	LCA approach to identify the following life cycle activities with significant impact were evaluated: Different recycling rates Different time boundaries for emissions of landfilled metals		
Product scope	Portable secondary (rechargeable) NiCd batteries		
Results	Excluding the user phase of the battery, 65% of the primary energy is used in the manufacture of batteries while 32% is used in the production of raw materials.		
	Metal emissions from batteries to water originate (96-98%) from landfilling and incineration.		
	Batteries manufactured with recycled nickel and cadmium instead of virgin metals has 16% lower primary energy use.		
	Considering an infinite time perspective, the potential metal emissions are 300-400 times greater than during the initial 100 years.		
	Recycled cadmium and nickel metal require 46 and 75% less primary energy, respectively, compared with extraction and refining of virgin metal.		
Conclusions	The transportation distance for the collection of batteries has no significant influence on energy use and emissions. Cadmium should be used in products that will probably be collected at the end of their life so as to avoid its dissipative losses.		
Comments	The environmental impact of portable primary batteries is not assessed The manufacturing and use phase of the batteries are not considered		



Box 5: Literature review of study 5

STUDY TITLE	LIFE-CYCLE METHODS FOR COMPARING PRIMARY AND RECHARGEABLE BATTERIES			
Goal of study	Evaluate the total environmental impact of portable primary and secondary batteries			
Publication year	2000			
Authors	Rebecca L. Lankey and F	Francis C. Mcmichael, U.S. Environment Protection Agency		
Geographical	U.S.A.			
coverage				
Website/source	Environment Science Technology, 2000, Volume 34, pages 2299-2304			
Environmental indicators	Global warming potential (GWP); Ozone depletion potential; Median external cost due to criteria air emissions; Conventional pollutants; Hazardous waste			
Data sources	1992 commodity input-output matrix of U.S. economy as developed by the U.S. Department of Commerce, 1992 Census of Manufacturers, the U.S. Environmental Protection Agency (1995) Toxics Release Inventory (TRI), the 1995 Annual Survey of Manufacturers, 1993 biannual U.S. EPA report on Resource Conservation and Recovery Act (RCRA) hazardous waste.			
Functional unit	The following two functional units have been used in this study: \$100 million market demand for both portable secondary (rechargeable) and primary (disposable) battery sectors. \$100 million market demand for portable primary (disposable) and a functionally equivalent demand for secondary (rechargeable) battery sector.			
Assumptions	 Rechargeable batteries can be used 200 times (charging cycles) Secondary battery costs 4 times more than an equivalent primary battery 			
Drainage rate	Not Available			
Methodology	The methodology is based on the Economic Input-Output Life Cycle Analysis (EIO-LCA) technique. Resource use and economic and environmental impact of the batteries are analysed separately during production, use and end of life phases.			
Product scope	The study compares two alternative battery system scenarios: Portable secondary battery: NiCd rechargeable batteries accompanied with a charger. Portable primary batter: Zinc alkaline batteries			
Results	Portable secondary	Requires up to 81 times less water resources		
	(rechargeable)	Need up to 33 times less electricity		
	batteries as	Converted fuel equivalent demand is about 49 times less		
	compared to portable primary (disposable) batteries:	Needs to be reused 17 times to equal the impact of air release		
Conclusions	Resource use and emissions are substantially lower if a rechargeable battery can be substituted for a primary battery. However, consumer use patterns will affect the relative environmental benefits of rechargeable batteries.			
Comments	No information provided regarding the drainage rate during use phase, it's very crucial to carry the comparison as disposable battery capacity is strongly influenced by the characteristics of the electronic device that it is used in.			



3.2. COMPARATIVE ANALYSIS

The results and main conclusions of the most relevant LCA studies (David Parson, 2007-Study 1, Uniross, 2007-Study 2, and Lankey & McMichael, 2000-Study 5) on portable batteries reviewed above are summarised in the table below:

Table 7: Factor of improvement for portable secondary batteries over portable primary batteries according to the studies reviewed in this section

Environmental impact indicators	Study (Box 1)	Environmental impact indicators	Study (Box 2)	Environmental impact indicators	Study (Box 5)
Acidification/Eutrophi cation	108	Non-renewable natural resources use	19	Lead and zinc use	6
Respiratory organics	57	Climate change	29	Water use	81
Respiratory inorganics	90	Photochemical oxidation	32	Coal use	56
Fossil fuels	115	Air acidification	9	Iron use	190
Carcinogens	42	Sedimentary ecotoxicity	12	Electricity	33
Ecotoxicity	60			Copper use	14
Land use	110			SO ₂ release	23
Minerals	10			NO ₂ release	46
Climate change	131			GWP	50

David Parson (2007) commented that NiCd and NiMH batteries showed little difference except for human health where the toxicity of cadmium gave a 20% advantage to NiMH batteries. For an optimistic scenario of 400 recharging cycles, secondary batteries caused less environmental damage by factors varying from 10 to 131 when compared to primary batteries. For secondary batteries, significant factors in the environmental impact were the production of batteries themselves, the electricity used for wholesaling and retailing, the transport to landfill and the copper and other components in the battery charger. Conversely, in the case of disposable alkaline batteries, the dominant impacts came from the electrical energy used for wholesaling and retailing the batteries, followed by the production of the batteries.

Although the results of Uniross (2007) and Lankey & McMichael (2000) studies agree broadly with those of the David Parson (2007) study regarding the lower environmental impacts of secondary batteries compared to primary batteries, given the difference in the geographies covered and assumptions made in these studies, these results do not sufficiently complement each other in order to make concrete recommendations at the EU level.



3.3. LABELLING OPTIONS

This section evaluates the potential of a single labelling scheme for both primary and secondary portable batteries based on the analysis performed in the previous section. When compared to the capacity labelling options discussed in the first study, LCA based labelling would have the advantage of focusing the message clearly on the environmental impacts of portable batteries; however the extent of such an advantage is questionable. Therefore, the possibility of a single labelling option for both types of batteries at this stage seems very unlikely to be achieved because of the following concerns:

- Limited availability of literature on the environmental impact of portable batteries over their life cycle.
- The differences in various assumptions made in the literature reviewed makes it difficult to validate/compare the results of these studies between themselves.
- The life cycle scenarios covered in the literature reviewed generally focus on one particular type of battery application and neglect others (e.g. low drainage rate) hence it they are not representative of the whole portable battery market.
- The literature reviewed covers different geographical scopes and hence it
 would be inappropriate to generalise their results and recommendations to the
 EU domain (i.e. as some of the crucial environmental indicators like GWP are
 heavily impacted by the local energy policies of electricity generation and
 hence could have different values for different countries).

Therefore, based on the LCA the analysis in this chapter, a new single labelling option for both primary and secondary portable batteries is not recommended as a significant amount of time and resources would be required to create a comprehensive system that would include reliable quantitative indicators of the environmental impact of portable batteries. However, to gain further knowledge and insight into this area, it is recommended that a dedicated comparative LCA study be conducted to thoroughly cover the scope of both portable primary and secondary batteries placed on the European market.

The dedicated LCA study can potentially be utilised for a cross-product-group comparison of primary and secondary batteries. The approach here should be to develop a more elaborate labelling option based instead on the environmental impact of the portable primary and secondary batteries over their life rather than their performance or capacity. The principle of such a labelling approach will be to communicate the environmental impact information (e.g. impact on human health, impact on natural resource use, impact on ecosystem quality etc.) to the end-user, by using a colour code associated to a letter as it is already done in the European Energy Labelling scheme. Such an approach may ensure a rapid and easy understanding by consumers and non-experts alike.



The European Energy labelling scheme associates the energy consumption of a device to a certain "Energy class" (e.g. A, B, C) and a colour (see Figure 6), based on the calculation of an index I (see Table 8), as follows:

$$Energy \ Efficiency \ Index = \frac{(Energy \ consumption) \ tested \ product}{(Energy \ consumption) \ European \ average}$$

Figure 6: EU energy efficiency rating scale Table 8: Example of the determination of

Energy Manufacturer More efficient ess efficient Energy consumption kWh/year 325 Actual consumption will depend on how the applicused and where it is local Fresh food volume I Frozen food volume I Noise (dB(A) re 1 pW) Norm EN 153 May 1990 Retrigerator Label Directive 94/2/EC

energy classes for domestic fridges

Energy efficiency grades used in EU energy label ³¹	EU Energy Label		
I<30 % of base line	A++		
30< <42	A+		
42 <i<55< td=""><td>A</td></i<55<>	A		
55 <i<75< td=""><td colspan="2">В</td></i<75<>	В		
75< <90	С		
90< <100	D		
100< <110	E		
110< <125	F		
125 <i< td=""><td>G</td></i<>	G		

The same approach could be carried out for an environmental labelling based on the calculation of an "environmental index" defined as follow:

$$Environmental\ Index = \frac{(\sum_{i=1}^{n} w_i \times EI_i)\ tested\ product}{(\sum_{i=1}^{n} w_i \times EI_i)\ European\ average\ product}$$

Where: El_i is the ith Environmental Indicator

 W_i is the weightage given to the i^{th} environmental impact indicator category

"n" is the total number of environmental impact indicator categories considered for the environmental impact of the batteries

However, the development of this environmental battery labelling option requires further research which includes:

Here, the lower the index the better. In the case of the battery environmental index, the higher the better, so the letter grading will go from G to A as the index increases.



- The most suitable weightage index values for relevant environmental impact categories for portable primary and secondary batteries needs to be identified and evaluated.
- The definition of a product representing an average of the portable primary and secondary batteries currently in stock in Europe.
- The environmental index for the worst and best products in stock on the European market must also be determined in order to define the threshold value of "environmental index class" in a representative manner for these batteries.

The above challenges need to be evaluated with a dedicated focus on the EU-27 geography which can be addressed in the proposed LCA study.



4. CONSUMER BEHAVIOUR REGARDING CAPACITY LABEL

This chapter aims to improve understanding of end-user interpretation of performance/capacity labelling options and to put these aspects in perspective of the level 1 and level 2 labelling options proposed in the first study. The main issues related to consumer interpretation of capacity/performance information are addressed and investigated. This allows for the identification of criteria that a label needs to fulfil from the perspective of end-user interpretation in order to effectively communicate useful information.

In order to more fully understand consumer response to a battery capacity label, so as to develop the most optimal labelling option, information on consumer behaviour was collected through a questionnaire sent to relevant stakeholders. This was complimented by an in-depth literature review of existing information on consumer behaviour. Before diffusing the questionnaire, BIO identified stakeholders who were able and willing to provide an informed contribution through its already strong contacts in the battery sector and in consumer associations at EU-level. A list of the stakeholders that were sent questionnaires are included in Annex 2. Overall, 18 questionnaires responses were received from primary battery manufacturers, and 3 questionnaires received from other stakeholders.

The two questionnaires were developed to target different types of stakeholders. The first questionnaire targets primary battery manufacturers in particular and includes questions relating to existing primary battery labelling methods and consumer response to these labels, options for a new and harmonised primary battery capacity label, and the impacts that a new capacity label may have on the industry. The second questionnaire was destined for all other relevant stakeholders such as consumer associations, manufacturers of energy using products that use primary batteries, etc. and includes similar questions except those related to existing labelling methods. However, only 3 total responses were received: one from a battery recycling association, one from a retailer, and one from a standardisation body.

Due to limited time and resources, primary battery consumers could not be directly consulted for this study, therefore BIO has taken into account existing literature sources and stakeholders opinion through targeted questionnaires and interviews, which allows for some general observations about consumer response to battery labels. A stakeholder meeting with EPBA, which was held in early January 2010 was also organised to gather further information on consumer behaviour.

The following section provides an introduction to consumer behaviour in relation to product labels and information provision, and reviews existing knowledge on consumer



behaviour that can be used to develop more informed capacity labelling options for portable primary batteries.

4.1. INTRODUCTION TO CONSUMER BEHAVIOUR AND THE USE OF LABELS AS A POLICY INSTRUMENT

Labelling is a common requirement in measures aimed at regulating batteries. Nearly every jurisdiction that places environmental regulations on batteries also has labelling requirements. These vary by battery type/chemistry, jurisdiction, heavy metals content, and depending on how the batteries are incorporated into the product/package. Nonetheless, the requirement to mark batteries with their capacity can be seen as encouraging consumers to select higher capacity batteries resulting in a shift in the market. However, consumers need further knowledge to understand the capacity and performance information indicated on battery labels, as trends show that consumers are becoming more dependent on portable electronic devices (portable DVD players, MP3 players, etc.). Many of these portable electronic devices use primary batteries. Therefore, consumers are paying more attention to the efficiency of their batteries in terms of choosing the best battery for a specific device.

Understanding the reasons behind why consumers behave in the way they do in terms of purchasing decisions will be an important first step in designing a primary battery capacity label that will be capable of influencing consumer decision by communicating the necessary product information. Consumer behaviour involves the psychological processes that consumers go through in recognising needs, finding ways to solve these needs, making purchase decisions (e.g. whether or not to purchase a product and, if so, which brand and where), interpreting information, making plans, and implementing these plans (e.g., by engaging in comparison shopping or actually purchasing a product)³². Figure 7 shows the numerous sources of influence that consumers face.

The following section gives a brief introduction to the use of labels and information provision as a policy instrument to influence consumer choice.

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³²University of Southern California, Department of Marketing, [Accessed 12/01/10, www.consumerpsychologist.com/intro Consumer Behavior.html]



Perception/
Sensation

Cognition

Strategy

Choices

Beliefs

Social & Other influence

Market research

Info search

Communication

Communication

Figure 7: Influences on and of consumer behaviour³³

4.1.1. THE USE OF LABELS AS POLICY INSTRUMENTS

Recently BIO participated in a study analysing real world consumer behaviour relating to the purchasing of environmentally preferable goods for Directorate General for Environment (DG ENV) and is currently working on a similar study aimed at designing policy to influence consumer choice. Both of these studies provide useful insight into consumer behaviour³⁴. These studies show that labels are important policy instruments as they provide the main source of information on a product or service. Labels involve a number of activities, ranging from business-to-business transfers of product specific environmental and technical information to labelling in retail marketing. One of the main goals of product labelling is to encourage the demand for, and supply of, those products and services that are environmentally preferable through the provision of verifiable, accurate and non-deceptive information on environmental and technical features of products and services.

However, consumer choice is often limited by the complexity of labels and excessive choice. Too many labels can confuse shoppers and mean that less rather than more thought is devoted to making purchasing decisions. In addition, unless consumers think that the label is telling them something beneficial, they may choose not to invest time in even reading the label. Although energy labels may appeal to those with environmental concerns (which may only be a small percentage of the total population) or those concerned with saving energy, they will not necessarily capture the interest of all shoppers. Labels that convey energy efficiency in terms of cost savings, or ideally lifetime cost savings across the average lifetime of the product are likely to prove a more effective way on influencing non-environmental consumers.

Finally, consumer choice is often driven by recognition of products, brands or labels. This is the case even if consumers remember nothing about the relative qualities of the

³³ Graphic taken from: www.consumerpsychologist.com/intro Consumer Behavior.html

³⁴ PSI, BIO, Ecologic (2009) Real World Consumer Behaviour, Report for DG ENV, [Available online: www.psi.org.uk/pdf/2009/RealWorldConsumerBehaviour_FINAL_091123.pdf]



product itself – recognition of the label (as opposed to the information it conveys) can be sufficient to make consumers buy the product. Although the information contained on energy labels is important, labels need to be consistent and easily recognisable.

4.1.2. INFORMATION PROVISION OR INFORMATION-BASED MARKETING

It is often assumed that when individuals make poor choices it is due to misinformation or lack of information. For this reason, and because it is a relatively low cost policy tool, information provision has been the mainstay of consumer-facing product policy. In turn, it has generally been assumed that an excess of information does not harm consumers.

However, the limitations of information provision demonstrate that consumers rarely search out, read or properly digest all of the information available to them when making a decision. In many ways, this is a perfectly 'rational' decision, given the amount of information presented on products and the time it would take to actually read it all. However, striking a balance between providing enough information to inform discerning consumers, while also meeting regulatory requirements (on information that has to be provided) and ensuring less concerned consumers are not overwhelmed by information, is a challenge. The sheer volume of information now found on products and packaging can make understanding information harder rather than easier.

Information provision can thus be improved by making information more meaningful to consumers and by a greater consideration of how consumers actually receive and process information. In many situations, the influence of an in-store sale person can be critical. Similarly, in the context of online retailers, consumer 'star ratings' or recommendations are highly influential.

The question of consumer comprehension of labels is also significant. UNESAP (United Nations Economic & Social Commission for Asia and the Pacific) recently reviewed energy labelling programmes and their effective implementation on influencing consumer behaviour. One of the main factors that impede the success of labelling programmes is the unintentional misunderstanding of consumers. This may particularly be the case for labels that contain very technical product information. Understanding the stimulus and use of information for the individual's purchasing decision will be important. Consumers need to be able to understand what the label for in order to process this information for their own purpose or purchasing decision. On the issue of label comprehension, the results of the review indicate that most consumers, regardless of country, showed their intention to use label information³⁵.

³⁵ UNESAP, Guidebook on Promotion of Sustainable Energy Consumption , "Energy Labelling Programmes and Their Effective Implementation: Perspectives on Consumer Behaviour" [Accessed 12/01/2010: www.unescap.org/esd/energy/publications/psec/guidebook-part-two-energy-labellingprogrammes.htm]



4.2. ANALYSIS OF CONSUMER BEHAVIOUR IN THE CONTEXT OF CAPACITY/PERFORMANCE LABELLING OPTIONS

Some existing literature sources (specialised press, consumer guides on which products to purchase, etc.) as well as stakeholder input provide various types of information to consumers in terms of suggesting how to choose the best battery. Understanding how portable primary batteries are marketed and the purchasing behaviour of consumers is important in order to identify aspects that should be taken into account in order to design a meaningful capacity label for consumers. The following section thus goes into further detail on how consumers purchase portable primary batteries; interpret environmental and technical product information, and how this might influence consumer purchasing decision of portable primary batteries. The analysis also seeks to most effective way to communicate primary capacity/performance information so that it is end-user friendly, and determine whether the location and the size of the label strongly influences the end-user's interest in the information displayed, as well as the types of supports that would be most appropriate to ensure maximum impact on the end-user's buying decision.

4.2.1. CONSUMER PURCHASING BEHAVIOUR OF PORTABLE PRIMARY **BATTERIES**

There lacks extensive detailed and quantified information on consumer behaviour related to portable primary batteries; however some general observations can be made based on literature review and input from stakeholders. Consumer demand for batteries is greatly linked to the demand for products that rely on them. For example, in the EU, the increasing penetration of consumer electronic items such as MP3 players, battery powered toys, digital cameras and electronic toothbrushes are on the rise³⁶. In addition, multiple ownership of products such as TVs and DVD players which require batteries for their remote controls, is also growing. In the UK, the average household uses approx 20-30 batteries per year and is increasing³/.

It is important to remember that contrary to secondary rechargeable batteries, portable primary batteries need to be replaced once the energy supply is depleted, as they cannot be recharged for re-use. Portable primary batteries are often times referred to as "disposable batteries" as they are intended to be used once and discarded afterwards.

This disposable characteristic of portable primary batteries also encourages them to be purchased as "impulse items". In other words, these products are those that many consumers have no intention of buying when they enter the store, but that they might

 $^{^{36}}$ West, Tracy, 18 September 2009, "Cash in: battery arming", The Grocer wesbite: The Business of Food [Accessed 24/03/2010 Drink Retailing website, online <u>www.thegrocer.co.uk/articles.aspx?page=independentarticle&ID=203464</u>]

37 Rebatt, UK website, "Battery Facts", [Accessed online 24/03/2010: <u>www.rebatt.co.uk/facts.shtml</u>]



add to their shopping cart at the last minute. Primary batteries are also often sold in packs containing 4 to even 20 batteries per pack. This enables shoppers to purchase numerous batteries in a single pack without having to replace them more often. In fact, as one article states, "Consumers will stockpile batteries if they see them on offer. They will buy them and keep them in a drawer."³⁸ In addition, primary batteries are much cheaper than secondary rechargeable batteries so consumers may spend less time comparing the different brands and prices than for secondary batteries. This may also explain why primary batteries are often found in the check-out aisles of stores. A large share of shoppers purchase primary batteries in this "impulsive" manner purchasing the cheapest product possible and without hesitating, because the battery is normally inexpensive and easy to replace, or choosing batteries based on brand recognition. Other similar impulse items located at checkout counters include items such as gum, phone cards, drinks, snacks, magazines, razor blades, and gift cards. They are displayed primarily at or near the checkout area and are meant to catch the shopper's eye just before reaching the cash register. However, there are also "expert consumers" who are more informed about battery types (i.e. chemistry) and the best type of application. Insights into this kind of consumer behaviour enable us to understand how consumers purchase primary batteries. These trends highlight the fact that because batteries are products that are for the most part spontaneously purchased, labels need to be as effective as possible in conveying the most important information needed to influence purchase decision.

Recent reports that include consumer surveys provide interesting insights into what influences the purchasing decision of consumers. For example, a recent market study surveyed thousands of North American customers on how they make their purchase decisions for electronics. Portable primary batteries are used in many electronic devices; therefore consumer surveys in this area can be used as a relevant comparison. However, it is important to note that batteries, unlike the devices they are used in, are often purchased as 'impulse items', meaning that little thought and time is taken before deciding to purchase the battery. Results of the consumer survey show that when purchasing electronics, buyers consider "performance" to be the main purchasing factor, followed closely by "price" and "energy efficiency". Figure 8 below shows survey results of the comparison of different product attributes.

³⁸ West, Tracy, 18 September 2009, "Cash in: battery arming", The Grocer wesbite: The Business of Food and Drink Retailing website, [Accessed online 24/03/2010: www.thegrocer.co.uk/articles.aspx?page=independentarticle&ID=203464]



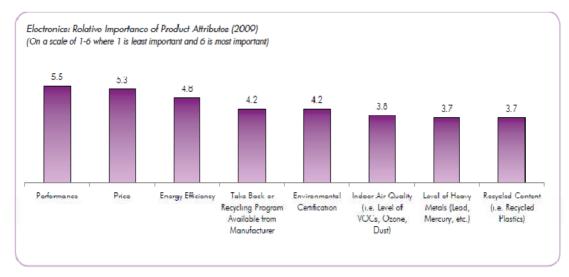


Figure 8: Electronics: relative importance of product attributes (2009)³⁹

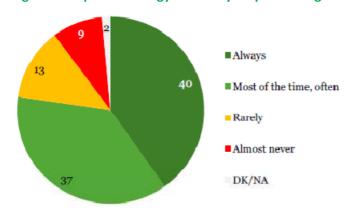
The Flash Eurobarometer's recent publication, "Europeans' attitudes towards the issue of sustainable consumption and production" examined EU citizens' knowledge and levels of concern about sustainable consumption and production. The study conducted a survey on over 26,500 randomly-selected EU citizens. In particular, the survey examined whether energy efficiency was a deciding factor when buying products. According to the survey results, almost 4 in 10 respondents (37%) said that, when buying products that use fuel or electricity, they often take into account how energy efficient these products are, and a slightly higher proportion (40%) answered they always consider energy efficiency. Only slightly more than a fifth of EU citizens said they almost never or only rarely take energy efficiency into account when buying products that use fuel or electricity (9% "almost never" and 13% "rarely"). 40 Figure 9 shows the survey's results on the impact of energy efficiency on EU consumers' purchasing decisions. These findings show that energy efficiency is an important factor in EU citizens' purchasing decisions. The study survey defined an energy efficiency product as one that can perform the same task as another while using less energy to do so. Therefore in the context of this current study on battery capacity labelling, it would be important to be able to effectively convey to consumers that using certain portable primary batteries would use less energy and save costs in the long term.

³⁹ TerraChoice Environmental Marketing, 2009, EcoMarkets Summary Report [Available online here: www.terrachoice.com/files/EcoMarkets%202009%20Summary%20Report%20-%20Oct%202009.pdf]

⁴⁰ Eurobarometer, 2009, Europeans' attitudes towards the issue of sustainable consumption and production Analytical report for the European Commission; ec.europa.eu/public_opinion/flash/fl_256_en.pdf



Figure 9: Impact of energy efficiency on purchasing decisions⁴¹



Q12. When buying products that use electricity (like TVs or computers) or fuel (boilers, cars), do you take into account how energy efficient they are? An energy-efficient product is one that can perform the same task as another while using less energy to do so. Base: all respondents, % EU2?

4.2.2. CHARACTERISTICS OF PRIMARY BATTERY MARKETING

The ways in which retailers, manufacturers, and suppliers market portable primary batteries is an important source of information to investigate as many marketing strategies are based on consumer attitudes and trends towards portable primary batteries. For example, a recent article analysed the marketing strategies of Duracell and Energizer, who are among key players in the EU and global portable primary battery market. The analysis shows that brand plays an important role in influencing consumer choice. A significant amount of battery marketing focuses on individual and consumer-level branding, even though most battery companies market to a more diversified set of demographics, therefore both Energizer and Duracell focus on branding for important image and perception-related reasons. In an attempt to differentiate themselves from each other, both Energizer and Duracell use iconic brand designs, coloration, slogans, and mascots⁴². The analysis concludes that consumers choose Duracell and Energizer products because they are more familiar with these brands in terms of recognition and consider these brands to make quality, trustworthy batteries as the result of branding and being exposed to information about the product. Therefore, the advantage of implementing a mandatory primary battery capacity label under the Batteries Directive could allow consumers to not only compare battery performance in a harmonised manner across different brands, but also create competitive advantage by encouraging less recognised brands to produce higher performing batteries.

⁴¹ Eurobarometer, 2009, Europeans' attitudes towards the issue of sustainable consumption and production Analytical report for the European Commission; [Available online: ec.europa.eu/public opinion/flash/fl 256 en.pdf]
⁴² Sauer, Abram, 15 October 2007, "Energizer and Duracell opposites attract", Brand Channel website,

³² Sauer, Abram, 15 October 2007, "Energizer and Duracell opposites attract", Brand Channel website, [Accessed online 16/01/2010: www.brandchannel.com/features_profile.asp?pr_id=357]



Other trends in marketing on portable primary batteries reveal that advertising in the batteries market is heavily seasonal. For example, a recent Mintel battery market reports indicated that in the UK, over 60% of all expenditure in the consumer portable battery sector in 2005 comes in the last quarter of the calendar year, reflecting the importance of the pre-Christmas period. These sales trends can be explained by the increased uptake of the purchase of consumer electronics due to the holiday season, which require batteries to operate. This means that many wholesalers and retailers ensure that during the Christmas period, portable battery supplies are stocked and point of sales materials (e.g. posters, hanging signs used for highlighting store product categories and promotions, in store displays) are in place in stores⁴³.

Advice given to marketers and retailers on how to better sell batteries based on consumer behaviour suggest rendering portable primary batteries more visible in stores. Currently, portable primary batteries are often purchased on impulse; therefore, by increasing their visibility in other parts of the store, it may encourage consumers to take more time to make an informed decision⁴⁴. In fact, in the Eurobarometer study, EU consumers were asked about the best way retailers could promote the purchase of environmentally-friendly products. Around 3 in 10 (31%) EU citizens answered that the best way for retailers to promote environmentally-friendly products is to provide better information to consumers. Approximately half of EU citizens thought that retailers should promote environmentally-friendly products in their stores: by increasing the visibility of these products on store shelves (25%) or by having a green corner dedicated to such products (24%). Almost a fifth (18%) of interviewees felt that regular promotions focusing on environmentally-friendly products would be the best way to promote green purchasing. See Figure 10 for a graphically representation of this survey results.

Provide better information to consumers

Increase the visibility of environmentally-friendly products on shelves

Have a dedicated green corner within their stores with only environmentally-friendly products

Have regular promotions in their stores focusing on environmentally-friendly products

DK/NA

31

25

24

Figure 10: Best way for retailers to promote environmentally-friendly products

Q6. How can retailers best contribute to promoting environmentally-friendly products? Base: all respondents, % EU27

⁴³ Wholesale News & Features website, published 21 September, 2006 "Fully charged" [Accessed online 24/03/2010: http://www.wholesalenews.co.uk/news/fullstory.php/aid/1039/Fully_charged.html]

⁴⁴ Wholesale News & Features website, published 21 September, 2006 "Fully charged" [Accessed online 24/03/2010: http://www.wholesalenews.co.uk/news/fullstory.php/aid/1039/Fully_charged.html]



Other suggestions and examples of market strategies to boost portable battery sales and awareness include pre-packaged displays provided by manufacturers such as counter units (see Figure 11 for examples), that aim at boosting sales for the retailer by encouraging visibility and impulse purchases. In-store point of store materials can be eye catching and positioned in various locations around the store. Shop display stands can also include different battery brand and information campaigns. Thanks to an inshop display for its portable primary batteries, the UK manufacturer Maplin was able to improve the visibility of their batteries in store and achieve a return on investment in just four months and a sales increase of 115% over the Christmas period compared to the previous year⁴⁶.

Figure 11: In-store retail displays of portable primary batteries ⁴⁷





The different marketing strategies discussed above can also be used in the context of this study to promote the awareness and understanding of a possible battery capacity label through the use of additional in-store information provision such as displays and targeting information campaigns on the battery capacity label during high peak battery sales periods.

4.2.2.1 Conclusions

Based on literature sources and stakeholder views, several observations can be made on the purchasing trends of portable primary batteries:

- Portable primary batteries are often spontaneously and impulsively purchased items, therefore labels need to be as effective as possible in conveying the most important information needed to influence the purchasing decision.
- The existence of a primary battery capacity label would allow consumers to compare battery performance across different brands, which could create a

⁴⁵ Wholesale News & Features website, published 21 September, 2006 "Fully charged" [Accessed online 24/03/2010: http://www.wholesalenews.co.uk/news/fullstory.php/aid/1039/Fully_charged.html

⁴⁶ Arken website, "Case Study: Maplin - Battery Shop Display Stand", [Accessed online 25/03/2010: www.arken-direct.com/pop/casestudies/maplin.aspx]

⁴⁷Images taken from: <u>www.creativemag.com/hardw0500.html</u> and <u>www.arken-direct.com/pop/casestudies/maplin.aspx</u>



competitive advantage by encouraging less recognised brands to produce higher-level performance batteries.

- Energy efficiency and performance are important criteria that influence consumer purchasing decision, therefore these product attributes should be emphasised in the context of a primary battery capacity label to help shape consumer choice.
- Consumers are particularly conscious of well-known brands of portable primary batteries and therefore often purchase these batteries according to brand, regardless of the end application intended for the battery's use.
- There exist more informed consumers that are knowledgeable about the particularities of selecting appropriate battery types based on the end-use application.
- According to a recent survey of Europeans, around 3 in 10 EU citizens answered that the best way for retailers to promote environmentally-friendly products is to provide better information to consumers⁴⁸. The same study indicated that approximately half of EU citizens thought that retailers should promote environmentally-friendly products in their stores by increasing the visibility of these products on store shelves or by having a green corner dedicated to such products². Almost a fifth of interviewees felt that regular promotions focusing on environmentally-friendly products would be the best way to promote green purchasing.
- Different marketing strategies can also be used to promote the awareness and understanding of a possible battery capacity label through the use of additional in-store information provision such as displays and targeting information campaigns on the battery capacity label during high peak battery sales periods.

4.2.3. Consumer interpretation of information included on battery labels

For a capacity label to be effective, end-users need to be able to understand the information that is being conveyed through the label. In the case of portable primary batteries, the end-user needs information concerning the appliance for which the battery is most suitable and the performance he can expect from the battery. However, it is difficult to explain and convey the complex technical content of portable primary batteries effectively. The following sections go into further detail on current consumer understanding of information on labels and access to the information requested by consumers.

Eurobarometer, 2009, Europeans' attitudes towards the issue of sustainable consumption and production Analytical report for the European Commission; [Avaialble online: ec.europa.eu/public opinion/flash/fl 256 en.pdf]



4.2.3.1 Consumer understanding of information on labels

Consumers are faced with an increasing amount of product information in the form of labels. Although product labels can play a key role in encouraging consumers to make sustainable consumption choices, they can also give misleading information or leave consumers feeling confused because of the complexity of information required to make a judgement on the greenness of a product⁴⁹. For example, according to a major European retailer, simple pictogram labels such as the crossed-out wheelie bin ("separate collection" symbol) included on electrical and electronic equipment, to show that the equipment should not be disposed of in the normal waste stream is still not generally understood. For this reason, the retailer decided to provide additional in store information explaining the meaning of the symbol.

Synovate, a market research firm, recently conducted a consumer survey in order to determine how consumers understand and interpret battery life information for Notebook PCs⁵⁰. Results of the consumer survey revealed that overwhelmingly, consumers wanted more information on the battery life a notebook PC delivers under normal operating conditions. Consumers were also asked about what they thought about the battery life icon and how they interpreted the information portrayed by the battery life image. Results of the survey showed that many consumers assume a literal interpretation of information presented and only 3 % assumed it presented ideal conditions. This shows that the majority of consumers misunderstood the information provided because they assumed that test conditions were set using real life operating conditions and not using ideal operating conditions (with screens dimmed to 20-30 % brightness, wireless radio turned off, no Internet browsing, no virus scans or other security software running, and no video or music playback software running, etc.).

Finally, of the 21 stakeholder questionnaires received, 5 stated that most of their EU consumers do not necessarily understand all the information provided by manufacturers on portable primary batteries, 2 stated that consumers do understand information on labels, and 13 questionnaire responses did not respond to this question. On the question concerning whether consumers understand that the capacity/performance for primary portable batteries may vary significantly according to the device, or way of use, 19 out of 21 stakeholders responded that consumers do not understand this information. When shopping for batteries, consumers are faced with many confusing options such as the type of battery to choose (primary non-rechargeable batteries vs. secondary rechargeable batteries), the chemistry of the battery to choose from (alkaline, zinc carbon, zinc chloride, NiCd, NiMH, etc).⁵¹

⁴⁹ Yates, Lucy, 2009, Green expectations: Consumers' understanding of green claims in advertising, Consumer Focus [Available online: www.consumerfocus.org.uk/assets/1/files/2009/06/Green-expectations-single-page.pdf]

⁵⁰ AMD website, "Consumers Deserve Better Information on Battery Life", [Accessed online 12/01/10: sites.amd.com/us/topic/Pages/better-information-on-battery-life.aspx]

⁵¹Noonan, Bryan "How to Choose the Right Battery" [Accessed online 12/01/10: articles.smashits.com/articles/computers/49445/how-to-choose-the-very-best-battery.html]



Nevertheless, information provision tools, such as labels provide an important outlet to convey environmental and technical information to consumers to help them make more efficient purchasing decisions. According to the Barometer EU consumer survey study, almost half (47%) of EU citizens surveyed said that ecolabelling plays an important role in their purchasing decisions. A quarter of interviewees answered that ecolabels are not important when making decisions on which products to buy and a similar proportion (26%) said they never pay attention to labels⁵². Figure 9 breaks down these figures in a graphic

Eco-labelling plays an important part in my purchasing decisions

Eco-labelling does not play an important part in my purchasing decisions

I never read any labels

DK/NA

Figure 12: Importance of eco-labels in purchasing decisions of EU consumers⁵³

Q3. Some products have an eco-label which certifies that they are environmentally-friendly. Which statement characterises you the best? Base: all respondents, % EU27

The current information provided on battery packaging is abundant: size, icons for recommended use, safety information, and environmental logos, therefore capacity information and labels would need to be as simple and effective as possible to ensure full consumer interpretation.

4.2.3.2 Information on portable primary batteries requested by consumers

Consultation of websites designed to guide consumers on buying batteries revealed some information pertaining to the type of information that end-users are expecting or take into account in terms of the technical performance of the battery. For example, frequently asked questions (FAQ) from several different sources such as the website Overstock⁵⁴, an online consumer electronics retailer and GP batteries⁵⁵, a primary battery manufacturer include:

⁵² Eurobarometer, 2009, Europeans' attitudes towards the issue of sustainable consumption and production Analytical report for the European Commission

⁵³ Eurobarometer, 2009, Europeans' attitudes towards the issue of sustainable consumption and production Analytical report for the European Commission

⁵⁴ Overstock batteries buying guide, [Accessed online 12/01/2010 <u>www.overstock.com/guides/batteries-buying-guide</u>]

GP Batteries FAQ page, [Accessed online 12/01/2010 www.gpbatteries.com/html/faq/index.html]



- How long will the batteries last?
- Which is better primary or rechargeable?
- Which is the best primary battery?
- What are the different types of batteries available in the market and their applications?
- How do different batteries rank in terms of performance and cost?
- How should I strike a good balance between performance and cost when selecting batteries?
- Do warm and cold temperatures affect batteries?

The answers to the above questions are provided in the indicated websites to assist consumers in purchasing the right type of battery for their end-use. Consultation of other online websites that inform consumers on what to look for when choosing the right battery also emphasise the importance of the expiry date, which the site claims consumers often underestimate⁵⁶. The importance of checking the expiration date when buying batteries was also highlighted as batteries deteriorate and are often less efficient when they have gone beyond their expiry dates.

4.2.3.3 Stakeholder responses on how to effectively communicate capacity/performance information to consumers

In the questionnaires that were sent to stakeholders and Member States, a question was asked about where the capacity label should be placed in relation to the battery. Out of the 21 responses, 20 portable primary battery manufacturers responded that the portable primary battery capacity label should be located on the battery packaging and only 1 felt that the label should go directly on the battery itself, however included the comment that if the battery was too small, that the label should then be included on the packaging.

Battery capacity is very complex information to communicate to the large majority of consumers and therefore requires more than one point for delivery of the messages. In fact, all respondents to the questionnaire with the exception of 1, felt that other than the battery capacity label itself, other information supports such as leaflets, brochure, information at selling point, and manufacturers' websites would be necessary in order to enhance consumer interpretation of the information on the capacity label. The use of the website of the battery manufacturers with the web address to be printed on the packaging was one of the most suggested solutions for effectively communicating the technical information on primary batteries. Such a website can provide information on what the consumer can expect from any given battery with values taking into account IEC (International Electrotechnical Commission) standards. Since Internet access is not available to all consumers, capacity information should also be provided and/or on the

⁵⁶ Dynamic marketing website, [Accessed 25/02/2010] <u>www.dynamicmarketingireland.com</u>]



packaging of the battery. For further information on how additional information supports can be used to compliment the different labelling options for portable primary batteries, please see section 4.3.3. Concerning the information to be included on labels, 15 out of 21 primary battery manufacturers suggested that the best way to communicate relevant information on portable primary batteries in order to influence consumer choice is to provide better information about the chemistry of the different batteries. Other relevant inputs from stakeholders suggested that most end-users select the battery based on the type of battery that operates best in the end-device. For example, some device manufacturers have also been known to recommend the best type of battery to be used in the device as end-users do not always know this type of information. For example, in the operating manual of the Canon PowerShot digital camera, the manufacturer states that, "This camera uses AA-size alkaline batteries or Canon AA-size NiMH batteries (sold separately). While it is possible to use AA-size nickel-cadmium batteries, performance is unreliable and their use is not recommended".57 Consideration of the above stakeholder input have been integrated into the proposed labelling options, which are further discussed in section 4.3.

The information on labels should be based on the IEC standards for the given batteries, which provide comprehensive information on what the consumer will get out of a battery. The IEC standards are also reviewed regularly to account for evolutions in technologies. Portable primary batteries have not evolved as much as many other electronic based products, therefore consumers are quite familiar with these batteries. See section 4.3. for the relevant standards that should be used for each of the proposed labelling options.

During the stakeholder meeting with EPBA, participants raised the concern that any new consumer information initiative needs to work towards gradually build upon the foundation of knowledge embedded within consumers to avoid overloading consumers with too much informant that are liable to confuse. This is due to the existence of the numerous different ways in which manufacturers market and labels their batteries, as well as the existence of other battery labelling initiatives. One such initiative is the Nordic Swan Ecolabel, which is locally implemented by the governments of Sweden, Norway, Iceland, Denmark and Finland. It is a voluntary license system where the applicant agrees to follow a certain criteria set outlined by the Nordic Ecolabelling in cooperation with stakeholders and current includes over 2000 licensed products. The Nordic Ecolabelling Board laid down the first criteria document for primary batteries in 1996. The document has been revised and adjusted since then and is today published as version 3.0. The label provides the portable primary battery's service time. The batteries must achieve a minimum service time as put forth by the Nordic Ecolabelling Board⁵⁸.

⁵⁷ Canon, 2006, Canon PowerShot A710 IS Digital Camera, Advanced Camera User Guide,

Nordic Swan Ecolabel, 2003, Background document on Primary batteries [Available online: www.ecolabel.dk/kriteriedokumenter/Bakgrund%20001e.pdf]



A new capacity marking label could work along with any other existing initiatives to enhance consumer understanding of product information. However, the capacity label should give sufficient information to the end-users at the moment of purchasing of their batteries.

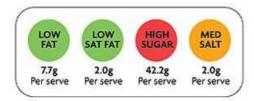
4.2.3.4 Effective labelling designs based on existing consumer behaviour research

Literature was undertaken on consumer research in the EU and around the world that analysed existing labelling initiatives and the different visual aspects of label designs that have been known to positively enhance consumer understanding. In the first study, three formats were recommended to display battery capacity information in a user-friendly way:

- Textual: In the case of capacity marking, this would be a number indicating the capacity of a battery in mAh or, in the practical sense, in number of pulses or service hours.
- Iconic or Illustrative: the approach here is to use an icon (e.g. a picture of a camera application) to show that the battery is suitable for that particular application
- Integrated: this type of label design combines the textual and iconic approaches.

The use of colour coding on capacity labels was also suggested in the first study, as well in other consumer behaviour literature. The first study states that in Europe, the traffic light colour scale is widely used and easily understandable by consumers, so that it does not require a legend (see Figure 13 for an example). The Food Standards Administration traffic light scheme in the UK has been adopted on a voluntary basis by many large retailers and manufacturers including Waitrose, the Co-op, Sainsbury's, McCain, Boots, and Marks & Spencer⁵⁹.

Figure 13: Example of traffic-light nutritional labelling⁶⁰



In a recent article on the colour coding for EU nutritional labels, Monique Goyens, director general of BEUC, the European consumers' organisation, said that "Research

⁵⁹ The Faculty of Public Health, 2008, Traffic-light food labelling, A position statement [Available online: www.fphm.org.uk/resources/AtoZ/ps food labelling.pdf]

 $^{^{60}}$ The Faculty of Public Health, 2008, Traffic-light food labelling, A position statement



from across Europe has told us that consumers find colour coding the easiest and simplest way to make informed and healthy choices."61

In the US, a research study was conducted to evaluate the efficacy of the US EnergyGuide label and determine the best label format and graphical element for U.S. consumers. The study's findings show that stars emerged as the most preferred rating element as consumers are familiar with star ratings and believe they are easiest to use Stars were also found to be most motivating to encourage consumers to use the label and consider energy use in their appliance purchase. Other categorical rating schemes, including letters and check marks, have confusing meanings and other associations (e.g., school grades, checklists) for consumers⁶². In Australia, consumers also understand to a great extent the star rating system currently seen on the Australian energy label⁶³. Figure 14 shows an example of the Australian label.



Figure 14: Example of the Australian energy label

In Europe, similar trends in terms of consumer recognition of the star rating scheme are also observed. For example, the Ecodynamic Enterprise label was created in 1999 by Brussels Environment - IBGE, the Brussels Administration of the Environment and Energy. The "Ecodynamic enterprise" label is an official recognition of good environmental management practices by the Brussels Region. There are three levels depending on the initial level of environmental performance within the organisation, which are symbolised by stars. The labelling system ranks the level of environmental performance obtained by the organisation from 1 to 3 stars⁶⁴. See Figure 15 for an example of the label.

⁶¹Banks, Martin, 16 March 2010, "MEPs reject traffic light system for food labelling" [Accessed online www.theparliament.com/no cache/latestnews/news-article/newsarticle/meps-rejecttraffic-light-system-for-food-labelling/]

⁶²Thorne, Jennifer and Egan, Christine, 2002: An Evaluation of the Federal Trade Commission's Energy Guide Appliance Label: Final Report and Recommendations, prepared for American Council for an Energy Efficient Economy (ACEEE), Washington DC. [Available online: www.www.aceee.org/pubs/a021.htm]

⁶³ NAEEEC, 1998, Final Report on a Qualitative Market Research Study regarding Appliance Energy Rating Labels for The National Appliance & Equipment Energy Efficiency Committee, [Available online: www.energyrating.gov.au/library/pubs/focus298.pdf]

website, "Ecodynamique label" ⁴Brussels Environment [Accessed online 25/03/2010: www.ibgebim.be/Templates/Professionnels/Niveau2.aspx?id=2978]



Figure 15: Example of the different star rating labels for the Ecodynamique label







In Europe, other prominent examples of the use of star rating schemes are seen on many online consumer rating sites to rate products, as well as to rate restaurants and hotels. Figure 16 shows an example of how consumers use star ratings to rate products on the widely-used online retail site, amazon.com.

Figure 16: Example of the use of stars to rate satisfaction with portable primary battery⁶⁵



In Europe, the quality of hotels is usually ranked on a scale from one to four stars, with four stars being the highest rating possible. Star ratings in Europe are determined by local government agencies or independent organizations. Organisations such as Hotelstars Union in Europe its associations have been working on bringing the hotel classification systems in the various European countries closer to one another based on harmonised criteria and star ratings⁶⁶.

Star rating is also seen in restaurants, through programmes such as the Michelin series of guides which accord from one to three stars to restaurants they perceive to be of high culinary merit. The guide awards one to three stars to a small number of restaurants of outstanding quality.

Literature review also revealed recent research results that would make labels more effective. These results may be relevant in the context of a capacity label for portable primary batteries:

 Information on labels needs to be grouped, delineated and presented in a hierarchy of importance (e.g. by using font size and reading order to delineate importance). Otherwise, presenting too much information will reduce the labels effectiveness.

⁶⁵Amazon website, "Customer Reviews: Duracell Batteries, AA Size, 16-Count Package, [Accessed online 21/03/2010:www.amazon.com/Duracell-Batteries-Size-16-Count-Packages/product-reviews/B001F0RCHI/ref=dp top cm cr acr txt?ie=UTF8&showViewpoints=1]

Hotel Stars website, [Accessed online 24/03/2010: www.hotelstars.eu/en/index.php?open=Criteria]



- Labels that present the efficiency of a product on a comparative scale compared to other similar products are more easily understood and motivating than those that present technical information only.
- Labels that present the comparative efficiency via discrete categories such as stars, letters or numbers are vastly more preferred and seem to be more effective. In addition, the thresholds used in these labels can be highly motivating for both manufacturers and retailers. Also, there can be strong connotations with colour and therefore it is helpful to exploit these to make the label more readily understandable and appealing.
- Overloading the label with excessive or poorly organised information is distracting and limits both comprehension and engagement with the label.
- Careful blocking of related information and appropriate choices of fonts are helpful to make it clear to consumers which elements are most important and which only need to be addressed if further information is required.
- Each label design may have some limitations. For example, often a small portion of end-users at least initially concludes the opposite of the desired message that more stars mean more efficiency⁶⁷.

4.2.3.5 Conclusions

Based on the analysis carried out in this section, the following conclusions can be made on how consumers interpret existing information on batteries:

- According to stakeholder input, many consumers do not necessarily understand all the information provided by manufacturers on portable primary batteries, nor do they understand that the capacity/performance for primary portable batteries may vary significantly according to the device, or way of use.
- Many portable primary battery manufacturers agreed the best way to communicate relevant information on portable primary batteries is to provide better information about the chemistry of the different batteries. For example, providing end-users with the information needed to ensure that the end-user is using the right chemistry based on the device. Most stakeholders felt that the portable primary battery capacity label should be located on the battery packaging rather than on the battery itself.
- Due to the complex nature of batteries, additional information should be provided to consumers, particularly through the manufacturer's website. This service is currently being provided by many manufacturers who communicate additional product information through their website. Other support such as brochures and in-store information would also be helpful.

⁶⁷ Egan, Christine and Paul Waide, CLASP, IEA, 2005, A Multi-Country Comparative Evaluation of Labelling Research, [Avaialble online here: www.clasponline.org/files/paper%204190.pdf]



 Labels that present the efficiency of a product on a comparative scale such as stars, letters or numbers, or a colour coding system are vastly more preferred and are more easily understood and motivating than those that present technical information only.

4.2.1. Existing labelling methods

During the stakeholder consultation process, it was observed that the reason why the primary battery industry had not more widely marketed its products based on their electrical capacity is because of the very complex and highly technical nature of this measurement, of which the average consumer has no knowledge, as well as due to the wide variety of devices. However, some primary battery manufacturers have developed schemes in order to market batteries based on their performance levels. An example is seen in Varta's Tri-Energy labelling scheme, which is further discussed in Box 6.

In addition, battery manufacturers have developed detailed technical specification sheets that are communicated in different ways e.g. via their website, or through instore leaflets. The data included on these information supports are often too large to be printed on battery labels. In addition, some manufacturers have implemented some labelling programmes and techniques to aid consumers to select the most efficient battery based on the end application for which it is intended to be use.

Furthermore, it has been observed that some producers of EEE appliances (Electrical and Electronic Equipment) recommend in the instruction manual which type of battery (chemistry) shall be used with the appliance. Some portable primary battery manufacturers also use pictograms of appliances on the packaging to indicate to the consumer the applications for which the battery is recommended. Such pictograms however do not indicate the capacity consumers may expect since this will depend on several environmental and usage factors such as temperature, humidity, continuous or intermittent power demand, etc. for which information is difficult to convey.



Box 6 - The Varta Tri-Energy Battery Labelling Scheme







Varta, a leading European primary batteries manufacturer, has recently re-designed its entire battery range to make it easier for consumers to pick the right power for the right device. Varta's Tri-Energy battery range is a new three tier range that uses device icons, colour coding, detailed point of sales materials and strong imagery to help consumers identify which type of battery should be used for certain devices. These portable primary batteries use colour as a way of educating the consumer on the best battery to buy. Varta hopes that the Tri-Energy battery range will help retailers drive sales by educating and empowering consumers to make the right choice by making the buying process simpler. For the retailer, the Tri-Energy battery range is supported with a comprehensive retail support pack, which contains numerous communication tools such as standalone display units with information wings, 'product choice wheels', detailed information panels for shelf edges and bus stops. The pack will also contain ideas and support materials on how retailers can maximise sales from their battery category. The purpose of the retail support pack is to help staff feel knowledgeable and confident when recommending a product to a consumer. The Tri-Energy range includes all Varta's alkaline batteries splits the range into three different levels of performance:

- Yellow represents batteries with long-lasting power and are designed to prolong the lifespan of low current devices that need consistent energy over longer periods of time such as alarm clocks, baby monitors and remote controls.
- Blue stands for powerful energy and are designed to give maximum power to higher energy-draining devices such as remote controlled cars and portable music players.
- Red represents precise energy are designed for hi-tech gadgets such as digital cameras,
 MP3 players and hand held video games consoles.

Varta also uses sporting imagery to help simplify the range concept. For example, a long distance runner for the 'yellow' long lasting power, a shot-putter for the 'blue' powerful units and an archer for those batteries in the 'red' precise category. The Tri-Energy batteries are already available in several stores located in Member States such as the UK, Sweden, and Finland.

Sources: Varta Tri-Energy batteries website: www.trienergy.varta-consumer.com/en/content1.html and Varta Press Release, 05.08.2009: <a href="www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php?path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php.path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php.path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php.path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php.path=/1249486458.html&domain=www.varta-consumer.co.uk/content.php.path=/1249486458.html&



4.3. SELECTION OF DIFFERENT OPTIONS FOR PORTABALE PRIMARY BATTERY CAPACITY LABELS

This section identifies the different labelling options for portable primary batteries that incorporate end-users perception of capacity/performance information. This allows for the development of an optimised labelling option, which is easily understood and properly interpreted by consumers and non-experts. Overall eight options are identified (four taken from the first study and four proposed in this study) based on the preceding analysis on consumer behaviour (see section 4.2.). These options differ in terms of one or more of these parameters:

- Technical basis of the information displayed on the label (e.g. capacity in Ah as measure in specific test conditions, performance in "service-hours" as measured in IEC standards, performance based on a battery chemistry criteria (performance level as described in the Minimum Average Duration (MAD) values of the International Electrotechnical Commission (IEC) 60086-2 standard)
- How information displayed on the label (e.g. textual, visual)
- Location of the label (e.g. on the packaging)⁶⁸

The selected options include:

- Option 1: First level labelling
- Option 2: Second level labelling based on application device for the battery
 - Option 2a: Colour code based on popular end-use applications
 - o Option 2b: Letter grading for popular end-use applications
 - Option 2c: Colour code based on popular end-use applications associated with textual information
- Option 3: Second level labelling based on battery chemistry
 - Option 3a: Simplified "star icon" labelling representative of relative performance of portable primary batteries based on their chemistry
 - o Option 3b: Black and white star ranking system based on chemistry
 - Option 3c: Relative battery performance information based on battery chemistry employing colour code
 - Option 3d: Comparative relative battery performance information based on battery chemistry employing the colour code

Please note: Individual portable primary batteries were suggested to be exempted from labelling in the first study (see section 5.2.3.1. page 119). Button cells were also recommended to be exempted from the labelling scheme in the first study (pages 135-136). The first study can be accessed at ec.europa.eu/environment/waste/batteries/pdf/battery_report.pdf

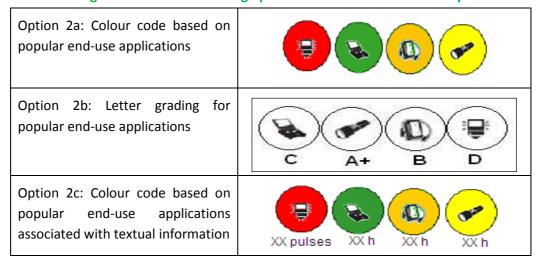


4.3.1. OPTION 1: FIRST LEVEL LABELLING AND OPTION 2: SECOND LEVEL LABELLING BASED ON APPLICATION DEVICE

Technical and interface issues related to the capacity labelling design and layout for Option 1 have already been discussed in detail in the first study and in the introduction of this report (section 2.3.3. on page 35) hence, to avoid repetition, they are not discussed in this section.⁶⁹

For option 2 which is based in second level labelling based on application device for the battery, three potential second level labelling schemes were presented for the Option 2 in the first study which includes⁷⁰:

Figure 17: 2nd level labelling options identified in the first study



4.3.2. OPTION **3: S**ECOND LEVEL LABELLING BASED ON BATTERY CHEMISTRY

Portable primary batteries exist in a wide variety depending on their size and chemical composition. Each battery fulfils the requirements of a range of applications (the battery must physically fit into the device and deliver an adequate nominal voltage). Primary batteries are produced using different technologies, each of them relying on a different electrochemical composition. Primary batteries comprise the following five main categories of chemistries which are summarised in Table 9.

The aspects related to the label design, size and location for this option have also already been addressed in the first study (Chapter 5, pages 129-134), ec.europa.eu/environment/waste/batteries/pdf/battery report.pdf

European Commission (DG ENV)

For further information please refer to the Chapter 5 (pages 105-134), in particular sub-section 5.2.3.1 (pages 117-123) of the first study. The first study can be accessed at ec.europa.eu/environment/waste/batteries/pdf/battery_report.pdf

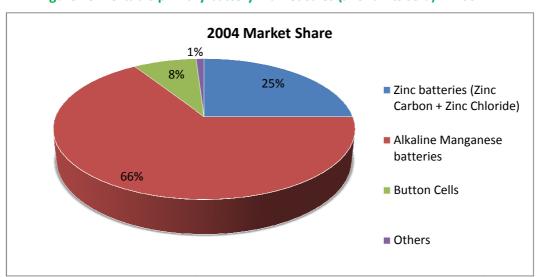


Table 9: Electrochemical composition of primary batteries

Electrochemical composition	Type of end-use
Alkaline Manganese	Very diverse: these are common type batteries, multipurpose batteries
Zinc Carbon and Zinc Chloride	Very diverse: these are common type batteries, more appropriate for low/moderate drain applications. Zinc carbon for general purpose (for intermittent use and most susceptible to leaking) and zinc chloride for heavy duty (intermittent use and less likely to leakage than alkaline batteries)
Lithium	More specific to cameras, and small electronic applications
Zinc Air	Used mainly in hearing aids
Silver Oxide	Miniature batteries (watches)

The portable battery market is not evenly distributed between the different types of chemistries instead it is largely dominated by alkaline batteries, followed by zinc carbon batteries. These two chemistries constituted 91% of all portable primary batteries market in 2004 (see Figure 18). The recent evolution of the market tends to confirm this trend for future years, with the proportion of alkaline increasing at the expense of other primary batteries (mainly zinc carbon batteries).

Figure 18: Portable primary battery market sales (% of units sold) in 2004⁷¹



Button cells (LiMnO₂, zinc-air and silver-oxide chemistries) were proposed to be exempted of labelling in the first study⁷², therefore, portable primary alkaline and zinc carbon is representative of all but 1% (excluding 8% of the market share in units sold and 0.4% in weight, represented by button cells) of the portable primary batteries

Source: The market data for this figure was provided by EPBA

For further information please refer to the Chapter 5, sub-section 5.3.1.1 (pages 135-136) of the first study. The first study can be accessed at:

<u>ec.europa.eu/environment/waste/batteries/pdf/battery_report.pdf</u>



which requires capacity labelling. In the year 2008, lithium primary batteries represented approximately 2% of the total share of primary batteries placed on the market⁷³. The weight and amount of waste generated by the remaining ("Others" in Figure 18) batteries is negligible compared to that of portable alkaline and zinc carbon batteries.

At this stage it is important to note the following points in line with the spirit of the Battery Directive:

- Capacity labelling places an additional strain on producers and manufacturers, most significantly in terms of cost. In some cases labelling costs can become prohibitive. Moreover, the materials and energy used for labelling also increase the environmental impact of batteries (e.g. more ink used on the packaging). Nevertheless, as the analysis shows, primary battery manufacturers are already implementing certain labelling schemes on a voluntary basis (as seen in the case study for Varta) aimed at assisting consumers make smarter purchasing decisions. For these primary battery manufacturers, such labelling schemes could are part of a marketing strategy to better communicate the appropriateness of their batteries. Therefore, a capacity label is not prohibitive in all cases.
- Article 21.7 of the 2006/66/EC Battery Directive states that: "Exemptions from the labelling requirements of this Article may be granted in accordance with the procedure referred to in Article 24(3)." Therefore, when the disadvantages of capacity labelling outweigh its advantages for certain batteries, it is possible to request an exemption.

In light of those remarks, it is questionable whether placing capacity labels on all the batteries falling within the scope of this study is the best course of action. For less common battery chemistries, or batteries that cannot be replaced by any others because of their specific end-use, capacity labelling can prove to be a burden to producers without helping reduce the amount of battery waste significantly or assisting the consumer in making choices.

Option 3 is a comparative labelling scheme based on the chemistry of the portable primary batteries. It proposes the labelling of the three most popular chemistries (Zinc chloride, Zinc carbon and alkaline) of portable primary batteries (by market share, see Figure 18) for all the different geometries considered in the first study (i.e. R6, R03, R14, R20, 9V (6F22/6LR61) geometries). The result is a simplified label for an easier understanding of the consumer with only one pictogram, which depicts qualitatively the performance rating (consistent with the amount of chemical energy contained in the selected battery) as indicated in the MAD values of the IEC 60086-2 standard.

The IEC 60086-2 defines MAD as that minimum average time on discharge which shall be met by a sample of batteries. The discharge test in case of portable primary

³ Source: EPBA



batteries is carried out according to specified methods and designed to show conformity with the standard applicable to the battery types (for different sizes and chemistries). In order to be placed on the market within the EU, the three category of primary battery chemistries considered in this section shall as a minimum conform to the MAD values specified in the IEC 60086-2 Standard as follows:

Table 10: MAD and typical performance values specified in IEC 60086-2 for R20 size

IEC Test	Zinc (performan	Carbon ce value)	Zinc Chloride (performance value)		Alkaline Manganese (performance value)	
	IEC MAD	Typical	IEC MAD	Typical	IEC MAD	Typical
Portable Lighting 1 ⁷⁴ hours	1.67		5.5-11.2	8.3-10	13.5	22-29
Portable Lighting 2 ⁷⁵ hours	0.53				7.5	13-18.3
Portable Stereo hours					11	13.5-20.1
Personal Cassette Player & Tape Recorder hours	4		6-12	15-20		
Radio hours	18		32	42-58	81	120.6-138.5
Motor/Toy hours	2		5	6-12.5	15	26.3-28.5
Performance rating	Lowest	Lowest	Middle	Middle	Highest	Highest

Table 11: MAD and typical performance values specified in IEC 60086-2 for R14 size

IEC Test	Zinc (performan	Zinc Carbon (performance value)		Zinc Chloride (performance value)		Alkaline Manganese (performance value)	
	IEC MAD	Typical	IEC MAD	Typical	IEC MAD	Typical	
Portable Lighting 1 hours	2		4.5	6.3-9.25	12.83	20.2-23.8	
Personal Cassette Player & Tape Recorder hours	3		9	9.7-16.1			
Portable Stereo hours					2	10.8-15.1	
Radio hours	15		27	39.1-51.8	77	112.5-131.3	
Motor/Toy hours	1.5		3	6.7	12	22.8-24.7	
Performance rating	Lowest	Lowest	Middle	Middle	Highest	Highest	

⁷⁴ Corresponds to the condition on daily use: 5 minutes/day

Corresponds to the condition on daily use: 4 minutes beginning at hourly intervals for 8 hr/day



Table 12: MAD and typical performance values specified in IEC 60086-2 for 9V (6F22/6LR61) size

IEC Test			Zinc Chloride (performance value)		Alkaline Manganese (performance value)	
	IEC MAD	Typical	IEC MAD	Typical	IEC MAD	Typical
Radio hours	24		24	29.5-30.9	33	46.5-53.6
Smoke Detector days	8		8	10.2	16	19.7-22.5
Motor/Toy hours	7		7	12.3	12	20-21.5
Performance rating	Lowest	Lowest	Middle	Middle	Highest	Highest

Table 13: MAD and typical performance values specified in IEC 60086-2 for R6 size

IEC Test	Zinc (performan	Carbon ce value)			hloride Alkaline Mar lue) (performance va	
	IEC MAD	Typical	IEC MAD	Typical	IEC MAD	Typical
Personal Cassette Player & Tape Recorder hours			4	5.9-6.4	11.5	18-21.2
Radio hours	22		27	32.8-34.5	60	85.6-97
Remote Control hours			11	16.5-17.2	31	43.8-49.2
Motor/Toy hours			1	1.68-2.01	4	6.8-8.4
Electronic Game hours					4.5	7.7-8.7
Pulse Test pulses			60	97-124		
Photo Flash pulses					200	371-570
Digital Camera pulses					40	51-110
Performance rating	Lowest	Lowest	Middle	Middle	Highest	Highest

Table 14: MAD and typical performance values specified in IEC 60086-2 for R03 size

IEC Test	Zinc Carbon (performance value)		Zinc Chloride (performance value)		Alkaline Manganese (performance value)	
	IEC MAD	Typical	IEC MAD	Typical	IEC MAD	Typical
Portable Lighting 1 hours	0.75		0.75		2.17	3.8-4.5
Personal Cassette Player & Tape Recorder hours	1.5		1.5		5	8.3-9.6
Radio hours	20		20		44	66.5-74.1
Remote Control hours	4		4		14.5	19.1-21.5
Photo Flash pulses					140	312-404
Performance rating	Lowest	Lowest	Middle	Middle	Highest	Highest

The chemistry based label presents the relative performance information using "star" icons. The number of "stars" in the label varies from 1 to 3 depending upon the



chemistry of the portable primary battery as shown below (in sync with the information provided in Table 10 through Table 14):

Zinc Carbon: 1 star

Zinc Chloride: 2 stars

Alkaline: 3 stars

Scope of battery geometries covered in the capacity labelling

In line with the first study, for the same reasoning, we suggest that the scope of chemistry based labelling option 3 should be restricted to the following sizes of portable primary batteries⁷⁶:

- AA (R6 geometry)
- AAA (R03 geometry)
- C (R14 geometry)
- D (R20 geometry)
- 9V (6F22/6LR61 geometry)

The concept of portable primary battery chemistry based labelling is broken down into three possible potential labelling options as presented and analysed below:

4.3.2.1 Option 3a: Simplified "star icon" labelling representative of relative performance of portable primary batteries based on their chemistry

Label design

This labelling option uses simple hierarchy based on battery chemistry. The more the number of stars icons in the label, the higher the performance (chemical energy stored in the battery as well as the delivered capacity) of the battery for a particular application (as specified in the MAD values of the IEC 60086-2 Standard). With such a label, the consumer is informed of the superiority of a portable primary battery over others (i.e. alkaline battery over zinc carbon and zinc chloride batteries, and zinc chloride battery over zinc carbon battery) in terms of its performance. This label is presented in black and white (see Figure 19).

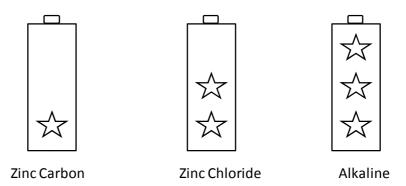
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Please refer to section 5.3.1.1 (page 135-136) of the first study (ec.europa.eu/environment/waste/batteries/pdf/battery_report.pdf).



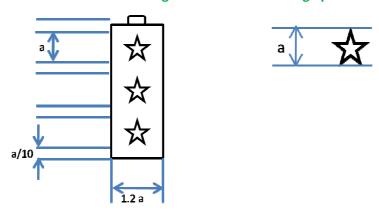
Figure 19: Labelling option 3a (based on chemistry of primary battery)



Label size and location

A typical blister⁷⁷ pack (i.e. four R6 batteries) measures about 120 mm X 80 mm, with about 60 mm X 50 mm for displaying the batteries (surface covered by the batteries). When determining the size of the icon, it should be considered that the size should be large enough in order for it to be visible. Therefore the size of the star icon should at least measure 5 mm⁷⁸.

Figure 20: Size of labelling option 3⁷⁹



It is recommended that the stars on the label be separated from one another by at least 0.5 mm for visual clarity (see Figure 20).

On the Packaging

The information on the label will be contained in a surface area measuring at least 17 mm x 6 mm (as described in Figure 20). The label icon could contain up to three stars depending on the chemistry type of the battery. The icons of the label can be either displayed horizontally located under the batteries (see Figure 21) or vertically located on the left or right side of the packaging (see Figure 19).

Blister pack is the pre-formed plastic used for packaging of one or more batteries. In some parts of the world the blister pack is also known as a Push-Through-Pack (PTP).

As per the recommendation of EPBA

Please note: In this figure, "a" = 5 mm



Figure 21: Displaying the label horizontally



Zinc Carbon Zinc Chloride Alkaline

On the battery

Considering that this label can require up to 3 icons (stars) it is therefore too large⁸⁰ (e.g. for R03 type batteries) to fit on the battery itself. Therefore, it is recommended that the portable primary batteries sold individually should be exempted from this labelling option.

The label should be put on the **front of the packaging**. This would ensure a greater visibility of the label for the end-user. The label should not be hidden by the batteries and should be clearly visible for the consumer.

4.3.2.2 Option 3b: Comparative black and white star ranking system based on battery chemistry

Label design

This labelling scheme is a more elaborate form of Option 3a. The design of this label is the same as the one in Option 3a except that the comparative performance information is conveyed based on the number of filled in black stars out of a total number of stars. In other words, the lower performance of the zinc carbon battery is communicated by one black star out of total of three stars, zinc chloride battery represented by filled in by two black stars out of three stars, and the higher performance of the alkaline manganese battery communicated by a total of three black stars (see Figure 23).

This labelling option will therefore be easier for consumers to understand than option 3a, which does not allow consumers to compare the relative performance of the battery. This labelling option clearly shows that the battery's performance is ranked 1, 2, or 3 stars out of 3 allowing for a quicker and easier way for consumers to compare and understand the battery performance.

This is in line with the requirements associated to the crossed wheeled bin symbol: « Where the size of the battery, accumulator or battery pack is such that the symbol would be smaller than 0.5cm x 0.5cm, the battery, accumulator or battery pack need not be marked but a symbol measuring 1cm x 1 cm shall be printed on the consumer packaging »



Figure 22: Labelling option 3b (based on chemistry of primary battery using filled out stars)



Label size and location

The requirements in terms of size are similar to the ones mentioned for Option 3a in terms of including the label on the front of packaging. However, it should be noted that some primary battery manufacturers suggested that this labelling option be placed on the back of packaging to further reduce printing costs, as well as to compliment the other technical and consumer information made available to the consumer on the back of primary battery packaging. However, the disadvantages of this option would be the risk of if being less eye-catching. With this labelling option, consumers may overlook the battery capacity information at the point of purchase as the icon would be on the back of the packaging.

4.3.2.3 Option 3c: Relative battery performance information based on battery chemistry employing a colour code

Label design

The design of this label is the same as the one in option 3a except that the performance information related to the stars is complemented with a colour code similar to the meaning of colours used in the European Energy Label or the traffic light labelling scheme. The lower performance of the zinc carbon battery is communicated by "one star" coloured in "red", zinc chloride batter by "two stars" coloured in "yellow" whereas the higher performance of the alkaline manganese battery is communicated by "three stars" coloured in "green" (see Figure 23). The "red" colour is associated with "least" energy efficient choice, the "yellow" colour relates to "medium" energy efficiency and the "green" colour represents the "highest" energy efficient product.

Although this labelling option adds an additional element with the use of colours to help consumers interpret primary battery capacity information, however, this labelling option runs the risk of confusing consumers who may find the use of stars and colours to be misleading as they may not necessarily associate specific colours to a specific performance.



Figure 23: Labelling option 3c (based on chemistry of primary battery employing a colour code)



Label size and location

The requirements in terms of size are similar to the ones mentioned for Option 3a.

4.3.2.4 Option 3d: Comparative relative battery performance information based on battery chemistry employing a colour code

Label design

This labelling scheme is a more elaborate form of Option 3c. The design requirements are the same as in Option 3c except that each label contains three stars and depending on the chemistry of the battery only one, two or all three of them are coloured in (see Figure 24) out of a total of 3 stars. The concept of having three stars like option 3b provides comparative information on the relative performance of the batteries. However, similar to option 3c, this option could confuse the consumer by the use of both a star ranking system and colour code.

Figure 24: Labelling option 3d (based on chemistry of primary battery employing a colour code)



Label size and location

The requirements in terms of size are similar to the ones mentioned for Option 3a.



4.3.3. ADDITIONAL INFORMATION PROVISION TOOLS

For all of the labelling options described above, it would be important to provide additional information provision tools to compliment information provided by the capacity label. Since the proposed labelling options would be too big to fit on the battery itself, they would be located on front packaging to increase visibility. Nonetheless, additional information given to consumers could greatly enhance consumer understanding of the capacity information on batteries.

In the questionnaire responses, many manufacturers expressed that manufacturers should provide additional technical data on the capacity and performance on their website for those consumers who want to know more about the batteries they purchase. However, internet access is not available to all consumers and as the consumer behaviour analysis in section 4.2. indicates, portable primary batteries are most oftentimes impulse items, therefore consumers are more likely to impulsively purchase them in store than while shopping on the internet. Therefore additional capacity information should also be provided at the selling point in the form of in-store or point of sale materials such as an in-store retail display (see Figure 11) that could provide additional information on the battery capacity label. Other materials such as hanging posters, stickers, and brochures could also be used to inform consumers about the capacity label and its implications of energy use in devices and given to consumers to take home.

EU consumers feel that one of the most important things that retailers can do to promote environmentally-friendly purchasing is to provide more information to consumers. The visibility of information and products are also an important purchasing factor for EU consumers. Therefore, working with retailers and manufacturers will be key to ensuring that information materials are provided to retailers by manufacturers, and that retailers make these materials visible and accessible to consumers while shopping. Ultimately, it should be primary battery manufacturer's responsibility to provide retailers and other actors involved in the marketing and sales of portable the information materials needed for them to communicate to consumers. It would be in the battery producer's interest to ensure that capacity information is accurately and conveyed so as to convince consumers of the quality of their product. In addition, the advantages of additional information materials would be that consumers could still have access to the capacity information of the batteries that may be individually without packaging, and thus would not have a capacity label.

4.4. SUMMARY OF SELECTED LABELLING OPTIONS FOR ANALYSIS

This section compares the different options of the labels and their relative advantages and disadvantages. The comparison of the labels according to the following criteria is presented below (in Table 15):



Table 15: Comparison of the different primary battery labelling options

Labelling option	Example of label	Size of the label ⁸¹	Legibility	Technical completeness of label	Consumer comprehension
Option 1	XX h XX h XX h XX pulses	Large (horizontal label: 537.5 mm2, vertical label: 530 mm2)	Accurate but complex design	Complete information possible on "lifetime" of the battery and means of comparison among products.	Relatively difficult for the consumer to understand the alpha numeric information presented in this label.
Option 2a		Medium (horizontal label same as vertical label: 430 mm2)	Relatively simpler(than Option 2c) design	Qualitative information on battery performance. Colour coding system provides an indication of the level of performance of the battery in comparison to the average European products.	The colour coding is relatively easier for consumer to understand than option 1.
Option 2b	C A+ B D	Large (same as Option 1)	Relatively simpler (than Option 2c) design	Complete (but less qualitative than Option 2a) information on battery performance. Letter grading system provides an indication of the level of performance of the battery in comparison to the average European products.	The textual information is relatively easier for consumer to understand than option 2a.
Option 2c	XX pulses XX h XX h XX h	Large (same as Option 1)	Accurate design and simpler than Option 1	Most complete information possible on "lifetime" of the battery. Colour coding system provides an indication of the level of performance of the battery in comparison to the average European products.	Alpha numeric information coupled with colour coding makes it easier to comprehend than option 1.
Option 3a	Zinc Carbon Zinc Chloride Alkaline	Small (horizontal label same as vertical label: 102 mm2)	Simple design	Provides relative performance for a product across different battery chemistries.	The star icons used in this label are relatively easier to understand (than option 2b).

The reference to size of label (large, medium and small) is done in a relative context to the size of all the labels considered here



Labelling option	Example of	label		Size of the label ⁸¹	Legibility	Technical completeness of label	Consumer comprehension
Option 3b	₹ Zinc Carbon	★ ★ Zinc Chloride	* Alkaline	Small (same as Option 3a)	Simple design	Provides comparative relative performance for a product across different battery chemistries.	This labelling option using a star ranking system would allow consumers to easily compare and rank the battery performance out of 3 stars making it easier to understand than option 3a.
Option 3c	Zinc Carbon	∑ inc Chloride	* Alkaline	Small (same as Option 3a)	Simple design	More elaborate form of Option 3a using colour coding.	The colouring of star icons in this label would provide an additional element to convey battery capacity information, however, the use of colours in addition to the star ranking system may be confusing to consumers and harder to interpret than option 3b.
Option 3d	Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż Ż	☆ ★ Zinc Chloride	* Alkaline	Small (same as Option 3a)	Simple design	Provides means to compare relative performance for a product across different battery chemistries. The use of stars and a colour code runs the risk of confusing consumers as consumers may not necessarily associate specific colours to a specific performance.	The comparative manner of using star icons in this label would provide an additional element to convey battery capacity information, however, the use of colours in addition to the star ranking system may be confusing to consumers and harder to interpret than option 3b.



Overall eight labelling schemes have been briefly analysed in Table 15. These seven labelling options are however based only on three different approaches. The most representative labelling option from each of the labelling schemes has been selected by taking into consideration their overall effectiveness on the parameters (consumer comprehension, legibility, size and technical completeness) analysed in Table 15. The three labelling schemes (representative of each of the overall three different approaches) selected for analysis include (see Table 16):

- Option 1: First level labelling
- Option 2b: Letter grading for popular end-use applications
- Option 3b: Comparative black and white star ranking system based on battery chemistry

Table 16: Selected labelling options for analysis

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Option 1	Option 2b	Option 3b
XX h XX h XX pulses	C A+ B D	Image: Control of the co

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5. ANALYSIS OF PROPOSED CAPACITY LABELLING OPTIONS

This chapter assesses the environmental, social and economic impacts of the different labelling options suggested for portable primary batteries (described in the previous chapter). These impacts are analysed by taking into account different stakeholders' perspectives:

- Producers' obligations and label implementation issues (e.g. costs, information to be provided)
- Regulatory responsibilities of the European Commission and Member States (e.g. enforcement and market surveillance)
- End-users (e.g. ease of access to the information and its usefulness)

Such an analysis will assist the European Commission in developing and reviewing policy options and recommendations on capacity labelling options for portable primary batteries. This chapter also includes the evaluation of different options for their completeness and their effectiveness from a visual communication point of view.

A questionnaire similar to the one sent to primary battery manufacturers was also sent to the authoritative bodies responsible for implementing the Batteries Directive in Member States. The questionnaire focused on administrative burdens and costs associated with the implementation and enforcement of a new primary battery capacity label for Member States. Valuable insights were gathered from the stakeholder meeting held with EPBA and through responses received to a questionnaires from Member States, portable primary battery manufacturers, and other relevant stakeholders

Overall, 9 responses were received from the Member States and 21 received from the manufacturers, industry associations and other stakeholders. Input included comments on the various costs and implications of the proposed labelling options for the primary battery manufacturers should a new capacity label be implemented. Some current concerns of industry include the difficulty to implement and harmonise the capacity label under the Battery Directive due to the existence of other similar battery labelling initiatives (e.g. the White Swan).

BIO complemented desk research of relevant literature by collection of data through target interviews with stakeholders. Stakeholders were interviewed to provide their estimate (quantitative and semi-quantitative) of the different parameters presented in Table 17 with regard to different labelling options presented in the chapter above.



5.1. IMPACT CATEGORIES

In order to express the costs and benefits, and other impacts of the proposed capacity labelling options for portable primary batteries, a number of indicators are used to assess the possible impacts related to the use of a label. Table 17 shows the list of the indicators used for the various impact categories. These indicators are mainly estimated on a qualitative basis, except where robust data was available (either through literature review or stakeholder consultation).

Table 17: List of impact categories and the corresponding methods of evaluation

Impact category	Indicator	Unit	Method for evaluation
	Battery waste	Tonnes	LCA taking into account the amount of battery waste generated
tal	Climate change	GWP	LCA based on the total number of portable batteries sold
Environmental	Packaging waste	Tonnes	Impact on packaging requirements
Enviro	Energy use	Mega Joules	LCA
	Consumer information ⁸²	Semi- quantitative	Expert consultation and literature review
	Employment generation	Semi- quantitative	Consultation (feedback to questionnaire) with experts representing MS and literature review
Social	Time required to implement the policy (MS)	Semi- quantitative	Consultation (feedback to questionnaire) with experts representing MS
	Implementation cost (industry)	Euros	Expert consultation (Portable battery industry representatives and industry associations) and literature review
	Enforcement cost (MS)	Euros	Consultation (feedback to questionnaire) with experts representing MS
Economic	Control and monitoring cost (MS)	Euros	Consultation (feedback to questionnaire) with experts representing MS

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⁸² Time spent by consumer to make purchase decision.



Economic impacts

In relation to economic benefits for industry, a capacity label for portable primary batteries may not influence competition in the short to medium term due to the large number of players in the market. However, in the long term it is possible that the battery market will be more technology driven and therefore favour those companies who are able to meet these demands, to the satisfaction of consumers.

An important consequence of the capacity marking requirement of the Battery Directive is that this will be legally binding for the battery producers. This will necessitate a careful control of the actual implementation of the marking requirements, not only at a visual level (i.e. the appropriate labelling as such) but also on a technical level. The latter will be of crucial importance since the labelled capacity should be the same as the delivered capacity. Therefore, the need for a proper enforcement on behalf of the authorities will be essential to ensure that consumers make their choice based on correct data. Any labelling scheme that involves additional testing and design changes will add extra work and costs for manufacturers (new tooling print plates for all the battery labels).

The main costs incurred by the Member States will be in relation to the enforcement and monitoring of either of the proposed labelling options. The Member States who responded to the questionnaire (9 Member State responses received) seem to agree (based on their past experience with compliance⁸³) that in the beginning it will be necessary for Member States to have some level of monitoring on the industry action to ensure compliance on an annual basis following entry into force of the capacity labelling scheme under the Battery Directive. This will ensure the appropriateness of the label and accuracy of the information on the label. Member States proposed to carry out such a monitoring activity by having a regular check on their borders, periodic check at the battery manufacturer's premises and a "continuous" control on the market.

Social impacts

Some positive social benefits can be expected as an outcome of better access to information on capacities of primary battery due to the various labelling options being analysed in this study. However on the short term, many stakeholders believe that the labelling options will not contribute to competitiveness, therefore these battery labelling schemes may not have short term social impacts on employment generation. On the contrary, at the long term, the appropriate battery labelling scheme can guide consumers towards portable batteries which would cause less environmental damage (considering the life cycle of the battery). A more informed choice of the primary battery using the label also brings more value to the consumer (lower overall cost due to its enhanced life during use phase in a device) compared to an inappropriate battery

In the opinion of one of the Member State as per their experience with the implementation of RoHS Directive, it was reported that while some manufacturers initially supplied compliant products, however, as time went on, it was less heedful.



selection. With time the consumer interpretation and acceptance of the label will improve. It may thus contribute to the overall competitiveness of the primary battery manufacturers therefore also resulting in some positive social impacts.

Environmental impacts

The environmental impact assessment identifies the influence of the labelling options on various environmental aspects (some of which include the amount of battery and packaging waste, energy use and climate change) over the life cycle of the portable primary batteries. Due to the lack of availability of statistical data, these environmental issues are mostly addressed on a qualitative basis only. It is presumed that the consumer interpretation of these labelling options is related to the type and level of detail in the information presented by the label.

5.2. ANALYSIS OF DIFFERENT LABELLING OPTIONS

This section evaluates how well each of the proposed three labelling options (a new one proposed in this study and two taken from the first study) follow the guidelines on transparency, reliability and clarity of information on the portable primary batteries communicated to the end-users, as stated in the Preamble 20 of the Batteries Directive.

A carefully chosen portable primary battery could lead to immediate environmental gain due to the advantage of noted benefit on service time of the battery, which in turn leads to a decrease in the number of batteries sold and therefore a decrease in natural resource consumption.

The labelling options nevertheless differ in terms of how the information is communicated. The options analysed in this section include:

- Business as Usual (BaU)⁸⁴
- First level labelling (Option 1)
- Second level labelling based on application device for the battery (Option 2b)
- Second level labelling based on battery chemistry (Option 3b)

5.2.1. BUSINESS AS USUAL (BAU)

The BaU scenario includes the current scope of the Battery Directive with no development of a capacity labelling option for portable primary batteries. This option serves as the baseline for comparison of costs and benefits with the policy options on capacity labelling. The impact of implementation of these labelling options is weighed against BaU option.

⁸⁴ BaU scenario assumes that no labelling option will be implemented for the portable primary batteries.



At present, in order to help consumers select the battery for their best-intended application, some manufacturers display on the blister (packaging) pictograms/icons which aim to inform the applications for which a particular battery type is recommended. Such pictograms however do not indicate the performance level the consumers may expect since that depends on several environmental and usage factors (such as temperature, humidity, continuous or intermittent power demand, etc over which the manufacturers have no control). As no performance level is indicated for these pictograms/icons, for the purpose of control and monitoring of the legibility of these icons, a complex performance testing is not required but simple battery chemistry verification (electrolyte test) will suffice, which costs approximately € 100 per battery⁸⁵. Two Member States indicated (in the response to the guestionnaire) that the enforcement of the Batteries Directive currently costs them approximately € 200 000 per year. This sum may vary depending on how the Batteries Directive is implemented in each Member States. For example, enforcement and monitoring costs can vary from one region to another within a Member States due to differences in several aspects such as geographic area covered, population density, regional organisation, authorities, etc.

Battery producers use these icons and pictograms as a marketing strategy in order to better sell their batteries. Therefore the initiative to display these pictograms and icons on the blisters is carried out by only some manufacturer's for a select few of the portable primary batteries produced by them. Therefore, this should be seen more as a marketing strategy than a voluntary labelling initiative with very limited product coverage. In addition, these pictograms and icons were introduced on the blisters of the battery packaging with other major design changes (marketing aspects) on the blister and therefore it is difficult to put numbers (cost estimate) on the design change requirements on the blister specific to these pictograms/icons.

As the icons/pictograms used in the BaU scenario do not provide any information on the performance level of the batteries, it is reasonable to assume that they do not have an effect on the environmental indicators (viz. reduction in primary battery production, climate change and reduction in energy usage). The implementation of the BaU scenario will not have any impact on employment generation (due to very low requirements on testing).

5.2.2. OPTION 1: FIRST LEVEL LABELLING

Although the design of this label provides the most complete information (on capacity and possible device applications) to the consumer, it is highly technical in nature (the label contains alpha-numeric symbols representing capacity which are also subject to language barriers across Member States).

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Source: This value reflects EPBA members' estimate of the cost associated with the electrolyte testing requirements



The icons, and the textual expression used in this labelling scheme, provide a good understanding of the "lifetime" of the battery, and means of comparison between products (end-use-devices). However, the delivered capacity of the primary batteries varies with the operating conditions in which they are used, therefore, the capacity number indicated in this label (corresponding to a value obtained under certain conditions as defined by the IEC standards) could be misleading for the consumer and prone to variations. This would therefore risk a low level of accuracy in terms of consumer interpretation of information.

Overall, compared to the BaU scenario, implementation of this labelling option may contribute to the effectiveness of making an informed choice on primary batteries. However, this contribution would not be significant compared to the BaU scenario (given that a high percentage of consumers are characterised as non-battery experts).

5.2.2.1 Economic impacts

The survey (carried out using a questionnaire) of portable primary battery manufactures and industry organisations forms the basis of the estimate of average costs provided in this section (one time-costs only) associated with the implementation of labelling option 1. As per the feedback received in this survey, the majority of participants agreed upon a common value for the cost per manufacturer to implement this labelling scheme. The cost breakdown and values agreed upon them are presented in Table 18.

Table 18: Cost breakdown for the implementation of labelling option 186

Implementation stage (per manufacturer)	Average cost (in €)
Testing	37 000
Design changes	423 000
Overhead costs (includes new printing tools)	90 000
Total cost	550 000

The implementation of labelling option 1 would cost the industry approximately five times more compared to the implementation of labelling option 3b. According to some

The cost estimates values provided in this table are based on a survey of EPBA members.

Source: responses received from manufacturers and industry organisations to the questionnaire survey carried out by BIO (see Annex 2).

Please note:

The cost associated with the design and testing requirements for labeling option 1 and option 2b presented here are only an average number per producer (based on the feedback received from the EPBA members) and the split of cost (between testing and design changes) is a very rough estimation (since not all members have given a split between design and testing costs).

The calculation of cost associated with testing is based on the costs for an external independent testing laboratory.

The cost calculation for the design change requirements base itself on the fact that the large size of the labelling option 1 and 2b will have a significant impact on the entire blister card and the way the already present information will have to be reshuffled.

The overhead cost among other points include changing numbers and SAP systems.



stakeholders, the additional cost of each label in order to make the necessary changes (testing, design and new tools for label printing) and implement it at the product level may cost up to 20% more of the current cost of producing a single unit of portable primary battery.

A questionnaire survey was sent to the authorities responsible at the Member State level for the enforcement and monitoring of any potential future primary battery labelling scheme (in the context of Batteries Directive). According to the majority of participants of this survey, costs related to administrative burden and obstacles to overcome non-compliance with the labelling scheme were regarded as the main barriers to the introduction of a possible labelling scheme for portable primary batteries. Agreement on a harmonised primary battery label however was regarded by most of the participants to be a less critical issue for the introduction of such a labelling scheme.

In the opinion of Member States (who responded to the questionnaire), an additional body for monitoring is not required. They suggested that it will most likely be handled by an already existing competent body which monitors the regular marking on batteries. Only 9 Member States responded to the questionnaire, but their response can very well be assumed to be representative (in this context) of all the 27 Member States in the EU as the Batteries Directive applies equally to all the 27 Member States and it already requires each one of them to regularly monitor the batteries for restricted substances (as also expressed by all the 9 Member States who responded to the questionnaire). To accomplish this, each one of these Member States is expected to already have competent bodies which can also handle the capacity labelling on the portable primary batteries. One of the Member States indicated (in the response to the questionnaire) that the enforcement of Batteries Directive currently costs them approximately € 200 000 per year.

The costs associated with the control requirements will add to the overall implementation burden of the Member States. The costs associated with the performance testing (as per IEC standards) for labelling option 1 are significant as shown in Table 19⁸⁷. The control requirement for the implementation of option 1 will cost more (approximately 10 times more) than that for the labelling option 3c due to specific requirements on testing.

Table 19: Costs associated with the performance tests required for labelling option

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Primary battery type	Cost (in €) per brand tested
AAA	1200

Four application tests for AAA, AA, C and D and 3 application test for 9V portable primary batteries

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Source: These values reflect EPBA members' estimate of the cost associated with the testing requirements (as per IEC standards) for labelling Option 1 and Option 2b



Primary battery type	Cost (in €) per brand tested
AA	1200
С	1200
D	1200
9V	900

5.2.2.2 Social impacts

The implementation of this labelling scheme (option 1) will have a substantial positive contribution towards generation of new employment due to the testing, design and printing requirements in the industry but not at the Member States level. Time required for the deployment of this labelling scheme at the Member States level would be substantially higher than labelling Option 3c due to the testing requirements. It is estimated that labelling option 1 would require around 18 months for deployment whereas only 12 months will be sufficient in case of labelling option 3b⁸⁹.

5.2.2.3 Environmental impacts

This labelling scheme (option 1) would provide consumers with the possibility to compare different portable primary batteries (cost/efficiency). As a result, consumers may purchase batteries with a longer lifetime, corresponding to the most relevant devices and so less overall waste is "produced". We therefore assume that this labelling option may result in a slight improvement concerning the choice of the most appropriate battery according to end-application.

This, in turn, results in a slight reduction in the overall production of primary batteries, which would also lead to a slight reduction in the consumption of natural resources. Similarly, this labelling option may also result in slight beneficial effects toward climate change and reduction of energy use over their life cycle due to the decrease in CO_2 emissions and energy savings arising from the slight reduction in demand for battery production.

In terms of the impact on packaging waste, the slight advantage provided by this labelling scheme (slight reduction in number of batteries produced in turn, resulting in slight reduction in packaging demand) is being compensated for by the additional space requirements on the blister (as this labelling option is quite space intensive compared to other labelling options considered in this section), therefore resulting in an overall neutral impact.

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Source: The estimate on time requirements reflect the opinion of EPBA members' for labeling option 1, option 2b and option 3b



5.2.3. OPTION 2b: SECOND LEVEL LABELLING BASED ON APPLICATION DEVICE FOR THE BATTERY

Labelling option 2b is a more elaborate version of labelling option 1. This labelling scheme provides complete information, however, not as precise (quantitatively) as the labelling option 1. It uses a grading system accompanying the visuals (instead of providing technical information using alpha numeric data as is the case for labelling option 1) which makes it relatively easier for the consumer to interpret the information communicated through this label. One interesting aspect of this option is that the letters provides an indication of the level of performance of the battery in comparison to the average European products (portable primary batteries). In addition, as the analysis on consumer behaviour has shown, labels that present the efficiency of a product on a comparative scale such as stars, letters or numbers are substantially more preferred, easily understood, and more motivating than those labels that present technical information only. The icons and the textual expression of the performance provide a good understanding of the "lifetime" (relative to the "lifetime" of the European average product of such a battery type) of the battery, and means of comparison between products. The design of the label is simple and straightforward, which is important, as overloading the label with excessive or complicated technical information limits both comprehension and engagement with the label.

5.2.3.1 Comparison of labelling option 2b with BaU scenario

When compared with the BaU scenario (pictograms/icons), the nature of the message conveyed by this labelling scheme (option 2b) is not as easy for the consumer to understand (although it provides elaborate information on the performance level of the battery whereas BaU scenario does not) due to the technical nature of the information conveyed by this labelling scheme (option 2b).

In contrast to the BaU scenario (assuming only a few manufacturers use pictograms/icons on the blister for some of their portable primary batteries), it will cost substantially more to the industry to implement this labelling scheme (option 2b) due to the extra costs associated with the performance testing and design change requirements (€460 000 more per manufacture as compared to BaU scenario).

Similar to option 1, the control and monitoring costs associated with this labelling scheme 2b will add to the overall implementation burden of the Member States compared to the BaU scenario. The costs associated with the performance testing (as per IEC standards) for labelling option 2b will roughly be €1200 (for each battery cell) which is approximately 10 times more than in case control was required in the BaU scenario (electrolyte verification costing only €100 per test)⁹⁰.

The implementation of this labelling scheme (option 2b) therefore has a slight positive impact on employment generation due to the (testing and design) requirements as

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⁹⁰ Source: These values reflect EPBA members' estimate of the cost associated with the testing requirements (as per IEC standards) and the electrolyte verification test for portable primary batteries



compared to the BaU scenario. In the context of BaU scenario, this labelling scheme (option 2b) will require 18 months (substantially high) for implementation.

On top of the end-use application suitability information (also presented by BaU scenario) this labelling scheme (option 2b) includes information on the performance level of the batteries and therefore is advantageous compared to the BaU scenario. The additional information on performance level provided in this labelling scheme (compared to pictograms/icons of BaU scenario) may have substantial contribution to the overall reduction in primary battery production. Similarly, it may also result in substantial beneficial effects toward climate change and a reduction of energy use over their life cycle due to the decrease in CO₂ emissions and energy savings arising from substantial reduction in demand for battery production.

5.2.3.2 Economic impacts

The implementation (for portable primary battery manufacturers), enforcement and controlling (for Member States) costs based on the feedback received to questionnaire from Member States and stakeholders comprising of industry and industry associations, are the same as that for the labelling option 1 (see section 5.2.2.1).

5.2.3.3 Social impacts

The textual nature of information presented in this labelling option makes it less complicated than the labelling option 1 and therefore relatively easier for the consumer to comprehend which results to a slight positive effect to the consumer information impact indicator. The implementation of this labelling option has a slight positive impact on employment generation due to the similar (testing, design and printing) requirements as the option 1. For the same reasons, the time required for the deployment of this labelling scheme will also be substantially high (18 months) when compared to option 3b (only 12 months)⁹¹.

5.2.3.4 Environmental impacts

This label communicates information to the consumer similar to labelling option 1 but does so more effectively by presenting the technical details corresponding to end-use-device by grades (textual) approach. This labelling option therefore is advantageous compared to option 1 in terms of end-user interpretation.

A better consumer interpretation of this labelling option (compared to first level labelling scheme) may have a substantial contribution to the overall reduction in primary battery production, therefore a substantial beneficial effect towards reduction in the consumption of natural resources.

Similarly, it may also result in substantial beneficial effects toward climate change and a reduction of energy use over their life cycle due to the decrease in CO_2 emissions and energy savings arising from substantial reduction in demand for battery production.

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Source: The estimate on time requirements reflect the opinion of EPBA members' for labeling option 1, option 2b and option 3b



This labelling scheme is as much space intensive as the labelling option 1 (both 530 mm²) but more than the labelling scheme based on battery chemistry (option 3b requires 102 mm²) and hence would have the same impact on packaging waste as in case of labelling option 1.

5.2.4. OPTION **3b**: COMPARATIVE BLACK AND WHITE STAR RANKING SYSTEM BASED ON BATTERY CHEMISTRY

In light of space constraints on the blister, this labelling scheme requires a relatively smaller area than labelling option 1 and option 2b (Option 1 and Option 2b require approximately 420% more labelling area as compared to labelling Option 3b). It provides the comparative information on the relative performance of a battery in the simplest and effective manner using the "star" icons. The filled (in black colour) "star" icons provide a good means of comparison between various possibilities of chemistries (zinc carbon, zinc chloride and alkaline) for primary batteries. Labels that present the efficiency of a product on a comparative scale such as stars, colour codes, letters or numbers are substantially more preferred, easily understood, and more motivating to consumers than those labels that present technical information only.

Further, due to the easy visual system of star ranking, the vast majority of consumers throughout the EU and European Free Trade Association (EFTA) countries would be able to easily comprehend the ranking scheme, which is based on the classic hierarchy of battery chemistries (i.e. 1 star coloured in "black" for zinc carbon, 2 stars coloured in "black" for zinc chloride and 3 stars coloured in "black" for alkaline primary batteries provides a comparison between the relative performance of these batteries). It is a simple scheme which replicates the differentiation achieved by labelling options 1 and 2b (which base themselves on specific measurement tests).

This labelling successfully communicates qualitatively the information with regard to "lifetime" of the battery. Even though this labelling option does not explicitly indicate the potential end-use application devices for the battery, it is implicitly taken into account in the label, which assigns a performance level (stars) to a particular battery chemistry type based on performance test carried out over a wide range of potential end-use applications (using MAD values). The issue of end-use application devices can however also be addressed by providing complimentary information on display counters in the retail stores, using, brochures, or even through informing salespersons who could communicate this information to consumers.

5.2.4.1 Comparison of labelling option 3b with BaU scenario

This labelling scheme (option 3b) is relatively as easy to understand for consumers as the pictograms/icons used in the BaU scenario. However the BaU scenario does not provide any information concerning performance level of the batteries. This labelling scheme (option 3b) therefore is more advantageous for the consumer than the icons/pictograms used in the BaU scenario as it qualitatively (using star icons) provides



information regarding the performance level (MAD values) of the battery tested over a wide range of suitable end-use application devices.

The costs associated with the implementation of this labelling scheme (option 3b) for the industry (€90 000) are quite comparable with those required for the implementation of icons/pictograms used in the BaU scenario. This is true for the costs incurred for the implementation by the Member States as well. It is so because similar to the BaU scenario this labelling scheme (option 3b) only requires simple chemistry verification for control and monitoring by the Member States (electrolyte test which costs approximately € 100 per battery).

The implementation of this labelling scheme (option 3b) therefore will not have any impact on employment generation as compared to the BaU scenario (due to similar requirements on testing). In the context of BaU scenario, this labelling scheme (option 3b) will require 12 months for implementation.

The performance level information provided in this labelling scheme (compared to pictograms/icons of BaU scenario) may have slight contribution to the overall reduction in primary battery production. Similarly, it may also result in slight beneficial effects toward climate change and a reduction of energy use over their life cycle due to the decrease in CO₂ emissions and energy savings arising from slight reduction in demand for battery production.

5.2.4.2 Economic impacts

This labelling scheme (option 3b) would reduce (cost approximately 90% less) the overall implementation burden for Member States in comparison to labelling option 1 or option 2b. The enforcement costs for Member States resulting from the requirement of market surveillance (for labelling option 3b) will be fairly low (as no new competent body required at the Member State level due to their current activity in the context of Batteries Directive in the BaU scenario). One of the Member States indicated (in the response to the questionnaire) that the enforcement of battery Directive currently costs them approximately € 200 000 per year. The control and monitoring by the authorities of the labelling option 3b would also not require any complex performance testing because this labelling can easily be verified on the basis of the battery electrolyte test which costs approximately € 100 per battery⁹². On top of a very low cost, such a testing can be done very quickly i.e. within a matter of hours.

The labelling option 3b requires approximately only 1% of the overall space on the blister⁹³. It is therefore assumed that this labelling scheme (option 3b) will not require any design changes due to its very low space requirement which will have insignificant impact on the entire blister card as it can be easily adapted to the blister in its current format (as the already present information on the blister need not be reshuffled).

Source: This value reflect EPBA members' estimate of the cost associated with the testing requirements for labeling option 3b

Please note: Labelling option 3b requires 102 mm² area and the overall area of the blister (see section 5.3.2.1) is 9600 mm²



The majority of stakeholders (primary battery manufacturers and industry associations) believe that the implementation of this labelling scheme would cost 85% − 90% less than the other labelling schemes (option 1 or option 2b) as it does not require any extra testing. An estimate of average costs of implementation per manufacturer (as per the feedback received from industry and industry organisation) is €90 000 (overhead costs only), which is much lower (costs €460 000 less per manufacturer) as compared to Option 1 and Option 2b alike. This labelling option is therefore considerate towards the implementation costs for battery producers and Member States.

Implementation of this labelling scheme presents very low enforcement cost burden for the Member States. This is so because this labelling scheme is easily verifiable since it is based on the chemistry of the battery and no testing needs to be done⁹⁴. It is relatively easy to monitor and control this labelling scheme (option 3b). This is so due to the control being only on the battery chemistry (simple electrolyte test needed) while in other cases, the battery performance validation under certain set conditions taking into account consumer use pattern, weather conditions (temperature) and different drainage rates (low, medium and high) situations (based on appliance they are used in) also needs to be tested.

5.2.4.3 Social impacts

This labelling scheme has the true advantage of being relatively easier for the consumer to interpret due to its simplicity. This may in-turn reflect in the substantial time savings (gain) to the consumers in terms of making the purchase decision of portable primary batteries. The administrative efforts required for the implementation, enforcement and monitoring of this labelling option are far less than the other labelling options and therefore it may not have a beneficial impact on the generation of employment compared to other labelling options. On the contrary, for the same reasons, this labelling scheme also will be the quickest (only 12 months required for its implementation which is approximately 33% less as compared to option 1 or option 2b) to deploy at the Member State level and therefore would result in a very beneficial impact on time savings for its deployment.

5.2.4.4 Environmental impacts

Given the simplicity of this labelling option, it may assist consumers in selecting a higher energy content battery. This labelling option however presents the risk of consumers not making the most informed choice possible due to the limited amount of information provided. Thus, this labelling option (like the first level labelling option) may only result in a slight positive contribution towards reduction of energy consumption and damage to climate (CO_2 emissions) over the life cycle of the batteries. Similarly, it also contributes to a slight reduction in battery waste due to the reduction in demand of battery production.

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As for labelling option 3b only a simple electrolyte test is required (€100 per test) which is approximately 90% lower when compared to the control requirements for labelling option 1 or option 2b (€1200 per test)



This labelling option takes into account the limited amount of space available on battery packaging. The corresponding space requirements on the blister is lowest for this option when compared to other labelling options and therefore has least impact in terms of the contribution towards packaging waste. The implementation of this labelling option may therefore also have slight beneficial impact towards packaging waste reduction.

5.3. SUMMARY OF ANALYSIS

Table 21 summarises the possible environmental, economic, social and administrative impact for implementation of the labelling options at the MS and industry level. In each cell of the matrix a qualitative score is given, hence, forming the basis for identifying the most workable approach in an efficient and effective manner.

To compare each of the labelling options assessed, a semi-quantitative score matrix approach is adopted (see Table 20). If there are external influencing factors, a range has been used, for example "0 to -" or even "- to +". Such scores are clarified by an additional note to the matrix. The level of detail in the analysis depends on the amount of information gathered as well as their quality.

Table 20: Semi-quantitative score matrix

+++	Very beneficial effect
++	Substantial beneficial effect
+	Slight beneficial effect
0	No effect
-	Negative effect
	Substantial negative effect
	Very negative effect
N/A	Not applicable

Table 21: Impact assessment matrix of various labelling options for primary batteries

Labelling Option Impact Indicator		Option 1	Option 2b	Option 3b
impact maica				
	Economic impact indicators	:		
Implementation costs (industry)		High	High	Low
		(€550 000)	(€550 000)	(€90 000)
Enforcement cost (MS)		Low	Low	Low
Control and monitoring cost (MS)		High	High	Low
	Social impact indicators:			
Consumer information		+	++	++



Labelling Option Impact Indicator		Option 1	Option 2b	Option 3b	
Employment generation		++	+	0	
Duration required for implementation MS)		-	-	+	
	Environmental impact in	dicators:			
Battery waste		+	++	+	
Climate change		+	++	+	
Packaging waste		0	0	+	
Energy use		+	++	+	
	Other criteria:				
Degree of uncertainty/risk		+	++	-	
Technical fea	sibility			+++	

The objective of Table 21 is to compare the impacts (environmental, social and economic) of the three labelling options in light of the current situation so as to come up with the proposal of the optimised labelling option (the BaU scenario is therefore not considered in this table).



6. OPTIMISED CAPACITY LABELLING PROPOSAL FOR PORTABLE PRIMARY BATTERIES

The principal objective of this chapter is to recommend the most suitable portable primary battery capacity label, which addresses the main issues related to the implementation, enforcement and monitoring of the labelling process, as well as the facility with which end-users interpret the information conveyed.

All the selected labelling options were developed with the goals of the Batteries Directive in mind — to provide consumers with transparent, reliable and clear information on batteries in order to make a more informed choice on the purchase of portable primary batteries. In addition, the analysis of consumer behaviour revealed that when purchasing electronics and similar products, buyers consider "performance" to be the main purchasing factor. All three labels analysed (Option 1, Option 2b and Option 3b) attempt to convey the performance information of portable primary batteries, which is a good indicator of the lifetime of the battery. However, the analysis of the different labelling options shows that they differ in terms of their environmental, social, and economic impacts. Based on results of the analysis, **option 3b: comparative black and white star ranking system based on battery chemistry** is the recommended labelling option.

Labelling options 1 and 2b are more technically capable of delivering similar or even better results on reducing environmental impacts, compared to labelling option 3b. However, the cost-effectiveness of implementing these labelling options is also questionable when compared to that for labelling option 3b. This is because options 1 and 2b would entail significant costs (on an average €550 000 implementation costs each per manufacturer) for the industry. There exists a plethora of battery-using devices that are constantly evolving, therefore it would be expensive (on an average overall €460 000 design and testing costs each per manufacturer) and time consuming as it would require frequent updating, to select a group of products for each battery type. These options therefore present the risk of generating a label with unclear or confusing information to the consumer, at a higher price (on an average overall €460 000 more per each manufacturer when compared to Option 3b).

Labelling option 3b can achieve reduction in environmental damage caused by portable primary batteries, fulfilling a major aim of the Battery Directive, and would involve less administrative burden reflecting in the costs (€460 000 less per manufacturer when compared to Option 1 and Option 2b alike) for manufacturers. As such, the enforcement burden for the Member States in case of Option 3b is significantly reduced (approximately 90% less) relative to options 1 or 2b. This labelling scheme (option 3b) would require a relatively smaller area (approximately 80% less area per label on the packaging when compared to Option 1 and Option 2b). Furthermore,



option 3b is based on the battery chemistry (simple electrolyte testing) rather than specific testing requirements (based on end-use applications) when compared to option 1 and option 2b and therefore can be implemented in the short term. Labelling option 3b also has strong stakeholder (involving portable primary battery manufacturers, industry associations, consumer associations, portable primary battery retailers and their associations) support. On the other hand, majority of the Member States (6 out of 9 Member States who responded to the questionnaire) had no preference for any particular labelling, 2 supported the Option 2b and one was in favour of Option 1. Therefore, it is difficult to make a general conclusion regarding Member States' preference for a particular option.

Although Option 3b does not provide detailed quantitative information on primary battery capacity, the star ranking scheme would present primary battery capacity information in a way that is easier to understand by consumers. This labelling option allows consumers to *compare* the capacity of portable primary batteries, which is an important element of an effective labelling scheme. In this labelling option, the label shows 1, 2, or 3 filled in stars out of 3 to give the consumer indication of the battery's capacity ranking. Furthermore, the provision of complementary information such as display counters in stores (shops), brochures, manufacturers' websites, or even through informing salespersons could provide additional information to consumers. Some primary battery manufacturers already provide such complementary materials in their marketing strategies through the use of attractive in store retail displays (see Figure 11) and through their websites. Nonetheless, it is not guaranteed that complementary information would be read by every consumer at the time of purchasing, nor available in every point of sale locations.

Therefore, based on the analysis of consumer behaviour literature, option 3b, which uses a comparative system based on stars, is deemed to be the most easily interpreted by consumers. Nevertheless, it should be noted that a consumer behaviour survey was not carried out specifically for this study; therefore the findings on consumer behaviour were not a direct outcome of such a consumer questionnaire

Finally, it is important to note that the discussion on capacity labelling for primary batteries is a new issue for consumers, which requires sufficient understanding on how they perceive and understand this information. As consumers were not directly consulted during the study, an additional consumer survey to compliment the analysis carried out in this study would be useful.



7. CONCLUSIONS

The study's findings indicate that labels which present the efficiency of a product on a comparative scale such as stars, letters or numbers, or colour codes system are vastly more preferred and are more easily understood and motivating than those that present technical information only. It is important to note that a new capacity labelling for primary batteries would also be a new issue for consumers. In order to further ensure that the proposed label would result in sufficient consumer understanding of the label, an additional consumer survey to compliment the analysis carried out in this study may also be useful.

Based on the results of the analysis, **option 3b: comparative black and white star ranking system based on battery chemistry** is the most optimal labelling option out of the three options proposed. Option 3b was deemed to be the most cost-effective option in terms of implementation costs for industries and Member States. Option 3b would also require less physical space than labelling Option 1 and Option 2b for the label. Labelling Option 3b also has more industry stakeholder support compared to the other labelling options. Finally, in terms of end-user interpretation on battery capacity information, option 3b is deemed to be the most easily interpreted by consumers as it uses a comparative system based on stars and colour codes, which research shows would be more easily interpreted by consumers.

In terms of a policy recommendation based on this study, extensive analysis has not yielded a labelling option that is simple and implementable, can give a clear recommendation to consumers as to which battery type (capacity) to buy for the application needed, and can be certain to yield significant environmental benefits. Moreover, it has been impossible so far to estimate the total and quantified benefits and costs for the options analysed as concerns portable non-rechargeable batteries. It may therefore be recommendable for the Commission to fulfil the requirements of Article 21 of the Batteries Directive (2006/66/EC) by requiring the capacity label adopted for portable rechargeable batteries only, and by granting an exemption from the capacity labelling requirement for all portable non-rechargeable batteries.



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Other data sources:

- EPBA Stakeholder meeting held 14 January 2010
- Questionnaire responses received from manufacturers and industry organisations to the questionnaire survey carried out by BIO



9. ANNEXES

List of Annexes:

Annex 1 – Extended information on the LCA studies reviewed

Annex 2 – Stakeholders to receive questionnaire



ANNEX 1: EXTENDED INFORMATION ON THE LCA STUDIES REVIEWED

Annex 1 contains the tables which show the information related to the results of the LCA studies being reviewed in the sub-section 1.1.

Table 22: UNIROSS study ("Study 2"), environmental impact of portable batteries

In terms of	The impact of a rechargeable battery is equal to	Reference units	Equivalence in disposable batteries
Consumption of non- renewable natural resources	1	kg of petroleum extracted	19
Climate change	16	km driven by car	457
Photochemical oxidation	73	km driven by car	2320
Air acidification	2122	km driven by car	19812
Sedimentary ecotoxicity	227	mg of water emitted into water	2731

Table 23: UNIROSS study ("Study 2"), comparative environmental impact of portable batteries

In terms of	Avoiding an impact corresponding to X Europeans/year	Avoiding an impact corresponding to
Consumption of non-renewable	106 000 If we replace all disposable batteries in Europe with rechargeable ones, we would also avoid the impact that 106 000 Europeans have on the consumption of non-	210 900 tonnes of petroleum extracted If we replace all disposable batteries in Europe with rechargeable ones, we would an impact on the consumption of non-renewable natural resources that is comparable to extracting 210 900
natural resources	renewable natural resources 62110	tonnes of petroleum
Photochemical oxidation	136820	5 billion km driven by car 25 620 billion km driven by car
Air acidification	109000	201 700 billion km driven by car
Sedimentary ecotoxicity	90410	29 tonnes of mercury emitted into the water



Table 24: Parsons study ("Study 1), range of battery types, scenarios and functional equivalents considered in this study

	NiMH			NiCd			Alkaline	
	Optimistic case	Realistic case	Worst case	Optimistic case	Realistic case	Worst case	Optimistic/	
Number of recharge cycles	400	50	50	400	50	50	-	-
Storage time and temperature	0	0	30 days at 37°C	0	0	30 days at 37°C	0	-
Discharge rate	Low	Low	High	Low	Low	High		
% of capacity assumed	100	100	30	100	100	36	100	40
Number of cells to deliver 1 kWh	2.3	18.2	66.7	3.8	28.6	100	834	2085



ANNEX 2: LIST OF STAKEHOLDERS THAT RECEIVED QUESTIONNAIRE

EPBA members

Primary battery manufacturers

CEGASA INTERNATIONAL SA

DURACELL Batteries Ltd

Energizer SA

GP BATTERIES (UK) LTD.

Contacts

Fernando Perez

Khush Marolia

Pascal Franchet

Gertjan Van Reenen

Eastman KODAK Company
PANASONIC Battery Sales N.V.
Wim Willems
RENATA AG
Eric Weber
SONY France S.A
Arne Campen
SUNLIGHT BATTERIES
Panagiotis Petrou
VARTA Consumer Batteries
Uwe Knoedler

National Battery Associations

Austria Manfred Kandelhart
Belgium Peter Binnemans
Czech Republic Petr Kratochvil
Denmark Frederik Madsen

Finland Marja Ola

France georges goguet
Germany eckhard fahlbush
Greece Christina Baka
Hungary Zoltan Cserepy
Italy Marco Ottaviani

Netherlands Jan bartels
Norway Frode Hagen

Poland Marek Sokolowski
Portugal Eurico Cordeiro
Spain Gonzalo Torralbo
Sweden Magnus Frantzell

Switzerland Jean Marki
Turkey Inci Kavustu
UK Warwick Smith



Other Primary Battery Manufacturers

Primary battery manufacturers Contacts

Allbatteries John Hedger
Dubilier Graham Stewart

Rayovac Gareth Thomas-Prause

Samsung Lily Heinemann
Sanyo Batteries Nigel Vincent
Sony United Kingdom Ltd Peter Evans

ATC Batteries Industry Co Ltd Sales/Marketing Dpt. Sales/Marketing Dpt. **BPI Battery Daily Power Batteries Limited** Sales/Marketing Dpt. Huanyu Battery Sales/Marketing Dpt. Sales/Marketing Dpt. Jiangmen Battery Factory Ningbo Osel Battery Sales/Marketing Dpt. Reliant Sales/Marketing Dpt. Sahamit Battery Sales/Marketing Dpt. Toshiba Battery Co, Ltd Sales/Marketing Dpt.

Other Stakeholders

Digital Europe Guillemette Vachey

Manbat Roger Pemberton

Society of the British Battery industry B.P. Kelley

Arden Marketing and Services Sales/Marketing Dpt. PC & Associates Sales/Marketing Dpt.

BEUC/ ANEC Laura Degallaix

EEB Doreen Fedrigo
EPTA Brian Cooke
Cenelec HQ contact
IEC Michael Babiak

Eurocoop Javio Calvo

Eurocommerce Géraldine Verbrugghe

Battery association Japan Watanabe Akira

IBDA JG Ferris

ICT Ireland Kathryn Raleigh

JVC Takahiko Wakabayashi

JVC Andre Overbeck

DOD EU monitoring Alice Pulh

Consumer Electronics Association HQ contact

ECOS Eduard Toulouse



Member States Authorities

Member State Competent Authority Contacted

Austria The Federal Ministry for Agriculture, Forestry, Environment and Water

Management

Belgium Federale Overheidsdienst Volksgezondheid, Veiligheid van de Voedselketen en

Leefmilieu; OVAM

Bulgaria Ministry of Environment and Water

Cyprus Ministry of Agriculture, Natural Sources and Environment

Czech Republic Ministry of Environment

Denmark Danish Environmental Protection Agency (DEPA)

Estonia Ministry of Environment

Finland Ministry of Environment

France Ministère de l'écologie, de l'énergie, du développement durable et de la mer

(MEEDDM)

Germany Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Ministry for

the Environment Baden-Württenberg,

Greece Ministry of Environment and Public Works Physical Planning and Public works

Hungary Ministry of Environment and Water

Ireland Environment Inspectorate, Department of the Environment, Heritage & Local

Government

Italy Environmental Ministry

Latvia Ministry of Environment

Lithuania Ministry of Environment

Luxembourg Administration de l'Environnement Division des Déchets

Malta Environment Planning Authority

Netherland Ministry of Housing, Special Planning and the Environment

Poland Ministry of Environment

Portugal Agência Portuguesa do Ambiente (APA)

Romania Ministry of Environment, Ministry of Economy and Finance

Slovakia Ministry of Environment

Slovenia Ministry of the Environment and Spatial Planning

Spain Ministerio de Medio Ambiente Plaza San Juan de la Cruz

Sweden Swedish Environmental Protection Agency (SEPA)

United Kingdom DEFRA; Department for Business, Enterprise & Regulatory Reform