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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators as regards the placing on the market of portable batteries and accumulators containing cadmium intended for use in cordless power tools

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Disclaimer

This report commits only the Commission's services involved in its preparation and does not prejudge the final form of any decision to be taken by the Commission

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Introduction

The Batteries Directive (Directive 2006/66/EC[1]) seeks to improve the environmental performance of batteries and accumulators and of the activities of all operators involved in their life-cycle. It lays down specific rules on placing batteries and accumulators on the market and on collection, treatment, recycling and disposal of waste batteries and accumulators.

To achieve its objectives, the Directive prohibits placing on the market of batteries and accumulators containing mercury and cadmium. This prohibition to use cadmium in batteries and accumulators applies to "portable batteries and accumulators, including those incorporated in appliances, that contain more than 0.002% of cadmium by weight" (Article 4 (1)(b) of the Batteries Directive). However, Article 4(3) exempts portable batteries and accumulators intended for use in:

– emergency and alarm systems, including emergency lighting;

– medical equipment;

– cordless power tools (CPT).

The Commission was requested to review the exemption in relation to cordless power tools and submit a report to the European Parliament and the Council by 26 September 2010, "together, if appropriate, with relevant proposals, with a view to the prohibition of cadmium in (portable) batteries and accumulators" (Article 4(4) of the Directive). The Commission was asked to only review this exemption as at the time of the adoption of the Directive in 2006 there were doubts whether technical substitutes were already available for this application. Article 4(4) does not require the Commission to re-assess exemptions provided for (a) and (b). It was demonstrated that the availability of viable substitutes is disputed for the emergency lighting applications for safety reasons and no viable substitutes were identified for the medical equipment applications.[2]

The purpose of this impact assessment is to provide a sound knowledge basis for a possible Commission proposal on the exemption for the use of cadmium in portable batteries intended for the use in cordless power tools. **The scope of this impact assessment is therefore solely limited to a review of Article 4(3)(c) of the Batteries Directive and will not analyse impacts of the wider policy decision on the prohibition on the use of cadmium in portable batteries in general.** In this impact assessment the term ‘batteries’ is used to mean both batteries and accumulators.

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

2 Extended Impact Assessment prepared by the Commission services in preparation of the Batteries Directive (2006/66/EC), [COM(2003)723 final], see p. 27 and Annex V.

SECTION 1: PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Identification

Lead DG: ENV

Agenda planning/WP reference: 2010/ENV/016

Proposal for amendment of Article 4(3)(c) of Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC ("Batteries Directive" here afterwards)[3].

1.2. Organisation and timing

Work on the review of the exemption of the use of cadmium in portable batteries intended for use in cordless power tools started in 2009.

An Impact Assessment Steering Group (IASG) was established in March 2010 to which the following Directorates-General were invited: Enterprise and Industry; Environment; Energy; Health and Consumers; Competition; Economic and Financial Affairs; Internal Market and Services; Trade; Eurostat; Enlargement; Information Society and Media; Joint Research Centre; Employment, Social Affaires and Inclusion; Mobility and Transport; Research and Innovation; Secretariat General and Legal Service.

Meetings of the Impact Assessment Steering Group (IASG), comprising representatives from the Directorates-General ENTR, SANCO, ENV and the Secretariat-General were held on 2.04.2010, 19.09.2011 and 14.10.2011. In addition, written comments were also received from DG ENTR, ENV (F1) and Secretariat-General. The members of the steering group were also invited to participate in meetings with experts, stakeholders and Member States representatives[4]. The IASG was regularly informed on and provided input to all important milestones of the review (preparation of study reports, stakeholder consultations).

1.3. Consultation and expertise

1.3.1. External expertise

Studies

The following studies concern the review of the exemption of the use of cadmium in portable batteries intended for use in cordless power tools:

– In 2009 the Swedish Environmental Protection Agency published a report on 'Cadmium in power tool batteries - The possibility and consequences of a ban'[5]. The report stated that it is possible to replace portable NiCd batteries in power tools. In particular, development of one alternative technology - lithium-ion (Li-ion) batteries

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[3] Consolidated version of the Batteries Directive (2006/66/EC) is available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2006L0066:20081205:EN:PDF

[4] A Stakeholder Workshop was organised on 18 July 2011 in the framework of BIOIS study on LCA.

[5] See http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5901-9.pdf

- has progressed extremely rapidly over the last few years. The different types of battery technologies all have advantages and disadvantages. Today Li-ion and nickel-metal hydride (NiMH) are fully competitive alternatives to NiCd battery technologies, in terms of both price and performance, according to this report.

– In 2009 the Commission ordered a synthesis study to assist it with the review of the exemption ("ESWI study"). The study was published on the DG ENV website in March 2010.[6] The objective was to assess the available data and information and to identify and address remaining needs for a review of the exemption. The available data indicated that it could be technically feasible today to replace NiCd batteries by existing Li-ion and NiMH battery technologies, with certain reservations in applications where the temperature lies below 0°C.

– In 2010, the Commission ordered a comparative life-cycle assessment (LCA) of the three main battery technologies used in portable batteries intended for use in cordless power tools (nickel-cadmium, nickel-methal hydrate and lithium-ion) in order to complete a comprehensive cost-benefit analysis and data gaps need for an impact assessment that would accompany a possible legislative proposal on the exemption for the use of cadmium in portable batteries intended for use in cordless power tools ("BIO study"[7]).

1.3.2. Consultation process and results

An on-line **public stakeholder consultation**[8] (10 March-10 May 2010) has been launched via the EUROPA website, based on the ESWI study published in 2009. Contributions and summary of stakeholder comments were published on EUROPA website[9].

Stakeholders were invited to give their views on the environmental, social and economic impact that might result from any future ban on cadmium in portable batteries and accumulators intended for use in cordless power tools.

Some stakeholders favoured withdrawal of the exemption for use of nickel-cadmium (NiCd) batteries in cordless power tools, since they viewed the economic costs as minimal and the environmental benefits as substantial in the long term. Others opposed withdrawal of the exemption and underlined that the data on the economic, environmental and social impact do not justify withdrawal. Overall, the stakeholder consultation confirmed the need for a comparative life-cycle assessment in order to provide a firm basis for the cost-benefit analysis. A summary of the stakeholders' comments is presented in Annex 1.

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6 ESWI study (2010) is available at: http://ec.europa.eu/environment/waste/batteries/pdf/cadmium_report.pdf.

7 BIO study (2011) was conducted prior to the full completion of all relevant Handbook documents, it is available at: http://ec.europa.eu/environment/waste/batteries/index.htm

8 The consultation remained open from 10 March until 10 May 2010, respecting the minimum standard of eight weeks. 14 contributions were received and individually acknowledged. Among the respondents were 2 Member States, 8 producers, producer responsibility organisations and industrial associations, 2 raw material suppliers and 2 recyclers.

9 Contributions and summary of stakeholder comments are available at: http://ec.europa.eu/environment/consultations/batteries_en.htm, see under "Results of consultation and next steps".

A **stakeholder workshop** (peer review) has been organised on 18 July 2011. The objective was to provide input to the BIO study, notably on the comparative life-cycle assessment of the three different battery chemistries used in portable batteries intended to be used in cordless power tools. Minutes of the stakeholder workshop is presented in Annex 2.

1.4. Consultation of the Impact Assessment Board

The Impact Assessment Board of the European Commission examined a draft version of the Impact Assessment and issued its opinion on 25 November 2011. The Impact Assessment Board made several comments and, in the light of those suggestions, the final Impact Assessment report:

– clarifies the environmental and health issues, including the risks of cadmium compared to other battery types

– the natural evaluation of baseline scenario without an EU ban and the interactions with other EU legislation;

– provides a more prominent discussion on policy options, including a clarification on different time horizons; adds additional evidence concerning possible impacts on relevant stakeholders, notably consumers, SMEs and competitiveness;

– adds more developed monitoring and evaluation arrangements.

2. SECTION 2: POLICY CONTEXT, PROBLEM DEFINITION AND SUBSIDIARITY

2.1. Policy context

The Batteries Directive seeks to improve the environmental performance of batteries and of the activities of all operators involved in their life-cycle. It lays down specific rules on placing batteries on the market and on collection, treatment, recycling and disposal of waste batteries and accumulators. To achieve its objectives, the Directive prohibits placing on the market of batteries containing mercury and cadmium. However, Article 4(3) exempts cadmium-contaning portable batteries intended for use in cordless power tools (CPT).[10]

The initiative on the prohibition of the use of cadmium in portable batteries is linked to the Commission Communication of 30 July 1996 on the Review of the Community Strategy for Waste Management, and a response to the Council Resolution of 25 January 1988 on a Community action programme to combat environmental pollution by cadmium[11] which stressed the need of limiting the uses of cadmium to cases where suitable alternatives do not exist in the interests of the protection of human health and the environment.

Article 4(4) of the Batteries Directive requires the Commission to review the exemption from the cadmium ban provided for portable batteries intended for use in CPT and submit a report

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[10] Examples of CPT include tools used by consumers and professionals for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, hammering, riveting, screwing, polishing or similar processing of wood, metal and other materials or for mowing, cutting and other gardening activities.

[11] OJ C 30, 4.2.1988, p. 1.

to the European Parliament and to the Council together, if appropriate, with relevant proposals, with a view to the prohibition of cadmium in batteries.

The prohibition of the use of cadmium in batteries was not proposed by the Commission, but only introduced by the co-legislators in the co-decision procedure on the Commission's proposal on a revised Directive on batteries and accumulators. It is also in line with similar prohibitions contained in other Directives such as Directive on end-of-life vehicles (Directive 2000/53/EC[12]), waste electrical and electronic equipment (Directive 2002/96/EC[13]) and packaging and packaging waste (Directive 94/62/EC[14]).

At the time of drafting the current Batteries Directive (2006/66/EC), both Council[15] and the European Parliament[16] prepared separate impact assessments on substantive amendments made to the Commission proposal.

A Commission Report was submitted to the European Parliament and to the Council in December 2010[17]. It concluded that at that stage it is not appropriate to bring forward proposals on the exemption for cadmium containing portable batteries intended for use in cordless power tools (CPT) because not all the technical information (notably costs and benefits of cadmium and its substitutes) was available to support such a decision.

2.2. Problem definition

Commission Decision 2000/532/EC[18], two categories of waste batteries were established: hazardous and non-hazardous batteries. NiCd batteries are classified as hazardous waste as various compounds of cadmium are also clasified under Regulation (EC) No 1272/2008.[19] The substitutes of NiCd batteries (e.g. NiMH and Li-ion batteries) are, however, not clasified as hazardous waste.

Cadmium is classified as a CMR substance (carcinogenic, mutagenic or toxic for reproduction). According to the CLP Regulation (EC) No 1272/2008 Annex VI it is a type 1B carcinogen (presumed to have carcinogenic potential for humans, classification is largely

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12 OJ L 269, 21.10.2000, p. 34

13 OJ L 37, 13.2.2003, p. 24

14 OJ L 365, 31.12.1994, p. 10

15 Draft impact assessment of key Council amendments to the Commission proposal for a Batteries Directive (November, 2004), available at: http://register.consilium.eu.int/pdf/en/04/st14/st14372.en04.pdf

16 Ban on leaded batteries: Analysis of an amendment to Article 4 in the Council common position for adopting a Directive on batteries and accumulators and waste batteries and accumulators and repealing 91157/EEC (November, 2005), available at: http://www.europarl.europa.eu/comparl/envi/pdf/externalexpertise/ieep_6leg/batteries.pdf

17 The Commission Report is available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010DC0698:EN:NOT

18 OJ L 226, 6.9.2000

19 Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (OJ L353, 31.12.2008, p. 1.)

based on animal evidence), a category 2 mutagen (substances which cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans) and category 2 reproductive toxicant (suspected human reproductive toxicant). It is also classified as toxic for aquatic organisms and chronic toxicity category 1.

The scale of the environmental and health problems due to cadmium contained in batteries has been assessed in preparation of the Batteries Directive itself. In 2003 the Commission concluded that any restriction on the use of cadmium in batteries should result in decreased negative environmental impacts in the future, since NiCd batteries are classified as hazardous waste and their substitutes (e.g. NiMH and Li-ion batteries) are not.[20] Further studies were undertaken by the Commission in 2009 and 2010, especially to ensure sufficient knowledge of the comparative benefits (life-cycle assessment) of alternatives battery technologies (see section 1.3.).

The International Agency for Research on Cancer has identified cadmium as a known human carcinogen. Cadmium is a toxic and carcinogenic substance that can cause irreversible adverse effects (e.g. lung cancer, kidney damage, bone and hematologic disorders, organ toxicity in animals)[21]. Due to its low permissible exposure limit, overexposures may occur even in situations where trace quantities of cadmium are found. Humans normally absorb cadmium into the body either by ingestion or inhalation. Dermal exposure (uptake through the skin) is generally not regarded to be of significance. It is widely accepted that approximately 2% to 6% of the cadmium ingested is actually taken up into the body. In contrast, from 30% to 64% of inhaled cadmium is absorbed by the body, with some variation as a function of chemical form, solubility and particle size of the material inhaled. Thus, a greater proportion of inhaled cadmium is retained by the body than when cadmium is taken in by ingestion. For the non-occupationally exposed individual, inhalation exposure to cadmium does not usually contribute significantly to overall body burden[22]. Cadmium is also very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Batteries have the highest concentration of cadmium compared to the other typical metal concentration of municipal solid waste (MSW) constituents. The EU regional consumption of cadmium reaches the value of 2.638 tonnes, which are distributed for 75.2% to NiCd batteries, 14.9% to pigments, 5% to stabilisers and 5% in alloys and plating". Portable NiCd batteries are reported to contain on average 13% of cadmium by weight and industrial NiCd batteries 8% by weight.[23]

Spent batteries enter the environment when they are landfilled or incinerated. Cadmium and other metals in batteries which are landfilled or incinerated may pollute lakes and streams, vaporise into the air when incinerated, or may leach into groundwater after landfilling and expose the environment to highly corrosive acids and bases.

Directive 2000/76/EC on the incineration of waste sets stringent emission limit values, which could lead to a significant reduction in emissions of various pollutants to the atmosphere. At

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20 Extended Impact Assessment of 24.11.2003, COM(2003)723 final

21 Risk Assessment, Cadmium oxide/Cadmium metal, Final Draft, July 2003, available at: http://esis.jrc.ec.europa.eu/doc/existing-chemicals/risk_assessment/DRAFT/R303_0307_env_hh.pdf

22 European Union Risk Assessment Report (RAR): Cadmium Metal, EC, 2008, available at: http://esis.jrc.ec.europa.eu/doc/existing-chemicals/risk_assessment/REPORT/cdmetalreport303.pdf

23 Extended Impact Assessment of 24.11.2003, COM(2003)723 final

present, incinerators have to meet emission limit values of 0.05 mg/m^3 cadmium.[24] In case of incineration of batteries, metals such as cadmium, mercury, zinc, lead, nickel, lithium and manganese will be found in the bottom-ashes and fly ashes. Incineration of batteries thus contributes to emissions of heavy metals to air and reduces the quality of the fly ashes and bottom-ashes (incineration residues).

The main disposal route for spent batteries is landfilling. It is estimated that 75% of the disposed spent batteries are being landfilled. The main environmental concerns associated with the landfilling of batteries are related to the generation and eventual discharges of leachate into the environment.[25, 26]

The environmental risks related to the disposal of cadmium batteries was assessed in the draft Targeted Risk Assessment Report "Cadmium (oxide) as used in batteries" (TRAR).[27] According to the TRAR, the cadmium emissions of portable NiCd batteries due to incineration was calculated to be 323 – 1.617 kg of cadmium per year to air and 35-176 kg of cadmium per year to water. Total cadmium emissions of portable NiCd batteries due to landfill was calculated at 131-655 kg of cadmium per year.[28]

In 2002, 45.5% of the portable batteries and accumulators sold in the EU-15 that year went to final disposal (incineration or landfill).[29] It is estimated that in 2002 at EU level 2.044 tonnes of portable NiCd batteries were disposed of in the MSW stream.[30] However, a large quantity of batteries - even spent batteries - are kept at home, for many years, by end-users before being discarded ('hoarding of batteries'). At EU level it is estimated that households hoard 37% of portable batteries.[31] With rechargeable batteries, including NiCd batteries, the

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24 Directive 2000/76/EC on the incineration of waste, OJ L 332, 28.12.2000, p. 91; limit for new plants as from 12/2002 and for existing plants as from 12/2005. Directive to be repealed by Directive 2010/75/EU on industrial emissions (integrated pollution and prevention control) with effect by 7 January 2014 (OJ L334 of 17.12.2010, p. 17)

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

26 Leachate is generated as a result of the expulsion of liquid from the waste due to its own weight or compaction loading ('primary leachate') and the percolation of water through a landfill ('secondary leachate'). The source of percolating water could be precipitation, irrigation, groundwater or leachate recalculated through the landfill.

27 Targeted Risk Assessment Report (TRAR), draft final report of May 2003, carried out by Belgium within the framework of Regulation 793/93 (OJ L 224 of 3.9.1993, 9.p 34). TRAR has been taken into account in the EU RAR on cadmium issued in 2007 (see: http://esis.jrc.ec.europa.eu/doc/existing-chemicals/risk_assessment/REPORT/cdmetalreport303.pdf under "Introduction")

28 See TRAR, draft final report of May 2003, page 133. The following assumptions are made: portable NiCd batteries account for 10-50% of the total MSW cadmium content, the total cadmium content of MSW on dry weight basis equal 10 g/tonne, and 24.4% of the spent portable nickel-cadmium batteries are sent to incineration activities and 75.6% to landfill activities.

29 Annual sales in 2002 were estimated at 158720 tonnes and an estimated 72155 tonnes of portable batteries were set to landfill or incineration. "Impact Assessment on Selected Policy Options for Revision of the Battery Directive", Bio Intelligence 2003.

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

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

hoarding effect may be even higher.[32] At the moment, whenever the end-user decides to dispose of those batteries and accumulators conventionally, they may end up in the municipal solid waste stream. The TRAR stated: *"If NiCd batteries cannot be collected efficaciously, the future cadmium content in the MSW stream is predicted to increase. The impact of this potential increase on future emissions has been assessed for MSW incineration only. The impact of a future change in the MSW composition on the composition of the leachate of a landfill could not be judged based on the current lack of knowledge and methodology".*[33]

The Council underligned (November 2004) that the *"key advantage of a ban is that it would be a sustainable means of limiting the environmental impact of cadmium in the longer term, consistent with the precautionaryprinciple"*. It agreed that *"it is very difficult to quantify the positive environmental impact of a ban on the use of cadmium in portable batteries and the extent to which different policy options would increase or diminish this impact.*

The reasons for this uncertainty include:

– *the lack of an agreed scientific methodology; and*

– *potential developments in the batteries market, consumer behaviour and waste treatment and disposal policies within Member States.*

Nevertheless, Bio Intelligence estimated[34] that, in 2002, over 2,000 tonnes of portable NiCd batteries ended up in the MSW stream in the then 15 Member States, Norway and Switzerland. It further estimated that this was equivalent to an input to groundwater of between 13 and 66 Kg of cadmium. A ban on portable NiCd batteries would prevent this pollution." [35]

Concern over cadmium's toxicity persuaded the European Parliament and the Council to restrict the use of cadmium in portable batteries to 0,002% of cadmium by weight as from 26 September 2006.

The exemption of cadmium-containing batteries in cordless power tools (CPT) was given by co-legislator because there was uncertainty whether viable technical substitutes existed for this application at the time of the adoption of the Batteries Directive. For instance, the European Parliament in its first reading (April 2004) stated:

"A list of exemptions shall be provided for those applications where the use of the heavy metals in unavoidable; in other words, where no substitutes exist. Other buttons cells than for

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32 The industry claims that 65-95% of portable NiCd batteries sold over the last 10 years are still being hoarded, source: CollectNiCad.

33 TRAR, Final Draft May 2003, page 7. Furthermore, the TRAR itself also indicates the following lack of methodologies to assess certain impacts: *"neither the delayed cadmium emissions of the re-use of incineration residues not the impact of future expected increase in cadmium content of bottom ash and fly ash on the re-usability of these incineration residues have been quantified"* (page 6) and *"the contamination of the groundwater compartment due to fugitive emissions of landfills have not been quantified in this TRAR since no guidance is available to perform these calculations"* (page 7).

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

35 Draft impact assessment of key Council amendments to the Commission proposal for a Batteries Directive (November, 2004), available at: http://register.consilium.eu.int/pdf/en/04/st14/st14372.en04.pdf

hearing aids (in the same wording as article 4(2) of the Commission proposal) and cordless power tools are also added to this list. This list of exemptions shall be reviewed to ensure that always the latest development on technology is reflected in this list. It is the objective of the Battery Directive that the use of cadmium, lead and mercury is prohibited in case the use is avoidable."

The Council's Common Position (March 2005) stated:

"The Commission should evaluate the need for adaptation of this Directive, taking account of available technical and scientific evidence. In particular, the Commission should carry out a review of the exemption from the cadmium ban provided for portable batteries and accumulators intended for use in cordless power tools. Examples of cordless power tools are tools that consumers and professionals use for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, hammering, riveting, screwing, polishing or similar processing of wood, metal and other materials, as well as for mowing, cutting and other gardening activities."

This is reflected in Recital 11 of the Batteries Directive which was published in 2006 and confirms the co-legislator's intention that the basis for the Commission's review of the exemption for the use of cadmium in portable batteries intended for use in cordless power tools (CPT) should be **technical availability of cadmium-free substitutes** in this particular application. Latest studies prove that appropriate substitutes are commercially available on the market.

In 2007, Belgium finalized a Risk Assessment for cadmium and cadmium oxide[36], in accordance with Council Regulation (EEC) 793/93 on the evaluation and control of the risks of existing substances.[37] This Risk Assessment was peer-reviewed by the Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE). This comprehensive document integrated in particular the targeted risk assessment on batteries, issued by Belgium in 2003, which has been updated.

The conclusions of this global risk assessment led to a Commission communication and a Commission recommendation published in 2008[38], indicating that in the EU cadmium is used mainly in the manufacture of nickel-cadmium (NiCd) batteries and that there is a need for further specific measures to limit the risks for workers as a consequence of inhalation exposure that could arise from cadmium production, batteries manufacture and recycling and for the environment (aquatic ecosystem including sediment). However, for the latter, the risk was linked to local specific issues.

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36 European Union Risk Assessment Report (RAR): Cadmium Metal, EC, 2008
RAR available at:
http://esis.jrc.ec.europa.eu/doc/existing-chemicals/risk_assessment/REPORT/cdmetalreport303.pdf ;
Addendum available at:
http://esis.jrc.ec.europa.eu/doc/existing-chemicals/risk_assessment/ADDENDUM/cdmetal_cdoxide_add_303.pdf ;
Commission Communication on the results of the risk evaluation and the risk reduction strategies for the substances cadmium metal and cadmium oxide available at: http://esis.jrc.ec.europa.eu/doc/existing-chemicals/risk_assessment/OJ_RECOMMENDATION/ojrec7440439.pdf .

37 OJ L 84, 5.04.1993, p.1.

38 OJ L 156/22, 14.6.2008. Documents available at: http://esis.jrc.ec.europa.eu/doc/existing-chemicals/risk_assessment/OJ_RECOMMENDATION/ojrec7440439.pdf

The question now is whether a removal of the exemption can be justified on the basis of the economic, social and environmental impacts.

2.3. Who is affected, in what ways, and to what extent?

Parties concerned

The actors that would mainly be affected by the fact that the exemption for the use of cadmium in portable batteries for CPT application exists are as follows:

– Producers of portable rechargeable batteries intended for use in cordless power tools (for example NiCd, NiMH, Li-ion and other technical substitutes) – all located outside EU;[39]

– CPTs producers;

The main producers of CPTs[40] placed on the EU market are located in the United Kingdom (2), Germany (3), Finland (1), Ireland (1): 5 of them already sell CPTs with NiMH batteries and 7 of them with Li-ion batteries.

– Recycling companies that recycle portable batteries to be intended for use in cordless power tools or that recycle cordless power tools;

Portable NiCd batteries are currently recycled by the following companies: SNAM (France)[41], SAFT AB (Sweden)[42] and Accurec (Germany)[43]. These recyclers also recycle portable and industrial NiCd batteries from other applications than CPT. All these companies also recycle portable NiMH batteries. SNAM (France) also recycles portable Li-ion batteries. In addition, Li-ion batteries are recycled by Umicore (Belgium)[44], Batrec Industrie AG (Switzerland) and Recupyl (France)[45].

The actors that might be affected are as follows:

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39 (i) for NiCd batteries - 4 companies in Japan, 1 company in Korea and 1 company in China; (ii) for NiMH batteries - 3 companies in Japan, 1 company in China and 1 company in North America; (iii) for Li-ion batteries - 5 companies in Japan, 3 companies in China, 2 companies in Korea and 1 company in Taiwan.

40 CPTs producers with a significant market share in EU and an annual turnover from 338 million € to 47 260 million € in 2010.

41 The annual overall turnover is 12 million €. The annual turnover directly related to the recycling of portable NiCd batteries is approximately 8.4 million €.

42 The annual overall global (EU and non-EU) turnover is 591 million €.

43 The annual overall turnover is 3 to 4 million €. This company recycles also other products (e.g. power tools, photovoltaic panels). The annual turnover directly related to the recycling of portable NiCd batteries is 2.1 to 2.8 million €.

44 The annual overall global (EU and non-EU) turnover is 2619 million €. This company recycles also other products and batteries.

45 The annual overall global (EU and non-EU) turnover is 1155 million €. This company recycles also other products and batteries.

– Producers of raw material used in portable rechargeble batteries intended for use in cordless power tools (for example nickel, cadmium, lithium, cobalt and manganese industry). Cobalt is mined in the Democratic Republic of Congo and China, lithium in Chile and rare-earth oxides in China. Primary cadmium is generally not mined on its own but recovered as a by-product from zinc concentrates;

– Battery back assemblers;

– Retailers;

– Professionals and consumers of CPTs;

– Society and environment;

– Member States authorities.

The causal relations in the supply, recycling and disposal chain of all batteries used in CPT and of CPT themselves are presented in Annex 3.

Possible impacts

– Economic impacts for these stakeholders are potentially in the form of costs and change in turnover (of producers of raw materials, battery producers, battery back assemblers, CPT producers, and recycling companies), change in price of CPTs (on consumers), change in external costs (on society and environment) and possible change in administrative burdens (on Member State authorities).

– Social impacts are likely to be in form of impact on employment (of producers of raw materials, battery producers, battery pack assemblers, CPT producers, Member State authorities and recycling companies).

– Environmental impacts are due to the hazardousness of materials used in the batteries and chargers during their production and the environmental impacts that occur during the use-phase and end-of-life management of waste batteries and chargers.

2.4. How would the problem evolve, if no action is taken

The baseline scenario is also referred to as a "Business as Usual" (BaU) scenario which is used to explain how the current situation would evolve without additional intervention or "no change in policy". The baseline scenario is considered as a possible option and provides the basis for comparing policy options. In this option, the present situation would continue, meaning there would be no withdrawal of the current exemption in the Batteries Directive (Article 4 (3)(c)) to the use of portable NiCd batteries in CPTs.

If cadmium is to continue to be used in batteries, a good collection system is decisive. The cadmium that is not collected and recycled in an appropriate manner could continue to accumulate and migrate in the environment and cause considerable damage to health and the environment. Although collection targets for all portable batteries are already set up in the Batteries Directive - 25% to be achieved by 26 September 2012 and 45% to be achived by 26 September 2016 - it would mean that half of all portable batteries, including cadmium-contaning batteries used in CPT, would not be collected in the long-term. Given the hoarding effect, sonner or later consumers would also start discarding hoarded portable batteries.

It has to be noticed, that in spite of very well established and montiored separate collection systems in some Member States, such as in Germany for example[46], the majority of NiCd batteries and thus of the contained cadmium is collected with residual household waste and possibly other waste streams, and either incinerated in municipally solid waste incineration plants, mechanical-biological treatment plants, in plants of treating non-ferrous metals separated from residual waste or directly landfilled. Thus there is some likelihood that cadmium can dissipate uncontrolled into the environment during the waste-phase of portable NiCd batteries.

ESWI study estimated that without a ban of NiCd batteries for CPT, it is expected that the European NiCd battery waste arisings would stabilize at a level of 12,000 tonnes per year and continue at this level for the foreseeable future.[47] The recycling of NiCd batteries would have to continue for several years for decreasing amounts of NiCd batteries. Part of the market share of NiCd recyclers would shift to recyclers of other battery-types. In the medium term the waste management sector may profit from the elimination of one of the most hazardous substances they have to deal with.

Interactions with other EU legislation

REACH[48] regulates and fully harmonises restrictions of chemicals. The purpose of this Regulation is to ensure a high level of protection of human health and the environment, including the promotion of alternative methods for assessment of hazards of substances, as well as the free circulation of substances on the internal market while enhancing competitiveness and innovation.

Cadmium and its compounds are regulated through the entry 23 of the Annex XVII ("restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles") of REACH. However, the use of cadmium in batteries, including portable batteries used in CPT is not regulated in REACH, the principle of *lex specialis* should applied. Batteries within the scope of the Batteries Directive do not fall within any REACH general exemption. Both REACH and the Batteries Directive provide defence-related exemptions.

The Batteries Directive provides exemptions from its cadmium related prohibition on placing batteries on the market for portable batteries for use in emergency and alarm systems, medical equipment, or CPT (Article 4(3)).

In this context the *lex specialis* principle having to be applied, REACH is not the appropriate tool to deal with the problems related to cadmium in batteries. There is therefore a need of using the appropriate sectorial legislative instrument to regulate the use of cadmium in portable batteries used in CPT, and namely the Batteries Directive.

EU and worldwide market trends

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46 More information on battery sales and separate collection of NiCd batteries in Germany is presented in Annex 19.

47 ESWI study (2010). The current situation is an annual waste arising of ~ 16 000 tonnes/ year.

48 Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), (OJ L 396, 30.12.2006, p. 1)

According to the ESWI study, in total a number of around 1060 million cells (NiCd, NiMH and Li-ion) have been used in cordless power tools (CPT) worldwide in 2008. The number of cells used in CPTs in Europe in 2008 is about 41 % of the world market and estimated to amount to 436 million cells. These were used in about 12.9 million CPT units. The number of NiCd cells used in CPTs in 2008 was about 515 million cells worldwide and 240 million cells within the EU. This corresponds to a world market share of 47%.

The BIO Study summarized data on the worldwide and EU market for cordless power tools as follows:

Table 1: Worldwide and EU market of CPT sector[49]

Market	**Units**	**Year**	**Worldwide**	**EU**
CPTs as % of overall electric power tool market	%	2007	38	38
CPT market value	Million euro	2007	€3500	€1440
Battery cells used in CPTs (number in use in EU)	Million cells	2008	1060	€494*
Battery cells used in CPTs	Million euro	2008	€1025	€478*
NiCd cells used in CPTs	Million cells	2008	515	240

* These values are estimated based on the assumption that the EU market share (both by value and number of units sold) of overall worldwide battery cell is the same as the EU market share of the worldwide market of NiCd cells used in CPTs: 47% (=240*100/515).

EPTA (CPT manufacturers) estimates that in 2008, 65% of the EU CPT market (by value) was represented by Professional (PRO) users and the remaining 35% by Do It Yourself (DIY) users. This compares with EPTA's estimate of 37% of EU market (by number of units) represented by PRO and remaining 63% by DIY during the same year. The main reason that the PRO market segment for CPT has moved towards substitutes for NiCd batteries is that the alternatives provide a better technical performance and that the technical advantages of Li-ion batteries are more important than the additional costs. CPTs in EU are currently operated with portable rechargeable NiCd, Li-ion, or NiMH batteries and accumulators specific to the battery chemistry[50]. The worldwide market share (by number of units) of these battery technologies was 55% for NiCd, 36% for Li-ion and 9% for NiMH in 2008[51]. The EU sales

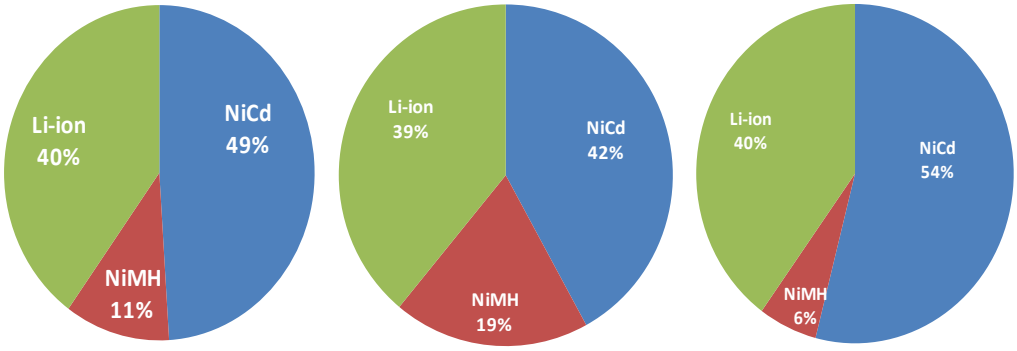
[49] Based on data provided in the European Stakeholder Consultation document regarding a review of the exemption of Cadmium ban provided for portable batteries and accumulators intended for use in cordless power tools (CPT), March-May 2010, available at: http://ec.europa.eu/environment/consultations/batteries_en.htm

[50] Please note: A same charger can be used for NiCd and NiMH based CPTs

[51] Based on worldwide market data published by Hideo Takeshita in 2008, Vice President of the Japanese Institute of Information Technology

(by number of units) of CPTs per battery technology were 49% for NiCd battery technology, 40% for Li-Ion battery technology and 11% for NiMH battery technology in 2008 (see Figure 1)[52].

Figure 1: EU market share (number of units sold) of NiCd, NiMH and Li-ion technology based CPTs in the year 2008 (From left to right, overall market share, PRO market share and DIY market share)



As reported by EPTA, the EU CPT market in 2010 witnessed sales worth €3.2 billion and the share (by value of the sold CPTs) of NiCd, NiMH and Li-ion technologies based CPT was as per following:

– NiCd CPT: 34%;

– NiMH CPT: 6%;

– Li-ion CPT: 60%.

A natural evolution of sales of NiCd and other alternative battery technologies used in CPTs will continue towards replacement of NiCd batteries by existing NiMH and Li-ion technologies. It is estimated that the overall CPTs market in EU will grow in both DYI and PRO segments by 5% annually between 2010 and 2020[53]. Market size of NiCd portable batteries is expected to decrease by 50% between 2008 and 2020, which leads to a natural annual decrease in NiCd batteries of 5%[53]. It can be expected that the above trends in overall CPT market evolution will continue until 2025.

The average mass of a NiCd cell used in CPTs is 51,4 g resulting in a total mass of 13,200 tonnes of NiCd cells used in CPTs in Europe in 2008.[54]

SAFT (France) is the last European producer of NiCd batteries (portable and industrial). Applications of portable NiCd batteries from SAFT are for example medical equipment, radio, communication and tracking equipment, emergency lighting and security devices. SAFT does not produce any more portable NiCd batteries intended for the use in CPTs. All portable NiCd batteries used in CPTs are imported to the EU mainly from Asia. All portable NiMH and Li-ion batteries used in CPTs are also imported to the EU mainly from Asia.

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52 Arcadis, 2010, The use of Portable Rechargeable Batteries in Cordless Power Tools: Socio-Economic and Environmental Impact Analysis

53 Avicenne, 2009, presentation on "Present and future market situation for batteries", presented at Advanced Battery Technologies in Frankfurt (30th June to 2nd July 2009) by Christophe Pillot

54 ESWI study, 2010

The decrease in share of portable NiCd batteries usage in CPTs during this period will be replaced by portable Li-ion and NiMH batteries. The following constant market replacement ratesare expected (during the period 2010-2025): [55]

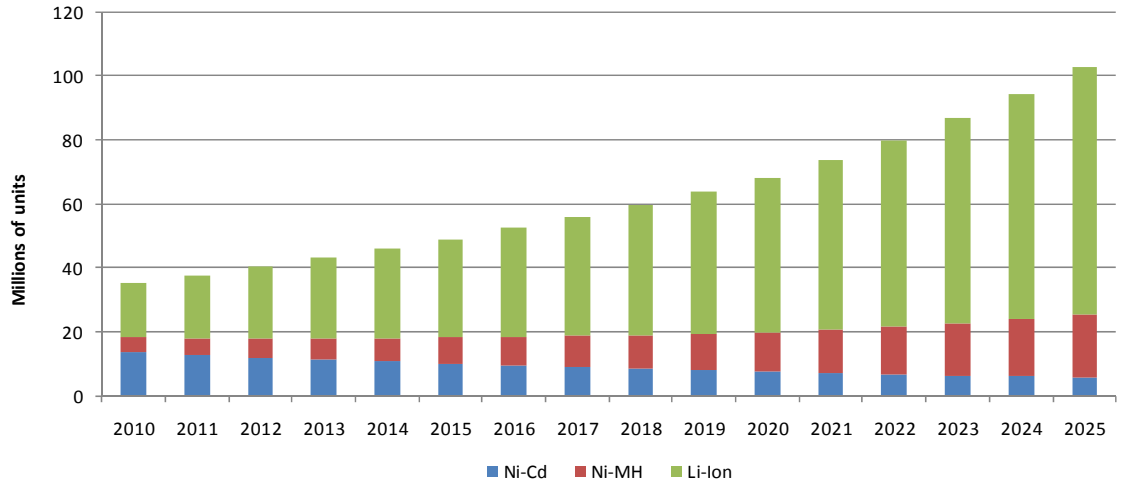
– 80% replacement by portable Li-ion batteries;

– 20% replacement by portable NiMH batteries.

The evolution of the overall CPT battery market (PRO and DIY) in the BaU scenario over the period 2010-2025 in EU is presented in the figure below. The evolution of PRO and DIY market is presented in Annex 5.

[55] Source : EPTA and RECHARGE

Figure 2: Evolution of overall CPT battery market (number of battery pack units) in EU until 2025 in BaU scenario (Option 1)



Substitutes and technical assessment

It is clear that since the adoption of the Batteries Directive in 2006, alternative battery chemistries than cadmium batteries have increasingly being used in cordless power tool applications. The available data indicates that alternatives to cadmium batteries in cordless power tools (CPT) already exist (such as Li-ion and NiMH technologies). [56]

Current market trends and the technical assessment let expect that:

– For existing NiCd-driven cordless power tools[57] NiMH power packs would be used as replacement (power tools that are sold today can be driven by either NiCd or NiMH batteries, only a different charging equipment may be necessary[58]);

– New cordless power tools[59] would be driven by Li-ion battery power packs.

So, already today's Li-ion battery is a more than good substitute for NiCd batteries in CPT. Li-ion batteries are lighter, lose less energy during storage, have a better energy efficiency, store more energy per volume. Li-ion batteries having three times the cell voltage of NiCd batteries, will allow to design much more powerful CPT in future.

The above "natural" trend is to some extent also influenced by the review of the cadmium ban itself and the expectation of industry that the exemption will be lifted. It is considered that the

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56 ESWI study (2010)

57 Existing CPT means CPT manufactured and placed on the market prior to a possible ban of NiCd batteries for CPT, ESWI study (2010)

58 Please note: A same charger can be used for NiCd and NiMH based CPT.

59 New CPT means CPT manufactured and placed on the market after a possible ban of NiCd batteries for CPT, ESWI study (2010).

"natural" trend to better performing Li-ion batteries would not render a cadmium ban unnecessary in the medium term (e.g. 2016). Although the Li-ion technology is more expensive than NiCd technology, the withdrawal of the current exemption could accelerate the transition of the European CPT industry towards the Li-ion technology, allow CPT producers to develop new, more powerful applications that contain less hazardous substances and ensure even level playing for all economic operators.

It has to be noted, that providers of CPT such as Bosch claim that their youngest generation of Li-ion power packs they distribute together with their power tools have the same number of charging cycles and life time as NiCd batteries.[60]

It is assumed that a replacement of NiCd batteries by the existing alternatives would not have dramatic consequences from the technical point of view as the leading CPT producers sell for standard tools all three types of battery technologies (NiCd, NiMH and Li-ion) while developing their most advanced tools in line with Li-ion batteries only.[61]

Shortcomings of Li-ion batteries in comparison to NiCd batteries are the limitation in operations below 0 °C and a yet uncertain lifetime.[62] The poor sub-zero °C performance of Li-ion batteries, however, does not keep professionals from preferring Li-ion batteries over NiCd batteries even in cold areas such as Northern Sweden.[63]

A cordless power tool producer stated that Li-ion batteries can operate also at lower temperatures, as it produces heat as long as it is in use.[64] Even if its core temperature goes below –10 °C no irreversible damage would occur with Li-ion batteries. Also professionals operating CPT by Li-ion batteries in the cold region of northern Sweden have no problems with this battery type.[65] It also needs to be mentioned that below 0°C NiCd batteries show a much lowered energy storage capacity.[66]

The uncertain lifetime[67] is less a technical as an economic restriction. Even a more conservative estimate reports Li-ion batteries of having 62 % of the NiCd's life-time-energy

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60 See ESWI study (2010), [Bosch 2009a]

61 See ESWI study (2010), [Bosch 2009b,c]

62 ESWI study (2010): As reported by EPTA, for NiCd batteries an operation temperature range of -20°C to 60°C, for NiMH a range of 0°C to 50°C and for Li-ion an operation temperature range of 0°C to 60°C.

63 "Cadmium in power tool batteries-The possibility and consequences of a ban", The Swedish Environmental Protection Agency, 2009, report available at: http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5901-9.pdf

64 See ESWI study (2010), [Bosch 2009a]

65 "Cadmium in power tool batteries-The possibility and consequences of a ban", The Swedish Environmental Protection Agency, 2009, report available at: http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5901-9.pdf

66 ESWI study (2010), see Figure 4-7.

67 The life time of Li-ion batteries needs to be confirmed, but seems to be between 4 and 7 years. The life time of NiCd batteries is 7 years. The life time of NiMH batteries is approximately 4 years.

storage capacity.[68] Other sources attest Li-ion batteries to have the same life-time-energy storage capacity as NiCd batteries.[69]

Consequently the lifetime system costs of Li-ion batteries are:

– 49 % higher than NiCd-system costs when assuming as an average life-time of 4.3 years for the Li-ion power pack;

– or only 10 % higher when assuming as an average lifetime of 7 years for the Li-ion power pack.

However, the difference in lifespan is not relevant here because our assumption for the purpose of this impact assessment is that batteries are disposed off together with CPT and therefore it is the CPT, and not the battery, which limit the lifespan of the whole system (CPT+battery).

Annex 4 gives an overview of the conclusions from a technical assessment on the commercially available technical substitutes for cadmium batteries used in cordless power tools.

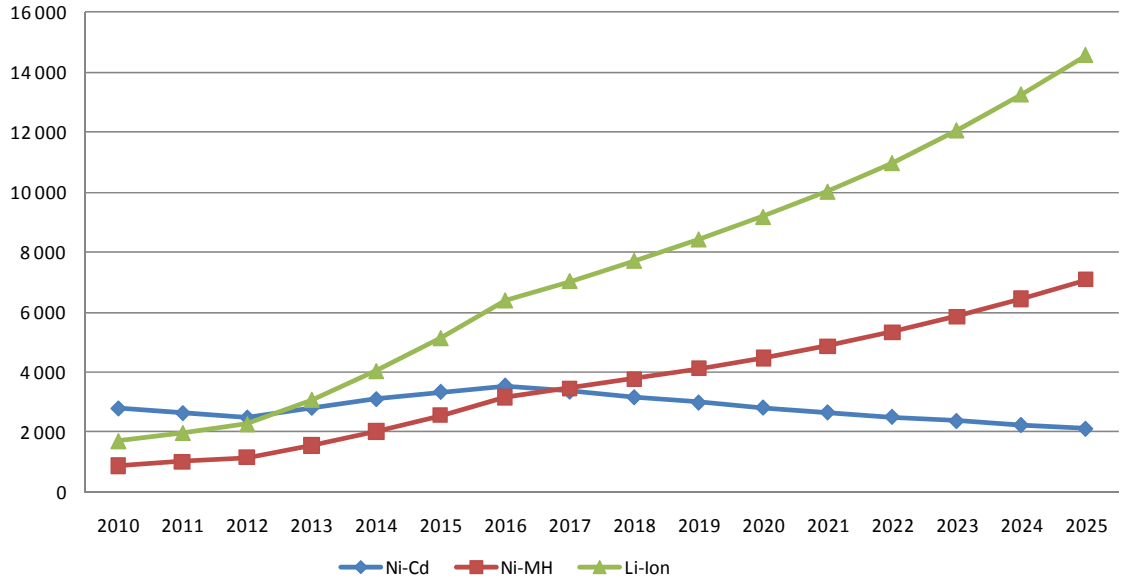
Waste management

Today, no reliable data is available on the collection of batteries used in CPT in the EU as Member States are not obliged to report at this stage and data collected by the industry refer to a limited number of application. However, the WEEE Directive provides statistics on the collection of CPT. In 2008, the collection rate of CPT was around 10%. The evaluation of waste CPT battery collection in the BaU scenario over the period 2010-2015 is presented in the figure below:

Figure 3: Evolution of waste CPT battery collection (in tonnes) in EU, 2010-2025 in BaU scenario (Option 1)

[68] See ESWI study (2010), [EPTA 2009b]

[69] See ESWI study (2010), [Bosch 2009a]



The collection targets of the Batteries Directive (25% by 2012 and 45% by 2016 are used as well as lower collection rate of 10% is also considered based on collection data availale under the WEEE statistics for the collection of CPTs. It is assumed that the batteries used in CPT are collected together with the CPT and not separately.

2.5. The EU's right to act and justification (Does the EU have the right to act?)

The principle of subsidiarity requires that the Union shall only take action[70] if and insofar as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can therefore be better achieved by the Union, by reason of scale of effects of the proposed action. The proportionality principle requires Union action to not go beyond what is necessary to obtain the objectives.[71]

The present impact assessment takes account of the principles of subsidiarity and proportionality because:

– A prohibition on the use of cadmium in portable batteries and exemptions thereof have been established at EU level to avoid distortions of the internal market;

– The Commission has been requested to review the exemption for the use of cadmium in portable batteries intended for use in cordless powertools. Unilateral action by Member States would have a negative impact on the functioning of the internal market by creating barriers to trade and can distort competition.

EU action is necessary as this concerns the review of an exemption for the use of cadmium in portable batteries intended for use in cordless power tools which is established at EU level. All Member States are affected by the use of cadmium in different applications since batteries are freely circulating in the internal market - hence the harmonization and coordination of policies and implementing measures on the EU-level is crucial.

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70 This principle only applies to areas which do not fall within the Communities' exclusive competence.

71 See Article 5 of the EC Treaty.

No impact is expected on the EU budget.

3. SECTION 3: OBJECTIVES

3.1. General objective

The general objective is to contribute to the achievement of the objectives of the Battery Directive, in particular to Article 4(1) thereof, namely the development and marketing of batteries which contain smaller quantities of dangerous substances or which contain less polluting substances, in particular as substitutes for cadmium.

3.2. Specific objectives

The specific objectives are to:

– Specific objective 1: minimise environmental impacts from portable batteries intended for use in cordless power tools,

– Specific objective 2: minimise economic costs for consumers and manufacturers of CPT, inter alia by ensuring that technically feasible solutions are available.

3.3. Operational objectives

The operational objectives are to:

– reduce the introduction of cadmium in the EU economy associated with use of portable batteries in CPT;

– reduce the emissions of cadmium in the EU associated with use of portable batteries in CPT;

– reduce the overall environmental impact in EU associated with the use of portable batteries in CPT.

3.4. Consistency of the objectives with other goals (EU policies and strategies – e.g. Europe 2020)

The review of the exemption for the use of cadmium in portable batteries intended for use in cordless powertools is consistent with the principle of the prohibition on the use of cadmium in portable batteries as laid down in Article 4(1) of the Batteries Directive.

Under Commission Decision 2000/532/EC, cadmium batteries are classified as hazardous batteries. Limiting or restricting the use of hazardous substances is in line with other EU policies and strategies, for instance with REACH[72].

[72] Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), (OJ L 396, 30.12.2006, p. 1)

4. SECTION 4: DESCRIPTION OF POLICY OPTIONS

4.1. Policy options retained

For the purpose of the impact assessment, three policy options have been identified and retained for further analysis.

It appears appropriate to present options 2 and 3 as separate options with regard to withdrawal of the exemption to better reflect and distinguish between different possible impacts in short (2013) and long-term (2016).

Year 2013 (option 2) refers to an immediate withdrawal of the exemption following a normal co-decision procedure after adoption of a possible legislative proposal by the Commission (end 2011 or early 2012).

Year 2016 (option 3) refers to the date established in the Batteries Directive (26 September 2016) by which Members States should achieve a minimum collection rate of 45% for all portable batteries placed on the EU market, including portable batteries used in CPT. It was also indicated by the industry as feasible in terms of alternative.

It was not considered useful to consider other dates (e.g. 2014, 2015) for the withdrawal as different sub-options as the impact analysis would be largely the same.

As regards the 2015 review forseen in the Batteries Directive by the Commission after the second Member States' implementation reports (Article 23), at the this stage it is not expected this review to be accompanied by any legislative proposal. Furthermore, the co-legislator explicitly asked the Commission to review this exemption by 2010, so alignment to 2015 review does not seem appropriate.

Policy options related, for example, to mandatory recycling of portable batteries used in CPT were not considered appropriate as the Batteries Directive in its Article 12(1)(b) already stipulates that all batteries collected should be recycled. In addition, the Directive specifies minimum recycling efficiency levels that the battery recycling processes must meet by September 2011 (Article 12(4) and Annex III, Part B), namely for:

– Nickel-cadmium batteries: recycle cadmium as far as technically feasible, and recycle a minimum of 75 % of batteries by average weight;
– Lead-acid batteries: recycle lead as far as technically feasible, and recycle a minimum of 65 % of batteries by average weight;
– Other batteries: recycle a minimum of 50 % of batteries by average weight.

Option 1: "Baseline scenario" (no withdrawal of the exemption)

The baseline scenario is also referred to as a ‘Business as Usual’ (BaU) option which is used to explain how the current situation would evolve without additional intervention or “no change in policy”.

The ‘business as usual’ option would essentially mean that cadmium-containing batteries intended for use in CPTs would continue to be supplied to consumers and professional users

but these would be progressive displaced by NiMH and Li-ion tools and battery packs. It is already described in Section 2.6.

Option 2: Immediate withdrawal of the exemption (2013)

This option would immediately (in 2013) withdraw the exemption in force, restricting the use of cadmium content (by weight of no more than 0.002%) in portable batteries for CPTs.

As NiCd portable batteries for CPTs will not be available anymore starting from 2013, they would be replaced by existing NiMH (20% replacement of NiCd portable batteries) and Li-ion (80% replacement of NiCd portable batteries) portable batteries. The time required for the transposition of this policy option by the industry could be 18 months.[73]

Under this option, the overall CPT battery market (PRO and DIY) in EU would increase for NiMH portable batteries from 9 millions of units in 2013 to 21 millions of units in 2025 and for Li-ion portable batteries from 34 millions of units in 2013 to 82 millions of units in 2025. More details are provided in Annex 7.

The overall collected quantities of waste CPT batteries would increase from 5,370 tonnes in 2010 to 23,140 tonnes in 2025. The overall quantity of waste CPT batteries collected during the period 2010-2025 would be 210,325 tonnes. More details are provided in Annex 8.

Option 3: Delayed withdrawal of the exemption (2016)

This option would withdraw the exemption in force in 2016[74] thus restricting the use of cadmium content (by weight of no more than 0.002%) in portable batteries for CPTs. This option would facilitate the battery industry to further adapt the relevant technologies to the new requirements related to a possible cadmium ban in CPT-batteries.

From 2016 onwards, the NiCd portable batteries would be replaced by existing NiMH (20% replacement of NiCd portable batteries) and Li-ion (80% replacement of NiCd portable batteries) portable batteries.

Under this option, the overall CPT battery market would increase for NiMH portable batteries from 10 millions of units in 2016 to 21 millions of units in 2025 and for Li-ion portable batteries from 42 millions of units in 2016 to 82 millions of units in 2025. More details are provided in Annex 9.

The overall collected quantities of waste CPT batteries increase from 5,370 tonnes in 2010 to 23,140 tonnes in 2025. The overall quantity of waste CPT batteries collected during the period 2010-2025 would be 213,300 tonnes. More details are provided in Annex 10.

4.2. Policy options discarded at an early stage

Increased collection rates

[73] Source: The estimate on time requirements reflects the opinion of EPTA and RECHARGE.

[74] Year 2016 is chosen as a reference year in which the minimum collection target of 45% for portable batteries should be achieved.

Options related to **increased collection rates** for cadmium batteries intended for use in cordless power tools have been discarded at an early stage, as any proposals to increase collection rates would be premature at this stage:

The minimum collection rate of 25% for all waste portable batteries established by the Directive (Article 10(2)) only enters into force on 26 September 2012 (and 45% to be achieved by 26 September 2016). There are no specific collection rates for cadmium batteries, let alone for cadmium batteries used in CPT;

At this stage, Member States do not have the obligation to report on the collection rates achieved. In addition, data provided by the industry refer to a limited number of aplications. There is therefore no sufficient data on the collection of portable batteries and in particular portable cadmium batteries used in CPT.

In addition, in order for this option to be meaningful and provide a real alternative to the options related to a withdrawal of the exemption, the collection rates would have to be increased significantly, in order to crease a 'closed-loop' system where all waste batteries would be collected and recycled. This casts doubts about the political feasibility of this option and whether increased collection rates would be feasible and realistic for Member States to comply with.

Furthermore, the Commission is asked to review the implementation of the Batteries Directive (Article 23), including the appropriateness of the minimum collection targets for all waste portable batteries and the possibility of introducing further targets for later years, taking account of technical progress and practical experience ganied in Member States once it has recived the second Member States' implementation reports in the course of 2015.

Delete the cadmium ban

Option related to **delete the cadmium ban** provided for portable batteries, including those incorporated into appliances, has been discarded at an early stage. An extended Impact Assessment carried out by the Commission services in 2003 to support the preparation of the current Batteries Directive (2006/66/EC) demonstrated that batteries pose no particular environmental concerns when they are in use or kept at home. However, sooner or later those batteries will become waste and risk of contributing to the final disposal of waste in the EU. The environmental concerns related to batteries are linked to the hazardous substances they contain, in particular cadmium, mercury and lead. Cadmium is classified as a toxic and carcinogenic substance which could have irreversible effect on the environment and the human health.

Currently no evidence is pointing in a direction that a possible withdrawal of the current cadmium ban would be justified from a cost-benefit perspective. No stakeholder has mentioned this option as a vialable option during the various stakeholder consultations (both multilateral and bilateral).

Moreover, also from a political point of view this is not a desirable option to be further asssessed, without solid evidence available that this would be a viable one. This would question the evaluation and decision taken already by co-legislators during the adoption of the current Batteries Directive. It would also contradict the objectives set out in the Waste Framework Directive, which placing waste prevention, including qualitative prevention, on top of the waste hierarchy. It would also contradict other policies aimed at limiting the

hazardousness of products, such as REACH.[75] The Member States have adopted a long-lasting strategy on limiting the use of cadmium, for instance in the Council Resolution of 25 January 1988 on a Community action programme to combat environmental pollution by cadmium[76], namely the need of limiting the uses of cadmium to cases where suitable alternatives do not exist in the interests of the protection of human health and the environment, as far as such alternatives are already available today.

Voluntary agreement

Option related to a **voluntary agreement** with the industry was suggested during the ISG meeting held on 19 September 2011. This option has afterwards been discarded for several reasons. Firstly, it was not identified as a realistic option by any of the stakeholders during the stakeholder consultation. Secondly, it is questionable whether the level of ambition of such a voluntary agreement could go beyond the business as usual scenario. Thirdly, both the cadmium ban and the exemption from it for the use of cadmium in CPTs are established in a legal text and the co-legislator required the Commission to review this exemption and present a legislative proposal, not a voluntary agreement with a view to prohibit the use of cadmium in batteries.

Separate regulation of DIY and PRO markets

Option related to **separate regulation of DIY and PRO markets** has been discarded at an early stage. According to a confidential study financed by the industry the withdrawal of the current exemption to portable NiCd batteries use in CPTs can be more efficient should a distinction be made between the DIY and PRO markets. This is so because the PRO market benefits from being less sensitive to an increase in price of the CPT as compared to DIY market. According to this study the resulting innovation in the PRO market will be translated to the DIY market naturally once the alternative battery based CPT technology becomes mature and hence more price competitive.

These arguments could therefore be used to justify the withdrawal of the exemption to NiCd batteries use in CPTs meant for the PRO market and an extended phase-out of NiCd CPTs for the DIY market. However, it must be noted that a separate regulation of DIY and PRO markets is not practical because these markets are interrelated and therefore making it almost impossible to monitor the implementation of such a regulation by the Member State enforcement agencies. A separate regulation of PRO CPT market may lead to its abuse by certain manufacturers (selling the CPT to PRO users which was originally intended for DIY users) and PRO users (buying the NiCd based DIY CPT instead) therefore putting other manufacturers (abiding by such a regulation) at a disadvantage.

Assess the other exemptions from the cadmium ban, in view of their deletion

The option to also assess the possible deletion of the other exemptions for the use of cadmium in other applications was also discarded at an early stage. These exemptions were granted because no viable substitutes are available. No information to the contrary has been provided

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[75] Under REACH, since it is proved that the risk is controlled, some hazardous substances can still be used.

[76] OJ C 30, 4.2.1988, p. 1.

during the extensive stakeholder consultations held. No stakeholder indicated the need to extend the review to other applications.

5. SECTION 5: ANALYSIS OF IMPACTS

This section analyses the potential direct and indirect environment, social, and economic impacts of the three policy options retained in the previous section. It provides the qualitative and quantitative assessment of the impacts of the options over the short (2013), medium (2016) and long term (2025).

Analysis of impacts includes information on who is affected by these impacts, any risks and uncertainties in the policy choices, and to the extent possible, assessment of the impacts is measured quantitatively and in monetary terms.

The environmental impacts of the three options are assessed on the basis of two approaches. First, on the basis of the amounts of cadmium introduced in the EU economy coming from the CPT batteries and secondly, on the basis of aggregated environmental impacts which are based on the conclusions of the comparative Life-Cycle Assessment of the three battery types (NiCd, NiMH, Li-ion) used in CPT. In addition, a sensitivity analisys was carried out to test the robustness of the expected impacts.

Conclusions of the LCA

The LCA has demonstrated that no clear overall hierarchy between the three battery types (NiCd, NiMH and Li-ion) used in CPTs can be defined. In this impact assessment the term 'Li-ion' is used to mean Lithium Iron Phosphate technology ($LiFePO_4$) which is the main Li-ion technology in terms of current market shares. A clear conclusion can only be given for a limited number of indicators: Li-ion has a lower impact for Terrestrial Acidification Potential (TAP) and Particulate Matter Formation Potential (PMFP) but has a higher impact for Freshwater Eutrophication Potential (FEP).

Regarding natural resources, comparative results depend on the time perspective chosen for the policy analysis that is based on this LCA[77]:

– For a mid-term perspective, Metal Depletion Potential should be considered. In that case, NiCd technology appears to have a lower potential impact on resource than NiMH and Li-ion;

– For a long-term perspective, Abiotic Resource Depletion Potential should be considered. In that case, NiMH and Li-ion technologies appear equal and have a lower environmental impact than NiCd technology.

Time horizon appears to be a key issue for Human Toxicity Potential (HTP) and Freshwater Aquatic Ecotoxicity Potential (FAEP):

– For a short/mid-term perspective, NiCd and NiMH technologies appear to have a lower potential impact than Li-ion technology;

[77] The comparative results from the LCA for each indicator are presented in Annex 11.

– For a long-term perspective, NiMH and Li-ion technologies appear equal and have a lower environmental impact than NiCd technology.

The impact assessment analysis demonstrated that the risks associated with cadmium in batteries would be higher compared to other batery types. As mentioned in section 2.2., NiCd batteries are classified as hazardous waste whereas the other two battery types (NiMH and Li-ion) are non-hazardous waste. The possible environmental impacts of the materials[78] used in the three battery types were also assessed. It was concluded that all three battery technologies (NiCd, NiMH and Li-ion) contain hazardous substances. By far the most hazardous and cancerogenic substance to health and environment, however, is the cadmium contained only in NiCd batteries. More information on the environmental impacts related to the three battery types is presented in Annex 20.

Sensitivity analysis

The influence of major input data or assumptions on which a significant level of uncertainty exists was analysed. The main objective of sensitivity analyses was to understand the extent to which the comparative trends among batteries vary when key input data or assumptions are modified.

The sensitivity of comparative LCA results on a variation of the following parameters/assumptions was tested: (i) collection rate; (ii) assumption on the life-time of the batteries; and (iii) quantity of heavy metals emitted in the environment during the production of the cells. The results of the sensitivity analisys of these three parameters are presented in Annex 16, Annex 17 and Annex 18.

The impact on the global demand of raw materials (cobalt, lithium, nickel and rare-earth oxides) resulting from the withdrawal of the current exemption to NiCd battery use in CPT is almost insignificant (less than 1% for all of them). It can therefore be assumed that supply of these raw materials will not be limited due to the withdrawal of current exemption to NiCd battery use in CPT in EU in 2016. [79] Therefore on this particular aspect a sensitivity analysis was considered disproportionate.

Environmental impact analysis

In practice the CPTs are operated by two portable battery packs for each battery chemistry (NiCd, NiMH or Li-ion).

The assessment of environmental impacts of portable batteries used in CPTs under the three policy options considered here only include the impacts of the battery packs (for all the three battery types: NiCd, NiMH and Li-ion). The environmental impacts associated with the chargers of these battery packs are therefore **excluded** from the assessment carried out in this

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78 The materials assessed are: (i) the electrode materials: cadmium (anode of NiCd), cobalt (cathode of Li-ion), lithium (electrodes of Li-ion), manganese (cathode of Li-ion), nickel (cathode of NiCd and NiMH), rare-earth-metals (lanthanides) (as representative material for the NiMH anode), carbon/graphite (anode of Li-ion); (ii) and the electrolyte materials: alkali (in NiCd and NiMH) aprotic salts and solvents.

79 BIO Study (2011). The main raw materials used in the alternative batteries (to NiCd batteries) are presented in Annex 21.

section[80]. This is mainly due to the reason that the charger does not fall in the scope of the Batteries Directive but in WEEE[81] and RoHS[82] Directives and the objective of current assessment is only to review an exemption under the Batteries Directive.

The most relevant environmental impact indicators were selected on the basis of a LCA and are listed in Annex 12.[83]

5.1. Assumptions and methodology used for the quantitative assessment

The quantitative analysis provided in this Impact Assessment is based on the best available data and information collected by the Commission from stakeholders, Member States and the literature. However, data remains incomplete regarding some aspects and in particular for economic costs for CPT manufacturers which are either not reported (especially under the BaU scenario) or unverifiable as regards the costs indicated under Options 2 and 3.

The methodology used to estimate the environmental impacts is based on the amount of cadmium released in the environment and the LCA study conducted by BIOIS. Further details about the methodology are included in Annex 14. The social and economic impacts are based on mainly unverified data submitted by CPT manufacturers.

The impact on the WTO in case of withdrawal of the current exemption would be negligible as the alternative battery technoloqies for CPT, namely NiMH and Li-ion batteries are already in use not only at EU level but also worldwide.

5.2. Policy Option 1: Business as Usual

5.2.1. Economic impacts

No information is available on the impact on raw material suppliers, battery pack assemblers or the **CPT manufacturers**.

It should be noted that under this option, cadmium batteries intended for use in cordless power tools are already gradually being replaced by the existing substitutes: Li-ion and NiMH, as illustrated by the following figure:

Figure 4: Evolution of overall CPT battery market (number of units) in EU until 2025 in BaU scenario based on annual sales (Option 1)

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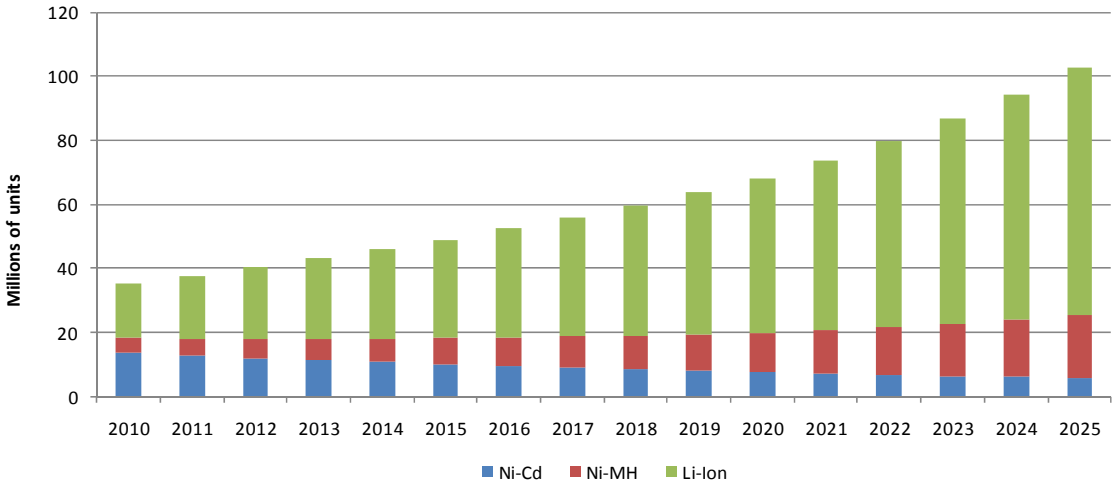
80 For informational purpose, environmental impacts of the three battery types (including the environmental impacts of their chargers) are provided in Annex 12

81 Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) (OJ L 37, 13.2.2003, p. 24).

82 Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (OJ L 37, 13.2.2003, p. 19)

83 BIO Study (2011)



The economic benefits of **recycling** waste NiCd and NiMH batteries primarily come from the extraction of as much Nickel as found in these batteries. On the other hand, the economic benefits of recycling waste Li-ion batteries are primarily due to extraction of Cobalt.

As NiCd and NiMH battery recycling is taking place in EU for more than last 20 years, it can therefore be assumed that these are mature technologies and have already reached saturation in terms of their cost of operation (see section 2.3).

According to SNAM[84], it is estimated that the amount of cadmium-containing batteries received for treatment in 2010 will gradually decrease by 2020, namely from 89% to 59% for NiCd batteries, whereas the amount of waste battery alternatives will increase, namely from 7% to 30% for NiMH batteries and from 4% to 20% for Li-ion batteries. The recycling efficiency achieved since 2009 is more than 65% for Li-ion batteries and more than 80% for NiMH and NiCd batteries.

Umicore has recently invested in a recycling plant that can recycle Li-ion and NiMH batteries. Currently, the plant recycles Li-ion batteries at a net loss. However, as volumes will increase, profitability will increase as well.

At this moment in the EU, the recycling of Li-ion batteries is still carried out at the net cost. However, technological developments in the future may change this situation.

BIO study estimates that the price of an average NiCd CPT[85] sold in the EU in 2010 is €60.80. No additional costs for consumers/retailers was reported.

5.2.2. Environmental impacts

Amount of Cadmium introduced into the EU economy

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84 SNAM is the European leading recycler of rechargeable batteries. It employs around 100 people in its plant located in France. It process around 5 000 tonnes of NiCd batteries per year, from which 2 000 tonnes of portable tools and represent about 50% of the European recycling capacity. It also recycles NiMH and Li-ion batteries. Data presented at the European Battery Collection Day, 4-5 October 2011, European Parliament, Brussels.

85 It includes two battery packs and a charger

Available information sources indicate that the emissions related to NiCd batteries would be small compared to the emissions from oil/coal combustion, iron and steel production or phosphate fertilizers. Thus NiCd batteries would be responsible for only 1.35% of the atmospheric cadmium emissions, 1.41% of the cadmium emissions into water and 0.65% of the total emissions.

NiCd batteries used in the EU in CPTs are responsible for 10.5% of total cadmium which is intentionally introduced in the economy.

In order to estimate the amount of cadmium associated with the use of NiCd batteries in CPTs placed on the EU market over the period 2010-2025, the following assumptions are made:

– The average mass of a NiCd cell used in CPTs is 51.4 g and the weight of a 18V power pack used in CPTs is 774 g;

– Cadmium proportion in the NiCd batteries used in CPTs is 27% by weight.

The environmental impacts resulting from this introduction of Cadmium mainly occur during the end-of-life phase due to the landfill of waste batteries and also due to the landfilling of the waste battery incineration residue. The landfilling in a sanitary landfill generates environmental impacts, notably through emissions of leachate to water bodies. As per the end-of-life scenario considered in PO1, **30,550 tonnes of Cadmium** introduced through CPT batteries will lead to around **945 tonnes of Cadmium emissions** through leachate[86] to water in ST + 5%LT[87]. The Cadmium released in water in turn impacts human health by increasing the morbidity in the total human population. The 945 tonnes of Cadmium released in water can cause cancer and non-cancer diseases in around **405 people**.[88]

Aggregated environmental impact at the EU level

The overall aggregated environmental impact for Policy Option 1 is presented in Table 2.

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86 Through leachate, Cadmium (and other metals) contained in batteries are slowly released in the environment over thousands of years. In a short-term perspective, e.g. less than 100 years in the case of a landfill, the battery mostly behaves like inert waste, meaning that metals contained in the cells remain 'locked' inside their housing. However, from a long-term (LT) perspective, a fraction of metals contained in the battery will eventually end-up in the environment

87 Please note: "ST" stands for Short Term and signifies the duration of operation of a landfill (usually less than 100 years) in the waste batteries are landfilled, whereas "LT" stands for Long Term and 5%LT signifies the period over which 5% of the overall emissions related to the landfilled battery waste take place (this duration can be anything between the time of closure of a landfill to 1000's of years).

The ST emissions only represent the emission occurring during the operation of the landfill which are almost insignificant when compared with the LT emissions (which assumes all the landfilled battery waste is emitted to environment), however the probability of its happening is very low. Therefore a most reasonable approach is "ST + 5% LT" which has been proposed in the study conducted by ERM for DEFRA and has received wide acceptance (ERM study on "Battery Waste Management Life Cycle Assessment", October 2008, DEFRA).

88 This value is calculated based on the data reported by USEtox™ database for cadmium emissions to water (1 Kg of cadmium emissions to water leads 4.28E-04 cancer and non cancer cases in humans).

Table 2: Aggregated environmental impact for Policy Option 1

Environmental impact	Inhabitant-Eq	Weighted Inhabitant-Eq
Global Warming Potential (GWP)	177 804	84 616
Photochemical Oxidant Formation Potential (POFP)	89 280	9 236
Terrestrial Acidification Potential (TAP)	207 865	17 204
Abiotic Resource Depletion Potential (ARDP)	693 906	100 504
Particulate Matter Formation Potential (PMFP)	191 985	27 807
Freshwater Eutrophication Potential (FEP)	6 647 225	320 464
Aggregated Environmental Impact		**559 831**

The annual environmental impact (for 25% and 45% collection rate) associated with the use of batteries in CPTs in EU in PO1 is equivalent to environmental impact caused by 559 83[89] of 464 043 141 European citizens ("EU25 +3"[90]).

This means that, the environmental impact due to the use of batteries in CPTs in EU contributes **0.1206%**[91] to the overall environmental impact of EU.

The aggregated environmental impact of Policy Option 1 as presented in Table 2 above is based on the collection rates as specified in the Batteries Directive as a mandatory legal requirement (25% collection rate by 26 September 2012 and 45% collection rate by 26 September 2016).

It is also considered a lower collection rate than expected to assess the potential aggregated environmental impact of PO1 to take into account the realistic collection values for CPTs in

89 To allow for a meaningful comparison between the different environmental impacts, each impact indicator was normalised to its 'inhabitant equivalent'. The normalisation process produced a value which is equal to the contribution of that many average Europeans' contribution to given impact indicator. The aggregated environmental impact for PO1 was then calculated using the scaled weighting factors.

90 EU25+ Iceland +Norway+ Switzerland

91 Assuming that the overall environmental impact of EU 27 is similar to the overall environmental impact of "EU 25+ Iceland +Norway+ Switzerland" in 2000 and that this overall environmental impact remains constant during the period 2000 till 2025 (which covers the duration of the scenario assessed in Policy Option1).

EU as reported in the WEEE statistics.[92] The aggregated environmental impact of Policy Option 1 is therefore also calculated for a collection rate of 10%, considering it to be the worst likely outcome over the period 2010 till 2025 as presented in Table 3 below. Obviously, as the collection rate is lower than the one previously used, the "aggregated environmental impact" is higher.

Table 3: Aggregated environmental impact for Policy Option 1 (10% collection rate)

Environmental impact	**Inhabitant-Eq**	**Weighted Inhabitant-Eq**
Global Warming Potential (GWP)	179 042	85 205
Photochemical Oxidant Formation Potential (POFP)	93 749	9 699
Terrestrial Acidification Potential (TAP)	251 093	20 782
Abiotic Resource Depletion Potential (ARDP)	806 481	116 809
Particulate Matter Formation Potential (PMFP)	222 093	32 167
Freshwater Eutrophication Potential (FEP)	6 912 102	333 234
Aggregated Environmental Impact		**597 896**

The annual environmental impact (for 10% collection rate) associated with the use of batteries in CPT in EU in PO1 is equivalent to environmental impact caused by 597 896[48] of 464 043 141 European citizens ("EU25 +3"[49]).

This means that, the environmental impact due to the use of batteries in CPT in EU contributes **0.1288%**[50] to the overall environmental impact of EU.

With Policy Option 1 environmental and health protection will remain at least at the same level, since this policy option does not foresee removal of the exemption from the cadmium ban provided for portable batteries used in CPT. This means that portable NiCd batteries will continue to create a potential risk of releases of cadmium to the environment during production and, more significantly, disposal of portable NiCd batteries.

5.2.3. Social impacts

As there is no additional impact than normal business functioning on the industry stakeholders linked to CPT, there is no impact on job creation.

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92 WEEE collection statistics for Category 6 (Electrical & electronic tools) in 2008 were much lower, around 10%.

5.2.4. Administrative burdens

As there is no policy change, no additional burdens for the competent Member States authorities are expected. Also, no additional burdens for the economic operators are expected with regard to their recycling and reporting obligations.

5.3. Policy Option 2: Immediate deletion of the exemption (2013)

Compared to Option 1, under option 2 as of 2013, the cadmium batteries intended to be used in cordless power tools will be replaced by Li-ion and NiMH batteries.

Over the period **2013-2025** and compared to option 1:

– the total amount of Li-ion battery packs intended for CPT use placed on the EU market will increase from 610.70 million units (option 1) to 696.79 million units, which means an increase of 14%;

– the total amount of NiMH battery backs intended for CPT use will increase from 157.45 million unites of battery packs (opion 1) to 178.97 million units, which means an increase of 13.6%;

– 107.61 million units of cadmium batteries will be avoided to be placed on the market, a decrease of 100%.

5.3.1. Economic impacts

According to Floridienne Chimie[93], it is estimated that this policy option will lead to 50 % reduction of the Cadmium oxide production at its plant in Belgium. This would lead to a yearly loss of operational revenues of € 15 to 20 million and to a Cadmium oxide processing plant shutdown. However, it should be noted that that the demand for industrial NiCd batteries is increasing (railways developments in BRIC countries -Brazil, Russia, India and China) and solar panel applications inside and outside the EU. Therefore, this scenario could be questioned because resulting volume gains from other sources could mitigate these effects. On the other hand, it highlights that a shrinking market of NiCd batteries will stimulate competition from other Cadmium oxide producers in particular the low cost labour countries like China and India will expand their Cadmium oxide producing activities.

It is estimated that over the period of 2013-2025, it will impact on an average annual basis the overall worldwide market of other metals as per following:

– Cobalt market: increase by 0.796%;

– Lithium market: increase by 0.374%;

– Nickel market: decrease by 0.012%;

– The rare-earths market: increase by 0.124%.

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93 Floridienne Chimie, a company based in Belgium is the world leader in Cadmium salts production with a yearly turnover in excess of € 90 million. It employs around 170 people in its plant located in Belgium and processes 4,000 to 6,000 tonnes of Cadmium per year, out of which 2,500 to 3,500 tonnes are used in NiCd batteries produced in Asia specifically for CPTs and the rest is used in industrial NiCd batteries, solar PV panels, electronic components, etc.

It is clear from the analysis presented above that the withdrawal of current exemption in 2013 to NiCd batteries for use in CPTs will not have any significant impact on the overall worldwide markets of metals. It can therefore be assumed that supply of these raw materials would not be limited due to the withdrawal of current exemption to NiCd battery use in CPT in EU in 2013.

As said in section 2.3., all portable batteries used in CPTs are imported to the EU, mainly from Asia and economic impacts on the EU battery industry due to Policy Option 2 are note expected. However, in case of a Policy Option 2, the major NiCd cells manufacturers will see a reduction in the demand for these batteries by approximately 25 %.[94]

Sanyo is the leading manufacturer of NiCd batteries with a worldwide market share of around 75% (all applications). Sanyo is investing in Li-Ion cells production for the CPT market, however it is still in a development stage. A withdrawal of the current exemption to NiCd batteries for use in CPTs would result in Sanyo losing its market dominance in the batteries for CPT sector (remaining with a market share of only 20-25% of the Li-Ion CPT market). Currently the Chinese company A123 is the dominant Li-Ion battery manufacturer. Therefore, a withdrawal of the current exemption to NiCd batteries for use in CPTs would shift the dominance of the sector for batteries production for CPTs from Japan to China.

Some stakeholders claimed that this policy option would have a negative impact on the battery pack assemblers of cadmium batteries. However, this may be compensated by the advancement of the EU production of portable NiMH and Li-ion batteries for CPT.

EPTA claims that this option will entail one-off technical costs of the 7 EU CPT manufacturers that they represent, namely:

- *Rsearch and Development (R&D)*: one-time R&D costs for EPTA member companies would be €35.5 million;
- *Upgradation of production lines*: one-time costs for EPTA members companies would be €4.6 million;[95]
- *Operating expenditures*: not quantifiable.

The total one-time technical cost for EPTA members[96] are in the range of €40 million, which represents 4% of their annual CPT turnover. The total one-time technical costs for the overall CPT market in EU are estimated to be €60 million.[97]

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94 Arcadis study (commissioned by industry) on "The ues of portable rechargeable batteries in cordless power tools", 2010.

95 Adaptation of production lines to new alternative technologies to replace the NiCd based CPTs requires one time capital expenditure. The cost of adapting production lines concern both the battery pack and CPT assembly lines.

Capital expenditure for the battery pack assembly lines of CPT manufacturers will be around €1.1 million spread over two years and mainly concerns investment in higher-grade welding equipment and test equipments for Li-ion batteries.

Capital expenditure for the CPT assembly lines of the manufacturers will be around €3.5 million. This expenditure will be spread over one to three years and mainly concerns investment in redesign of the tools according to the battery technology (Li-Ion); it includes the redesign of the interface of existing battery tools and associated investment in new casings, testing, etc.

96 For 7 companies representing 70 % of the CPT market share in EU.

It is however doubtful whether these costs should be attributed to the 14% increase of Li-ion batteries in CPT applications compared to the amounts placed on the market under Policy Option 1 and the 13.6% increase of NiMH batteries in CPT applications of this policy option, compared to the amounts placed on the market under Policy Option 1, or whether these technical costs would also occur under the BaU scenario, as also under the BaU scenario, the amounts of the NiCd batteries used in CPT applications will decrease with 50 % between 2013 and 2025. It therefore seems that the above costs could be exaggerated.

The impact due to already existing stock (in market) of the NiCd based CPTs in EU would be negligible.

Because of the claimed increases in battery costs and manufacturing costs of the CPT manufacturers, EPTA estimates a cost increase of 50% for making a Li-ion technology based CPT and 20% for making a NiMH based CPT when compared to the NiCd based CPT.[98]

It estimates that only half of this increase can be passed on and the other half needs to be absorbed in the commercial margin. Therefore, EPTA recommends that it is unlikely that manufacturers will benefit greatly or at all from the higher selling price on CPT using either NiMH or Li-ion technologies.

It is estimated that the increased cost for the retailers associated with Li-ion CPTs will be absorbed by their higher profit margins due to the higher selling price of the Li-ion CPT.

The impact of this increased cost for additional NiMH and Li-ion CPT units when translated on the overall NiMH and Li-ion CPT market in EU (Option 2) results in the following increase in cost of average tool for the consumer:

– Average NiMH battery based CPTs: 1.4% (average over the period 2013-2025) higher cost to the consumer than average NiCd CPT. The extra cost for average NiMH based CPT to consumer is 2.6% in 2013 falling down to 0.6% in 2025 when compared to average NiCd CPT.

– Average Li-ion technology based CPTs: 3.5% (average over the period 2013-2025) higher cost to the consumer than average NiCd CPT. The extra cost for average Li-ion based CPT to consumer is 6.7% in 2013 falling down to 1.4% in 2025 when compared to average NiCd CPT.

The impact on consumers would therefore be:

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97 Based on the analysis concerning the overall one-time technical costs Bio Intelligence made following observations:
Average technical cost per CPT manufacturer amounts to almost €5.7 million and the median value to about € 1 million.
High absolute technical costs: two companies estimate the total technical costs at more than 16 and more than € 20 million or respectively 6% and 7.5% of their yearly CPT sales turnover.
High end of the cost impact: a medium-size company (representing less than 0.5% of EU CPT market by value) active only in the EU market and producing only NiCd based CPTs estimates the total technical costs at more than 3 times the yearly turnover.
Low end of the cost impact: a medium-sized company (representing less than 5% of the EU CPT market by value) estimates the total technical costs at around 0.17% of its turnover.

98 This increase in cost takes in to account increase in battery cost to the CPT manufacturer and increase in CPT manufacturing cost.

– To replace a NiCd CPT (including two battery packs and a charger), which costs €60.80, by a NiMH CPT (including two battery packs and a charger) will cost €66.90 in 2013;[99]

– To replace a NiCd CPT (including two battery packs and a charger) which cost €60.80 by a Li-ion CPT (including two battery packs and a charger) will cost €76 in 2013.[100]

In case of the withdrawal of the current exemption in 2013 to portable NiCd batteries for use in CPTs, consumers will potentially be impacted due to the higher manufacturing cost of alternative battery technology based CPTs. Over the period 2013-2025, an average NiMH battery based CPT will cost €0.8 more, whereas an average Li-ion battery based CPT will cost €2.1 more to the consumer than the average NiCd-battery based CPT.

No significant impact is expected for the World Trade Organisation (WTO) as the alternative battery technologies for CPT are already in use.

Economic impacts on battery waste management

Under this policy option, the amounts of collected portable cadmium batteries will decrease with 50% more than under policy option 1 and the amounts of collected NiMH batteries and collected Li-ion batteries will increase with about 15% compared to policy option 1.

The costs/benefits of battery recycling depends to a great extend on the market price for nickel and whether lithium is recovered. Given that when looking at all batteries from the CPT sector in the EU, the net recycling costs could be between 7% to 60% higher compared to the base-line scenario.

Some cadmium recyclers have claimed annual turnover loss in the range of €10.5 million to €11.2 million. However, it should be noted that (i) compared to the base-line scenario, the amount of cadmium batteries in CPT will decrease with 50% but that (ii) these recyclers also recycle other battery chemistries (such as NiMH) and also industrial NiCd batteries and (iii) the industrial cadmium battery applications are expected to increase.

Compared to the base-line scenario, **no additional investment** in waste Li-ion battery recycling plant infrastructure would be required.[101] The withdrawal of the current exemption to NiCd battery use in CPTs in 2013 would lead to replacement of NiCd battery by existing alternative battery types, particularly by Li-ion based CPTs. This will in turn result in additional waste generation of Li-ion batteries at the end of their life.

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99 As the charger and tool used for both NiCd and NiMH CPTs are the same, therefore it is reasonable to estimate that the above increase in cost of NiMH CPT as compared to a NiCd CPT is solely due to the higher cost of NiMH batteries as compared to NiCd batteries.

100 A Li-ion CPT when compared to a NiCd CPT, only the tool is same however different types of chargers are used for Li-ion and NiCd battery packs. This is so due to the presence of an additional electronic circuit in case of a charger for Li-ion battery packs.

101 According to Umicore, one of the main suppliers of raw materials to rechargeable battery industry and a major recycler of waste Li-ion batteries in EU, their recycling facilities are equipped to handle the resulting additional flow of waste Li-ion batteries. Umicore also provided an estimate for the investment required to develop waste Li-ion based battery-recycling facilities as €25 million for a 7,000 tonne/year waste Li-ion battery recycling capacity.

Impacts on SMEs

It is estimated that the withdrawal of current exemption to NiCd batteries will lead to 50 % reduction of the cadmium oxide production of an SME in Belgium.[102]

In EU, there is still an activity of Nickel-based battery pack assembly which qualifies as SMEs. The withdrawal of the current exemption to NiCd batteries for use in CPT may theoretically affect the operations of these EU Nickel-based pack assemblers. Due to lack of information concerning the extent of these impacts, their quantification is not possible.

Of the seven[103] medium-sized CPT manufacturers identified as operating in the EU market, only three[104] of them still produce and sell NiCd based CPT in the EU market in 2011. All seven of these medium-sized CPT manufacturers already produce alternatives to NiCd based CPT (primarily Li-ion based CPT and some NiMH based CPT). It must be noted that these medium-sized CPT manufacturers on the other hand also produce corded power tools. It can therefore be concluded that the withdrawal of the current exemption should not question the viability of any of the SME CPT manufacturers.

SNAM and Accurec are two main NiCd waste battery recyclers in EU. Both these recycling companies qualify as SMEs and expect a combined annual turnover loss in the range of €10.5 million to €11.2 million. However, as these recyclers, other than portable NiCd batteries also recycle other battery chemistries (such as NiMH) and also industrial NiCd batteries, therefore the withdrawal of the exemption should not question their viability even though the economic impacts on them may not be negligible. At the same time, increased recycling of waste Li-ion and NiMH is expected to create some jobs and compensate for the turnover loss in the waste NiCd battery recycling activity.

Impacts on competitiveness

The demand for industrial NiCd batteries is increasing (railways developments in BRIC countries – Brazil, Russia, India and China). The resulting volume gains could mitigate the effects of a ban on CPT in EU. On the other hand, it highlights that a shrinking market of NiCd batteries in EU will stimulate competition from other Cadmium oxide producers in particular the low cost labour countries like China and India.

The Li-ion battery pack assembly is currently only done by Asian companies manufacturing these cells. On the contrary, the battery pack assembly activity for Nickel-based batteries can be performed in EU. A withdrawal of the current exemption to NiCd batteries use in CPT may therefore put EU Ni-based battery pack assembly activity at some disadvantage compared to battery pack assemblers elsewhere.

European CPT manufacturers face significant competitive pressure from cheaper producers in China and elsewhere in particular for the low-price segment primarily comprised of DIY users and still having a major share of the NiCd based CPT. The withdrawal of the current

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102 Floridienne Chimie, Belgium

103 (1) Andreas STIHL AG & Co. KG; (2) C. & E. FEIN GmbH; (3) Flex-Elektrowerkzeuge GmbH; (4) Kress-elektrik GmbH & Co.KG; (5) SPARKY Power Tools GmbH; (6) TTS Tooltechnic Systems AG & Co. KG ; (7) Rupes S.p.A.

104 (1) C. & E. FEIN GmbH; (2) SPARKY Power Tools GmbH; (3) Rupes S.p.A.

exemption to NiCd batteries use in CPT may therefore add to the competitiveness of the EU based CPT manufacturers in the EU market.

Out of the six[105] waste CPT battery recyclers identified operating in the EU market, only three[106] of them recycle portable waste NiCd batteries in 2011. These three recycling companies however also recycle other battery chemistries (such as NiMH and Li-ion) and also industrial NiCd batteries. All six of them recycle either waste NiMH or Li-ion batteries. The withdrawal of the current exemption to NiCd batteries used in CPT may therefore enhance the overall competitiveness of internal waste battery recycling market in the EU.

5.3.2. Environmental impacts

Amount of Cadmium introduced into the EU economy

The BIO study calculated that around **8,060 tonnes of Cadmium** will be introduced in the EU economy over the period 2010-2025 via the use of portable NiCd batteries in CPTs for Policy Option 2. The environmental impacts resulting from this introduction of Cadmium mainly occur during the end-of-life phase due to the landfill of waste batteries and also due to the landfilling of the waste battery incineration residue. The landfilling in a sanitary landfill generates environmental impacts, notably through emissions of leachate to water bodies. As per the end-of-life scenario considered in Policy Option 2, **8,060 tonnes of Cadmium** introduced through CPT batteries will lead to around **300 tonnes of Cadmium emissions** through leachate[107] to water in ST + 5% LT.[108] The Cadmium released in water in turn impacts human health by increasing the morbidity in the total human population. The 300 tonnes of Cadmium released in water can cause cancer and non-cancer diseases in around **128 people**[46]**,** which is **68% less** when compared to BaU scenario (Policy Option 1) over the same period of time.

Aggregated environmental impact at the EU level

The overall aggregated environmental impact for Policy Option2 is presented in Table 4.

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105 (1) SNAM, (2) Accurec, (3) SAFT AB, (4) Redux GmbH, (5) Umicore, (6) Recupyl.

106 (1) SNAM, (2) Accurec, (3) SAFT AB,

107 Through leachate, Cadmium (and other metals) contained in batteries are slowly released in the environment over thousands of years. In a short-term perspective, e.g. less than 100 years in the case of a landfill, the battery mostly behaves like inert waste, meaning that metals contained in the cells remain 'locked' inside their housing. However, from a long-term (LT) perspective, a fraction of metals contained in the battery will eventually end-up in the environment

108 Please note: "ST" stands for Short Term and signifies the duration of operation of a landfill (usually less than 100 years) in the waste batteries are landfilled, whereas "LT" stands for Long Term and 5%LT signifies the period over which 5% of the overall emissions related to the landfilled battery waste take place (this duration can be anything between the time of closure of a landfill to 1000's of years)..

The ST emissions only represent the emission occurring during the operation of the landfill which are almost insignificant when compared with the LT emissions (which assumes all the landfilled battery waste is emitted to environment), however the probability of its happening is very low. Therefore a most reasonable approach is "ST + 5% LT" which has been proposed in the study conducted by ERM for DEFRA and has received wide acceptance (ERM study on "Battery Waste Management Life Cycle Assessment", October 2008, DEFRA).

Table 4: Aggregated environmental impact for Policy Option 2

Environmental impact	Inhabitant-Eq	Weighted Inhabitant-Eq
Global Warming Potential (GWP)	179 045	85 206
Photochemical Oxidant Formation Potential (POFP)	88 526	9 158
Terrestrial Acidification Potential (TAP)	196 510	16 264
Abiotic Resource Depletion Potential (ARDP)	490 127	70 989
Particulate Matter Formation Potential (PMFP)	184 972	26 791
Freshwater Eutrophication Potential (FEP)	6 682 649	322 172
Aggregated Environmental Impact		**530 581**

The annual environmental impact (for 25% and 45% collection rate) associated with the use of batteries in CPTs in EU in Policy Option 2 is equivalent to environmental impact caused by 530 581[48] of 464 043 141 European citizens ("EU25 +3"[49]).

This means that, the environmental impact due to the use of batteries in CPTs in EU contributes **0.1143%**[50] to the overall environmental impact of EU.

This means that the annual environmental impact associated with the use of batteries in CPTs in Policy Option 2 is **5% lower** when compared to the use of CPTs in Policy Option 1. In other words, the Policy Option 2 is environmentally beneficial by 5% when compared to Policy Option 1.

Like in case of Policy Option 1, as per WEEE statistics reported for year 2008, the aggregated environmental impact of Policy Option 2 is also calculated for a collection rate of 10% over the period 2010 till 2025 as presented in Table 5 below.

Table 5: Aggregated environmental impact for Policy Option 2 (10% collection rate)

Environmental impact	Inhabitant-Eq	Weighted Inhabitant-Eq
Global Warming Potential (GWP)	180 139	85 727
Photochemical Oxidant Formation Potential (POFP)	92 592	9 579
Terrestrial Acidification Potential (TAP)	235 894	19 524
Abiotic Resource Depletion Potential (ARDP)	507 314	73 478
Particulate Matter Formation Potential (PMFP)	212 337	30 754
Freshwater Eutrophication Potential (FEP)	6 922 154	333 719
Aggregated Environmental Impact		**552 781**

The annual environmental impact (for 10% collection rate) associated with the use of batteries in CPTs in EU in Policy Option 2 is equivalent to environmental impact caused by 552 781[48] of 464 043 141 European citizens ("EU25 +3"[49]).

This means that, the environmental impact due to the use of batteries in CPTs in EU contributes **0.1191%**[50] to the overall environmental impact of EU.

This means that the annual environmental impact associated with the use of batteries in CPTs in Policy Option 2 is **8% lower** when compared to the use of CPTs in Policy Option 1. In other words, the Policy Option 2 is environmentally beneficial by 8% when compared to Policy Option 1.

Depending upon the choice of collection rate and the indicators to calculate the aggregated environmental impact, Policy Option 2 is environmentally beneficial by **5% to 8%** when compared to Policy Option 1.

5.3.3. Social impacts

Some stakeholders claimed job losses for raw material suppliers to the cadmium battery industry (20-30 directly job losses). In addition, the use of cadmium in industrial batteries is not prohibited.

Other stakeholders claimed that the nickel-based pack assembly operations **will lose the NiCd segment of their business** leading to a shift of the pack assembly activity outside of EU because of the geographical distribution of the manufacturing sites of Li-ion batteries. The quantification of resulting direct and indirect job losses in EU is however not available.

One CPT manufacturer reports a **positive impact** on employment whereas two others expect a **negative impact** on employment. The quantification of resulting direct and indirect job losses in EU is however not available.

Recycling industry estimates a job loss of **70 to 90 jobs**, as there are 70 to 90 employees which work exclusively for the recycling of NiCd batteries.[109] However, also the majority of Li-ion-battery types contain valuable materials worth for being recycled. Therefore, it is expected that **jobs lost** for the recycling of NiCd portable batteries would be related to **the creation of jobs for the recycling of Li-ion batteries**. Thus in balance **no negative impact** for the jobs in the overall recycling industry is expected.

5.3.4. Administrative burdens

The withdrawal of current exemption to NiCd batteries for use in CPTs will require the competent Member State authorities to monitor and control their markets in order to ensure effective implementation of the ban. 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. To accomplish this, each Member State is expected to already have competent bodies, which can also handle the ban of NiCd batteries use in CPTs. No additional administrative burden is expected.

5.4. Policy Option 3: Delayed withdrawal of the exemption (2016)

Compared to Policy Option 1, under option 3 as of 2016, the cadmium batteries intended to be used in cordless power tools will be replaced by Li-ion and NiMH batteries.

Over the period **2013-2025** and compared to Policy Option 1:

– the total amount of Li-ion batteries intended for CPT use placed on the EU market will increase from 610.70 million units (Policy Option 1) to 670.85 million units, which means an increase of 9.8%;

– the total amount of NiMH batteries intended for CPT use will increase from 157.45 million units (Policy Option 1) to 172.49 million units, which means an increase of 9%;

– the total amount of NiCd batteries intended for CPT use will decrease from 107.61 million units (Policy Option 1) to 32.42 million units, which means a decrease of 70%.

5.4.1. Economic impacts

This option is not expected to not have any significant impact on the overall worldwide markets of other metals (cobalt, lithium, nickel, rare-earth metals).

Currently there is no company having production facilities in EU to manufacture NiCd cells for portable batteries intended for the use in CPT. All portable NiCd batteries used in CPT are imported to the EU, mainly from Asia.

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[109] Wiaux, Jean-Pol. Brief Overview of the Enviro- and Socio-Economic Analyses on the use of NiCd batteries in Cordless Power Tools; personal e-mail communication on 8.12.2009 (see ESWI study, 2010)

Some stakeholders claimed that this policy option would have a negative impact on the battery pack assemblers of cadmium batteries. However, this may be compensated by the advancement of the EU production of portable NiMH and Li-ion batteries for CPT.

It is expected that Policy Option 3 would result in a **potentially lower impact** on CPT manufacturers as compared to Policy Option 2.[110] This would be due to the natural increase in market share of NiMH and Li-ion battery based CPTs in 2016 as compared to 2013.

Policy Option 3 **would cost less** to re-design the CPTs than Policy Option 2.[111] Policy Option 3 would lead to impact on CPT manufacturers of around **45% lower** when compared to that of Policy Option 2.[112]

EPTA claims that this option will entail one-off technical costs of the 7 EU CPT manufacturers that they present, namely:

– *Research and Development (R&D) costs*: one-time R&D costs for EPTA member companies would be €19.5 million;[113]

– *Upgradation of production lines*: one-time costs for EPTA member companies would be €2.5 million;

– *Operating expenditure*: not quantifiable.

The total one-time technical cost for EPTA members[114] are in the range of €22 million, which represents 2.2% of their annual CPT turnover. The total one-time technical costs for the overall CPT market in EU are estimated to be € 33 million.

The impact due to already existing stock (in market) of NiCd based CPTs in EU would be negligible.

Policy Option 3 would lead to similar economic impacts on retailers in EU as Policy Option 2.

In the case of the withdrawal of the current exemption in 2016 to NiCd batteries for use in CPT, consumers will potentially be impacted due to the higher manufacturing cost of alternative battery technology based CPT. EPTA suggests the following impact of the higher

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110 Based on consultation with EPTA.

111 EPTA suggests that it would cost more to re-design products in a short period of time rather than over the natural business cycle. Similarly, it would cost more to scrap or rework products that cannot be put on the market due to withdrawal of exemption in 2013 instead of at a later stage through stock management.

112 EPTA estimates that the reduction in cost to CPT manufacturers would be in the order of 15% for each year of postponing the withdrawal of exemption after 2013 (assuming a product design life of 5-7 years).

113 It should be noted that these R&D cost estimate are solely based on the data reported by EPTA and in the absence of other sources of information to verify this cost, the credibility of this cost estimate reported here can be questioned. According to BIO study, part of these R&D costs can be attributed to the natural evolution of the CPT battery market as per the BaU scenario, however, the quantification of this share is not possible due to lack of information.

114 For 7 companies representing 70% of the CPT market share in EU.

manufacturing costs of additional units (compared to BaU) of NiMH and Li-ion CPT on consumers:

– Each additional NiMH battery based CPT: 11% higher manufacturing cost than NiCd CPTs, 5,5% will be abbsorbed by the manufacturer;

– Each additional Li-ion technology based CPTs: 27.5% higher manufacturing cost than NiCd CPTs, 13,75% will be abbsorbed by the manufacturer.

The impact of this increased cost for additional NiMH and Li-ion CPT units when translated on the overall NiMH and Li-ion CPT market in EU (Policy Option 3) results in the following increase in cost of average tool for the consumer:

– Average NiMH battery based CPTs: 0.6% (average over the period 2016-2025) higher cost to the consumer than average NiCd CPT. The extra cost for average NiMH based CPT to consumer is 1% in 2016 falling down to 0.3% in 2025 when compared to average NiCd CPT.

– Average Li-ion technology based CPTs: 1.5% (average over the period 2016-2025) higher cost to the consumer than average NiCd CPT. The extra cost for average Li-ion based CPT to consumer is 2.5% in 2016 falling down to 0.8% in 2025 when compared to average NiCd CPT.

The impact on consumers would therefore be:

– To replace a NiCd CPT (including two battery packs and a charger), which costs €60.80, by a NiMH CPT (including two battery packs and a charger) will cost €64.10 in 2016;[115]

– To replace a NiCd CPT (including two battery packs and a charger) which cost €60.80 by a Li-ion CPT (including two battery packs and a charger) will cost €69,20 in 2016.[116]

Over the period 2016-2025, an average NiMH battery based CPT would cost €0.4 more whereas an average Li-ion battery based CPT would cost €0.9 more to the consumer than an average NiCd CPT (EPTA estimations).

No significant impact is expected for the World Trade Organisation (WTO) as the alternative battery technologies for CPT are already in use.

Economic impacts on battery waste management

Under this policy option, the amounts of collected portable cadmium batteries will decrease with 50% more than under policy option 1 and the amounts of collected NiMH batteries and collected Li-ion batteries will increase with about 15% compared to policy option 1.

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115 As the charger and tool used for both NiCd and NiMH CPTs are the same, therefore it is reasonable to estimate that the above increase in cost of NiMH CPT as compared to a NiCd CPT is solely due to the higher cost of NiMH batteries as compared to NiCd batteries.

116 A Li-ion CPT when compared to a NiCd CPT, only the tool is same however different types of chargers are used for Li-ion and NiCd battery packs. This is so due to the presence of an additional electronic circuit in case of a charger for Li-ion battery packs.

The costs/benefits of battery recycling depends to a great extend on the market price for nickel. Depending on the market price for nickel and whether lithium is recovered, when looking at all batteries from the CPT sector in the EU, the net recycling costs could be between 3% to 26% higher compared to the base-line scenario.

Compared to the base-line scenario, **no additional investment** in waste Li-ion battery recycling plant infrastructure would be required.[117] The withdrawal of the current exemption to NiCd battery use in CPTs in 2016 (similar to Policy Option 2) would lead to replacement of NiCd battery by existing alternative battery types, particularly by Li-ion based CPTs. This will in turn result in additional waste generation of Li-ion batteries at the end of their life and may require investments in development of waste Li-ion battery recycling plants hence supporting innovation in the waste battery recycling technologies.

Impacts on SMEs

A similar or potentially lower impact (due to the natural decrease in market share of NiCd batteries in 2016 as compared to 2013) impact as in case of Policy Option 2 is expected on SMEs in EU (see section 5.3.1.).

Impacts on competitiveness

A similar or potentially lower impact (due to the natural decrease in market share of NiCd in 2016 as compared to 2013) impact as in case of Policy Option 2 is expected on competitiveness of firms in EU (see section 5.3.1.).

5.4.2. Environmental impacts

Amount of cadmium introduced into the EU economy

The environmental impacts resulting from this introduction of Cadmium mainly occur during the end-of-life phase due to the landfill of waste batteries and also due to the landfilling of the waste battery incineration residue. The landfilling in a sanitary landfill generates environmental impacts, notably through emissions of leachate to water bodies. As per the end-of-life scenario considered in Policy Option 1, **14,830 tonnes of Cadmium** introduced through CPT batteries will lead to around **520 tonnes of Cadmium emissions** through leachate[118] to water in ST + 5% LT.[119] The Cadmium released in water in turn impacts human

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117 According to Umicore, one of the main suppliers of raw materials to rechargeable battery industry and a major recycler of waste Li-ion batteries in EU, their recycling facilities are equipped to handle the resulting additional flow of waste Li-ion batteries. Umicore also provided an estimate for the investment required to develop waste Li-ion based battery-recycling facilities as €25 million for a 7,000 tonne/year waste Li-ion battery recycling capacity.

118 Through leachate, Cadmium (and other metals) contained in batteries are slowly released in the environment over thousands of years. In a short-term perspective, e.g. less than 100 years in the case of a landfill, the battery mostly behaves like inert waste, meaning that metals contained in the cells remain 'locked' inside their housing. However, from a long-term (LT) perspective, a fraction of metals contained in the battery will eventually end-up in the environment

119 Please note: "ST" stands for Short Term and signifies the duration of operation of a landfill (usually less than 100 years) in the waste batteries are landfilled, whereas "LT" stands for Long Term and 5%LT

health by increasing the morbidity in the total human population. The 520 tonnes of Cadmium released in water can cause cancer and non-cancer diseases in around **222 people**[46]**,** which is **45% less** when compared to BaU scenario (Policy Option 1) over the same period of time.

Aggregated environmental impact at the EU level.

The overall aggregated environmental impact for PO3 is presented in Table 6.

Table 6: Aggregated environmental impact for Policy Option 3

Environmental impact	**Inhabitant-Eq**	**Weighted Inhabitant-Eq**
Global Warming Potential (GWP)	178 681	85 033
Photochemical Oxidant Formation Potential (POFP)	88 780	9 185
Terrestrial Acidification Potential (TAP)	200 189	16 569
Abiotic Resource Depletion Potential (ARDP)	557 936	80 810
Particulate Matter Formation Potential (PMFP)	187 269	27 124
Freshwater Eutrophication Potential (FEP)	6 673 681	321 740
Aggregated Environmental Impact		**540 460**

The annual environmental impact (for 25% and 45% collection rate) associated with the use of batteries in CPT in EU in Policy Option 3 is equivalent to environmental impact caused by 540 460[48] of 464 043 141 European citizens ("EU25 +3"[49]).

This means that, the environmental impact due to the use of batteries in CPT in EU contributes **0.1165%**[50] to the overall environmental impact of EU.

This means that the annual environmental impact associated with the use of batteries in CPT in Policy Option 3 is **3% lower** when compared to aggregated environmental impact of

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signifies the period over which 5% of the overall emissions related to the landfilled battery waste take place (this duration can be anything between the time of closure of a landfill to 1000's of years).

The ST emissions only represent the emission occurring during the operation of the landfill which are almost insignificant when compared with the LT emissions (which assumes all the landfilled battery waste is emitted to environment), however the probability of its happening is very low. Therefore a most reasonable approach is "ST + 5% LT" which has been proposed in the study conducted by ERM for DEFRA and has received wide acceptance (ERM study on "Battery Waste Management Life Cycle Assessment", October 2008, DEFRA).

Policy Option 1. In other words, the Policy Option 3 is environmentally beneficial by 3% when compared to Policy Option 1.

Like in case of Policy Option 1, as per WEEE statistics reported for year 2008, the aggregated environmental impact of Policy Option 3 is also calculated for a collection rate of 10% over the period 2010 till 2025 as presented in Table 7 below.

Table 7: Aggregated environmental impact for Policy Option 3 (10% collection rate)

Environmental impact	**Inhabitant-Eq**	**Weighted Inhabitant-Eq**
Global Warming Potential (GWP)	179 808	85 570
Photochemical Oxidant Formation Potential (POFP)	92 941	9 615
Terrestrial Acidification Potential (TAP)	240 473	19 903
Abiotic Resource Depletion Potential (ARDP)	597 452	86 533
Particulate Matter Formation Potential (PMFP)	215 277	31 180
Freshwater Eutrophication Potential (FEP)	6 919 125	333 573
Aggregated Environmental Impact		**566 374**

The annual environmental impact (for 10% collection rate) associated with the use of batteries in CPT in EU in Policy Option 3 is equivalent to environmental impact caused by 566 374[48] of 464 043 141 European citizens ("EU25 +3"[49]).

This means that, the environmental impact due to the use of batteries in CPT in EU contributes **0.1221%**[50] to the overall environmental impact of EU.

This means that the annual environmental impact associated with the use of batteries in CPTs in Policy Option 3 is **5% lower** when compared to aggregated environmental impact of Policy Option 1. In other words, the Policy Option 3 is environmentally beneficial by 5% when compared to Policy Option 1.

Depending upon the choice of collection rate and the indicators to calculate the aggregated environmental impact, Policy Option 3 is environmentally beneficial by **3% to 5% lower** when compared to Policy Option 1.

5.4.3. Social impacts

The withdrawal of current exemption (in 2016) to NiCd batteries for use in CPT will have a similar impact on the employment in EU as in case of Policy Option 2 for the following stakeholders:

– Raw material suppliers

– Battery cell manufacturers

In case of battery pack assemblers, CPT manufacturers, and recyclers however, it is expected that the negative impact on employment will be lower when compared to Policy Option 2. This is so as Policy Option 3 allows extra three years to these stakeholders to align to the natural business cycle The quantification of resulting direct and indirect job losses in EU is however not available.

5.4.4. Administrative burdens

The withdrawal of current exemption to NiCd batteries for use in CPT will require the competent Member State authorities to monitor and control their markets in order to ensure effective implementation of the ban. 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. To accomplish this, each Member State is expected to already have competent bodies, which can also handle the ban of NiCd batteries use in CPT. No additional administrative burden is expected.

5.5. Summary of the economic impacts

The summary of the economic impacts of the three scenarios is shown in the table below.

Stakeholder	Economic Impact / Option 1 2010	Economic Impact / Option 2 2013	Economic Impact / Option 3 2016
Mining companies	No additional impact as normal business functioning (no quantification of this expenditure available)	No impact	No impact
Raw material suppliers		Small turnover loss (in the range of €15 to €20 million/year) to Cadmium salt producers	Small turnover loss (in the range of €15 to €20 million/year) to Cadmium salt producers
Battery cell manufacturers		No impact	No impact
Battery pack assemblers		Slight loss of turnover to Nickel-based battery pack assemblers in EU (no quantification)	Slight loss of turnover (lower than Policy Option 2) to Nickel-based battery pack assemblers in EU (no quantification)
CPT manufacturers		One-time combined technical costs for all the CPT manufacturers in EU is estimated by EPTA to be € 60 million	One-time combined technical costs for all the CPT manufacturers in EU is estimated by EPTA to be € 33 million
Retailers		Insignificant impact (marginal cost due to the additional requirements concerning safe transportation and storage of Li-ion based CPTs)	Insignificant impact (marginal cost due to the additional requirements concerning safe transportation and storage of Li-ion based CPTs)
Consumers		Over the period 2013-2025, an average NiMH battery based CPT to cost €0.8 more whereas an average Li-ion battery based CPT to cost €2.1 more to the consumer than an average NiCd CPT (EPTA estimations)	Over the period 2016-2025, an average NiMH battery based CPT to cost €0.4 more whereas an average Li-ion battery based CPT to cost €0.9 more to the consumer than an average NiCd CPT (EPTA estimations)
Recyclers	Currently the recycling of Li-ion batteries is carried out at a net cost, however this is expected to decrease in the future as technology matures and economies of scale arise. Some stakeholders estimated an increase in recycling cost of waste CPT battery arsing over the period 2011 till 2025 is in the range of €33 million to €179 million because it would be more expensive to recycle NiMH and Li-Ion batteries compared to NiCd batteries	Currently the recycling of Li-ion batteries is carried out at a net cost, however this is expected to decrease in the future as technology matures and economies of scale arise. Some stakeholders estimated an increase in recycling cost of waste CPT battery arsing over the period 2011 till 2025 is in the range of €53 million to €192 million because it would be more expensive to recycle NiMH and Li-Ion batteries compared to NiCd batteries.	Currently the recycling of Li-ion batteries is carried out at a net cost, however this is expected to decrease in the future as technology matures and economies of scale arise. Some stakeholders estimated an increase recycling cost of waste CPT battery arsing over the period 2011 till 2025 is in the range of €42 million to €140 million because it would be more expensive to recycle NiMH and Li-Ion batteries compared to NiCd batteries.
Administrative costs (MS)	No impact	Insignificant impact (since Cadmium restriction in many portable batteries is already implemented under the Battery Directive)	Insignificant impact (since Cadmium restriction in many portable batteries is already implemented under the Battery Directive)

5.6. Compliance aspects

The administrative burden is limited for all policy options and therefore it should not lead to compliance issues.

6. SECTION 6: COMPARING THE OPTIONS

The policy options will be assessed against the following criteria:

– **effectiveness** – the extent to which options achieve the objectives of the proposal;

– **efficiency** – the extent to which objectives can be achieved at least cost;

– **coherence –** the extent to which options are coherent with the overarching objectives of EU policy, and the extent to which policy options are likely to limit trade-offs across the economic, social, and environmental domain.

In section 5 all relevant environmental, economic, administrative and social impacts have been identified and as much as possible quantified. In this section, the magnitude of the impacts in three policy options is compared. The comparison highlights the advantages and disadvantages of the three policy options, across the economic, social, administrative and environmental dimensions and it identifies the potential weaknesses and risks of these options.

The three policy options are compared from the point of view of effectiveness, efficiency and coherence, including potential trade-offs between competing objectives. Particular attention has been paid to cost-effectiveness of different policy options since some of them have budgetary implications.

To compare the three policy options, a semi-quantitative score matrix approach was adopted (see Table 8). The level of detail in the analysis depends on the amount of information gathered as well as their quality.

Table 8: Semi-quantitative score matrix

Legend	Likely effect
+++	Strongly positive impact
++	Positive impact
+	Slightly positive
≈	Marginal/Neutral
0	No effect (the baseline)
-	Slightly negative impact
--	Negative impact
---	Strongly negative impact
?	Uncertain

Table 9 summarises the possible environmental, economic, social and administrative impact for implementation of the three policy options at the Member States 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.

Table 9: Impact assessment matrix for the comparison of the three policy options

Policy Option Impact Indicator	**Option 1**	**Option 2**	**Option 3**
Economic impact indicators			
Mining companies	0 No additional cost or turnover loss	0 No additional cost or turnover loss	0 No additional cost or turnover loss
Raw material suppliers	0 No additional cost or turnover loss	- Small turnover loss (€15-€20 million/year) to Cadmium salt producers	- Small turnover loss (€15-€20 million/year) to Cadmium salt producers
Battery cell manufacturers	0 No additional cost or turnover loss	0 No CPT battery manufacturing in EU	0 No CPT battery manufacturing in EU
Battery pack assemblers	0 No additional cost or turnover loss	- Slight loss of turnover to Nickel-based battery pack assemblers in EU	≈ Marginal or no impact on Nickel-based battery pack assemblers due to availability of extra time for adapting to the natural business cycle of CPTs
CPT manufacturers	0 No additional cost or turnover loss	- Slight cost due to extra capital expenditure for R&D and adaptation of manufacturing facilities	≈ Marginal or no impact on NiCd based CPT manufacturers due to availability of extra time for adapting to the natural business cycle of CPTs
Retailers	0 No additional cost or turnover loss	≈ Marginal cost or neutral impact due to the additional requirements concerning safe transportation and storage of Li-ion based CPTs	≈ Marginal cost or neutral impact due to the additional requirements concerning safe transportation and storage of Li-ion based CPTs

Policy Option Impact Indicator	Option 1	Option 2	Option 3
Consumers	0 No additional cost	- Slight cost due to higher purchase price of Li-ion and NiMH based CPTs as compared to NiCd based CPTs	≈ Marginal cost or neutral impact of the higher purchase price due to the availability of extra time for natural evolution of Li-ion and NiMH based CPTs market
Recyclers	0 No additional cost or turnover loss	- Slight loss of turnover (to the waste NiCd battery recyclers) and slight increase in waste CPT battery recycling costs (due to higher recycling cost of waste Li-ion battery as compared to waste NiCd battery recycling)	≈ Marginal cost due to the availability of extra time for natural evolution of lower cost for waste Li-ion battery recycling
Administrative costs (MS)	0 No implementation costs for MS authorities	≈ Marginal or neutral cost since Cadmium restriction in many portable batteries is already implemented under the Battery Directive	≈ Marginal or neutral cost since Cadmium restriction in many portable batteries is already implemented under the Battery Directive
Environmental impact indicators			
Aggregated environmental impact	0 Contribution of annual environmental impact associated with battery use in CPTs to overall annual EU environmental impact in the range of	+ Environmentally more beneficial by 5% to 8% each year when compared to "Policy Option 1"	+ Environmentally more beneficial by 3% to 5% each year when compared to "Policy Option 1"

Policy Option Impact Indicator	Option 1	Option 2	Option 3
	0.1206% to 0.1288%		
Cadmium emissions to water[120], ST + 5% LT	0 945 to 1360 tonnes of Cadmium emissions to water in the EU over the period 2010-2025 related to use of batteries in CPTs	++ 68% less Cadmium emissions to water as compared to "Policy Option 1" in the EU over the period 2010-2025 related to use of batteries in CPTs	++ 45% less Cadmium emissions to water as compared to "Policy Option 1" introduced in the EU over the period 2010-2025 related to use of batteries in CPTs
Social impact indicators			
Employment generation (raw material suppliers)	0 Does not increase jobs	- Could lead to some job losses (20 to 30) in Cadmium salt production activity in EU	- Could lead to some job losses (20 to 30) in Cadmium salt production activity in EU
Employment generation (battery cell manufacturers)	0 Does not increase jobs	0 Unlikely to create additional jobs in EU	0 Unlikely to create additional jobs in EU
Employment generation (battery pack assemblers)	0 Does not increase jobs	- Could lead to some job losses in Nickel-based battery pack assembly activity in EU	≈ Unlikely to create additional jobs
Employment generation (CPT manufacturers)	0 Does not increase jobs	≈ Unlikely to create additional jobs	≈ Unlikely to create additional jobs
Employment generation (retailers)	0 Does not increase jobs	≈ Unlikely to create additional jobs	≈ Unlikely to create additional jobs
Employment generation (recyclers)	0 Does not increase jobs	- Could lead to some job losses in waste NiCd battery recycling activity in EU (about 100 losses). This should however partly be compensated by job gains in NiMH and Li-ion recycling activity	≈ Unlikely to create additional jobs
Employment generation (MS compliance authorities)	0 Does not increase jobs	≈ Unlikely to create additional jobs	≈ Unlikely to create additional jobs

[120] Although the environmental impacts associated with Cadmium emissions to water are already taken into account in the "aggregated environmental impact", however, it is important to present this indicator separately as it directly relates to one of the main operational objectives of the policy intervention

Based on the results of the comparison of impacts (environmental, social and economic) of the three policy options presented in Table 9, the assessment of their effectiveness, efficiency and coherence is described in the sub-sections below.

6.1. Effectiveness

Policy Option 1: "Baseline scenario"

The magnitude of the environmental impacts of the baseline scenario (as earlier presented in section 5.2.) is:

– 945 tonnes of Cadmium emissions in water which in turn can lead to cancer and non-cancer diseases in around 405 people;

– For collection rate as required by the Batteries Directive: aggregated environmental impact of 559 831 weighted inhabitant-eq corresponding to 0.1206% of overall "EU25 +3" impact in year 2000;

– For 10% collection rate (as reported in WEEE Category 6 statistics for 2008): aggregated environmental impact of 597 896 weighted inhabitant-eq corresponding to 0.1288% of overall "EU25 +3" impact in year 2000.

The magnitude of the environmental impacts presented above was taken as a point of reference for comparison of the effectiveness of other two policy options.

Policy Option 2: Immediate withdrawal of the exemption (2013)

The overall magnitude of effectiveness of the Policy Option 2 to achieve the environmental objectives is positive. Depending upon the choice of collection rate and the indicators to calculate the aggregated environmental impact, Policy Option 2 results in 5% to 8% lower overall environmental impact when compared to Policy Option 1. Policy Option 2 also results in 68% less emissions of Cadmium in water. It is therefore strongly positive concerning reduction of Cadmium emissions to water.

Policy Option 3: Delayed withdrawal of the exemption (2016)

The overall magnitude of effectiveness of the Policy Option 3 to achieve the environmental objectives is positive. Depending upon the choice of collection rate and the indicators to calculate the aggregated environmental impact, Policy Option 3 results in 3% to 5% lower overall environmental impact when compared to Policy Option 1. Policy Option 3 also results in 45% less emissions of Cadmium in water. It is therefore positive concerning reduction of Cadmium emissions to water.

6.2. Efficiency

Policy Option 1: "Baseline scenario"

The magnitude of efficiency of the baseline scenario is taken as the point of comparison for the other two policy options and hence assigned a neutral value.

Policy *Option 2: Immediate withdrawal of the exemption (2013)*

The magnitude of cost to achieve the objectives of this Impact Assessment in case of Policy Option 2 is negative for five of the most relevant stakeholders (raw material suppliers, battery pack assemblers, CPT manufacturers, consumers and recyclers) whereas marginal or neutral for retailers and Member State authorities. There are no cost impacts on mining companies and battery cell manufacturing activities in EU.

Policy Option 3: Delayed withdrawal of the exemption (2016)

The magnitude of cost to achieve the objectives of this Impact Assessment in case of Policy Option 3 is slightly negative for raw material suppliers whereas marginal or neutral for majority of the stakeholders (battery pack assemblers, CPT manufacturers, retailers, consumers, recyclers and Member State authorities). There are no cost impacts on mining companies and battery cell manufacturing activities in EU.

6.3. Coherence

Policy Option 1: "Baseline scenario"

The baseline scenario is the continuation of Battery Directive in its current form which is already coherent with the overarching objectives of EU policy.

Policy Option 2: Immediate withdrawal of the exemption (2013)

The Policy Option 2 is coherent with the overarching objectives of EU policy. In addition to the Batteries Directive, the withdrawal of current exemption to portable NiCd batteries use in CPTs is in line with similar requirements on prohibition of Cadmium use in batteries and accumulators in other Directives such as End-of-Life Vehicles (ELV) Directive and Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive, These are further elaborated hereunder:

– ELV Directive[121]: Both the ELV and the Batteries Directive contain substance restrictions. The substance restrictions in Article 4 of the Batteries Directive (for the use of mercury and Cadmium) indicate that these apply without prejudice to the ELV Directive. An exemption for the use of Cadmium in batteries for electric vehicles expired on 31 December 2008.

– RoHS Directive: The Batteries Directive and the RoHS Directive have similar substance restrictions. The RoHS Directive restricts the use of heavy metals, such as mercury and Cadmium in electrical and electronic equipment, however according to Recital (29) of the Batteries Directive, the RoHS Directive does not apply to batteries and accumulators used in electrical and electronic equipment.

Policy Option 3: Delayed withdrawal of the exemption (2016)

The Policy Option 3 is also coherent with the overarching objectives of EU policy (due to same reasons as described for Poicy Option 2).

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[121] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles (OJ L 269, 21.10.2000, p. 34)

6.4. Preferred option

The European CPT market is already in the transitions towards Li-ion battery technology as the most important energy source for CPTs. However, without withdrawal of the current exemption this transition will likely be long lasting and incomplete. It is to be expected that imported cheap NiCd battery driven CPTs would stay on the market for a long time without such a withdrawal of the current exemption.

Withdrawing the exemption would on the one hand lead to positive environmental impacts, but at the same time also to some costs for some economic operators. Policy Option 3 achieves almost the same level of effectiveness at a higher efficiency and is therefore a good candidate for the preferred option.

It also needs to be highlighted that the withdrawal of the current exemption to portable NiCd batteries used in CPTs will foster innovation thus creating opportunities for European companies to play a leading role in the global context.

The withdrawal of the current exemption could support the transition of the European CPT industry towards the Li-ion technology and allow CPT producers to develop new, more powerful applications, to develop new markets, to generate more revenue and to create new jobs.[122]

It is recommended that **Policy Option 3** be implemented for both PRO and DIY markets alike.

The table below summarises the comparison between the three policy options in terms of effectiveness, efficiency and coherence.

Table 10: Comparison of the policy options vs. effectiveness, efficiency and coherence

Option	Policy Option 1	Policy Option 2	Policy Option 3
Effectiveness			
SO 1[123]	Negative	Positive	Positive
SO 2	Negative	Positive	Very positive
OO 1[124]	Negative	Very positive	Very positive
OO 2	Negative	Very positive	Very positive
OO 3	Negative	Positive	Positive
Efficiency			
	Negative	Positive	Very positive
Coherence			
	Yes	Yes	Yes
Conclusion			**Recommended option**

122 ESWI Study, 2010

123 "SO" refers to Specific Objective

124 "OO" refers to Operational Objective

7. SECTION 7: MONITORING AND EVALUATION

In this section, a set of measurable indicators are identified that cover both the quality of the outputs of the policy options their implementation process. The plans for evaluation are also defined. In this way it is ensured that adequate data will be available and that future evaluations focus on the most relevant questions and core progress indicators.

7.1. Core indicators of progress towards meeting the objectives

The core indicators for progress towards meeting the objectives set for this policy initiative are the following:

– The amounts of NiCd batteries and substitute technologies for NiCd batteries used in CPTs placed on the market;

– Recycling and treatment of NiCd batteries and substitute technologies.

7.2. Broad outline for possible monitoring and evaluation arrangements

Monitoring of the possible implementation of a ban on the use of NiCd batteries for CPT should be relatively straightforward, given that under the Batteries Directive, Member States have to report to the Commission on the amounts of batteries and accumulators placed on the market on a yearly basis. There are separate reporting requirements which differentiate per battery chemistry, namely batteries containing mercury, cadmium and lead as regards the recycling of those batteries (recycling efficiency data to be provided annually as well). Based on this data, market trends of substitue technonomogies of NiCd batteries used in CPTs could be distilled. Addition reporting obligations for Member States do not seem necessary at this stage.

In addition, Member States must submit a national implementation report to the Commission every three years as set out in Article 22 of the Batteries Directive. The first report shall cover the period until 26 September 2012. These national implementation reports shall be drawn up on the basis of a questionnaire established in accordance with the procedure referred to in Article 24(2) of the Batteries Directive.In this report, Member States can submit information on main difficulties encountered when implementing the Directive. Such informaton could include compliance costs for industry of the cadmium ban and subsequent costss for consumers if appropriate.

A ban on NiCd batteries for use in CPTs will therefore only be a marginal addition to existing monitoring obligations. These include the requirement for Member States to monitor collection rates including reliable and comparable data on the quantities of batteries and accumulators placed on the market and the quantities collected and recycled (see Article 10 and Article 1(22) of the Batteries Directive).

On the basis of the national implementation reports, the Commission will publish its own report on the implementation of the Batteries Directive and its impact on the environment and the functioning of the internal market.

A review of the Batteries Directive will be carried out after the second round of national implementation reports from Member States. During the evaluation of the reports, the

Commission will examine the appropriateness of further risk management measures, minimum collection targets and minimum recycling obligations, and if necessary propose amendments to the Directive.[125] However, this review will not affect the current withdrawal of the exemption for the use of cadmium in portable batteries and accumualtors intended to be used in cordless power tools, but may look into the use of mercury in batteries and accumulators, in light of recent international developments in this area.

[125] http://europa.eu/legislation_summaries/environment/waste_management/l21202_en.htm

8. GLOSSARY

ARDP	Abiotic esource Depletion Potential
BaU	Business as Usual
BIOIS	BIO Intelligence Service
BRIC	Brazil, Russia, India and China
CLP	Classification, Labelling and Packaging
CMR (substance)	Carcinogenic, mutagenic or toxic for reproduction
CPT	Cordless Power Tools
DEFRA	Department for Environment, Food and Rural Affairs
DYI (consumers)	Do-It-Yourself (consumers)
ELV	End-of-Life Vehicles
EPTA	European Power Tool Association
ERM	Environmental Resources Management
ESWI	Expert Team to Support Waste Implementation
EU25 +3	EU25+ Iceland +Norway+ Switzerland
FAEP	Freshwater Aquatic Ecotoxicity Potential
FEP	Freshwater Eutrophication Potential
GWP	Global Warming Potential
HTP	Human Toxicity Potential
IASG	Impact Assessment Steering Group
IED	Industrial Emissions Directive
$LaNi_5$	Lanthanum Nickel
LCA	Life-Cycle Analysis
$LiFePo_4$	Lithium iron phosphate
Li-Ion	Lithium-ion
LT	Long-term
MS	Member State
NiCd	Nickel-Cadmium
NiMh	Nickel-Metal Hydride
NPV	Net Product Value
OEM	Operation Equipment Manufacturer
PAF	Potentially Affected Fraction
PMFP	Particulate Matter Formation Potential
POFP	Photochemical Oxidant Formation Potential
PRO (consumers)	Professional (consumers)
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (Directive)
RECHARGE	European Rechargeable Battery Association
ROHS	Restriction of Hazardous Substances (Directive)
ST	Short-term
TAP	Terrestrial Acidification Potential
WEEE	Waste Electrical and Electronic Equipment
WTO	World Trade Organization

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