Beryllium Science & Technology Association

Brussels, 07 November 2019

BeST comments to RoHS Annex II Dossier for Beryllium and its compounds.
Restriction proposal for substances in electrical and electronic equipment under RoHS

Executive summary

- BeST endorses the recommendation of Öko Institut not to include beryllium and beryllium oxide (BeO) in Annex II of RoHS based on the high technical importance of beryllium and BeO, the high functional reliability of beryllium-containing alloys and the medium risk during WEEE treatment and disposal.
- BeST agrees with Öko Institut that the scope of the substance assessment should be limited to beryllium metal and BeO.
- The identification and differentiation between the hazards associated with beryllium metal and BeO (insoluble) and those associated with soluble beryllium compounds would allow a more accurate identification and assessment of the hazards and actual risks connected to the presence of beryllium metal and BeO in EEE. The communication of hazards to the public, consumers and workers needs to reflect the form of material present in commerce. Soluble beryllium compounds are not used in EU manufacturing or in any product.
- In order to allow a correct understanding of the report and of the regulatory status quo concerning beryllium metal and BeO, a complete regulatory and legal picture should be described in the report. This will avoid miscommunication with the reader and/or presenting an incomplete illustration of the regulatory situation of the material.
- Chronic Beryllium Disease (CBD) is the adverse health effect associated with occupational overexposure to beryllium airborne particulates. Moreover, the largest and most recent scientific study has demonstrated that beryllium metal and BeO are not carcinogenic. Both these points should be included in the report.
- The existing guidance values included in the report, such as occupational exposure limits (OELs), should not include proposed recommendations or recommendations that are not based on sound science and were never implemented into actual regulations.
- The report should only contain statements and information supported by sound scientific evidence. All opinions, statements, assumptions and observations not scientifically supported should be removed.
- The recently adopted EU wide binding OEL for beryllium and its inorganic compounds and the implementation of the industry-led voluntary product stewardship programme already fulfill the final recommendations of the report and have the objective of ensuring the continued safe use and handling of beryllium in its important applications.

Beryllium Science & Technology Association aisbl • Avenue Marnix 30 • B-1000 Brussels• Belgium
Tel: +32 (0)2 213 74 20• e-mail:info@beryllium.eu • www.beryllium.eu

Beryllium Science & Technology Association

Introduction

The Beryllium Science and Technology Association, hereafter BeST, represents the suppliers of beryllium metal, beryllium-containing alloys and beryllium oxide ceramics in the EU market and has the objective of promoting sound policies, regulations, science and actions related to the use of beryllium as well as promoting good practices in the workplace, in order to better protect workers handling beryllium-containing materials.

BeST fully endorses the recommendation of Öko Institut not to include beryllium and BeO in Annex II of RoHS. Indeed, BeST is strongly supportive of the conclusions of Report No. 5 dedicated to Beryllium and compounds which illustrates the "*high technical importance of the substances [beryllium and BeO]*" and the "*medium risk*" during WEEE treatment and disposal. These conclusions are consistent with the outcome of the Risk Management Option Analysis (RMOA) conducted by the German Federal Institute for Occupation Safety and Health (BAuA) in 2016[1] which concluded that the societal impacts of a general or even partial ban of beryllium would be disproportionate.

However, discrepancies and inaccurate statements in the report, especially the numerous unsupported assumptions, suppositions and opinions, require BeST to provide specific comments to address these issues.

The comments below reflect BeST's recommendations on the RoHS Annex II dossier (hereinafter report) prepared by Öko Institut for beryllium and its compounds in the frame of the Study for the review of the list of restricted substances and to assess a new exemption request under Directive 2011/65/EU (RoHS 2) – Pack 15.

Comments

1. **The identification and differentiation between the hazards associated with beryllium metal and BeO and those referring to soluble beryllium compounds would allow a more accurate identification and assessment of the hazards and actual risks connected to the presence of beryllium metal and BeO in EEE.**

As identified in the report, the European Regulation No. 1272/2007 on Classification, Labelling and Packaging (CLP) contains a harmonised classification for beryllium and compounds in Annex VI. The mentioned group entry (Beryllium and compounds) inevitably classifies soluble and insoluble forms of beryllium as having equivalent health risks. However, the form of beryllium imported and used in the EU is exclusively insoluble and does not present the same risks as soluble forms. Table 1 provides the applicable CLP classifications based on the most current and best scientific evidence for beryllium metal, soluble beryllium compounds and beryllium oxide. As an example, the most recent and definitive cancer studies conducted by Dr. Boffetta (2014, 2016, 2019) provides clear evidence of no increased risk of lung cancer in case of occupational exposure to insoluble beryllium forms, therefore concluding that insoluble forms of beryllium are not carcinogenic. Additionally, the results of the required assessments conducted under the REACH registration process for beryllium and contained in the REACH registration dossier[2] further support the applicable classifications for insoluble forms of beryllium.

In addition, the hazard classes and category codes indicated in table 1-4 "*Classification according to part 3 Annex VI, Table 3.1 (list of harmonised classification and labelling of hazardous substances) of Regulation (EC) No. 1272/2008"*[3] do not apply to beryllium metal and BeO. Indeed, the hazard classes and category codes of Acute Tox. 2, Acute Tox. 3, STOT SE 3, Skin Irrit. 2, Eye Irrit. 2 and Skin Sens. 1 are solely associated with soluble beryllium compounds.

Given the sole presence of beryllium metal, alloys and BeO in EEE and the scope of RoHS, it is beneficial to limit the assessment to the hazards which are scientifically attributed to only these insoluble forms of beryllium. All stakeholders deserve the most scientifically accurate assessment of potential health risks.

[1] BAuA RMOA Beryllium 2016
[2] REACH Registration Dossier for Beryllium
[3] Ref. page 11 of the report

An example of the beneficial impact of the above can be found in section 7 of the report, dedicated to "*Impact and risk evaluation*", where there is a clear overestimation of the hazards associated with beryllium metal and BeO by referring to the group entry present in the CLP regulation and not distinguishing between soluble and insoluble forms of beryllium.[4]

Finally, BeST highlights that the physical state indicated for beryllium oxide in table 1-3. entitled "*physico-chemical properties*"[5] should not specify "*100% (solid white powder)*" as BeO is mostly found in commerce as a solid compact form.

Table 1
Applicable CLP Classifications Based on the Most Current Scientific Evidence

Chemical Identification	CAS No	Classification	
		Hazard Class and Category Code(s)	Hazard statement Code(s)
Beryllium	7440-41-7	~~Carc. 1B~~ ~~Acute Tox. 2 *~~ ~~Acute Tox. 3 *~~ STOT RE 1 ~~Eye Irrit. 2~~ ~~STOT SE 3~~ ~~Skin Irrit. 2~~ ~~Skin Sens. 1~~	~~H350i~~ ~~H330~~ ~~H301~~ H372** ~~H319~~ ~~H335~~ ~~H315~~ ~~H317~~
Beryllium Compounds	—	Carc. 1B Acute Tox. 2 * Acute Tox. 3 * STOT RE 1 Eye Irrit. 2 STOT SE 3 Skin Irrit. 2 Skin Sens. 1 Aquatic Chronic 2	H350i H330 H301 H372** H319 H335 H315 H317 H411
Beryllium Oxide	1304-56-9	~~Carc. 1B~~ ~~Acute Tox. 2 *~~ ~~Acute Tox. 3 *~~ STOT RE 1 ~~Eye Irrit. 2~~ ~~STOT SE 3~~ ~~Skin Irrit. 2~~ ~~Skin Sens. 1~~	~~H350i~~ ~~H330~~ ~~H301~~ H372** ~~H319~~ ~~H335~~ ~~H315~~ ~~H317~~

[4] Ref. page 39 of the report
[5] Ref. page 9 of the report

2. **In order to allow a correct understanding of the report and of the regulatory status quo concerning beryllium metal and BeO, a complete regulatory and legal picture should be described in the report. This will avoid miscommunication with the reader and/or presenting an incomplete illustration of the regulatory situation of the material.**

Section 1.3.1 dedicated to "*Regulation of the substance under REACH*"[6] must also include reference to the RMOA conducted by the BAuA in 2016, which followed the CoRAP Evaluation[7] mentioned in the report.

The above is relevant in order to correctly portray the regulatory situation of beryllium metal, alloys and BeO given that, as a result of the RMOA process, BAuA did not identify beryllium as a substance of very high concern (SVHC), consequently not recommending authorisation, and did not propose a restriction under REACH. This is also confirmed in the final part of the report.[8]

Furthermore, in its RMOA conclusions, BAuA determined that the risk associated with the exposure to beryllium is limited to the workplace and, therefore, the implementation of an EU wide binding Occupational Exposure Limit (OEL), and a complementary voluntary product stewardship programme by the industry, represented the best regulatory option to effectively protect workers processing beryllium imported in the EU, processed primarily by small and medium enterprises.

Consistent with BAuA's RMOA conclusions, beryllium was considered for regulation under the EU Carcinogen and Mutagen Directive (CMD), as correctly indicated in the report.[9] However, the regulatory process for the adoption of the OEL for beryllium is not fully illustrated given that the report does not mention the regulatory steps that followed the recommendation of the Scientific Committee on Occupational Exposure Limits (SCOEL).

Indeed, following the recommendation of SCOEL, the regulatory process for the recommendation of an EU OEL for a specific material includes an assessment and recommendation by the Advisory Committee on Safety and Health (ACSH), a tripartite body representative of the workers, employers and government authorities. In the specific case of beryllium, the opinion adopted by the ACSH recommended a transitional OEL of 0.6 micrograms per cubic meter of air (µg/m^3) – inhalable fraction 8-hour Time Weighted Average (TWA) to be reduced to an OEL of 0.2 µg/m^3 – inhalable fraction 8-hour TWA after the transitional period.[10] Unlike SCOEL, the ACSH takes into account scientific information as well as socio-economic factors and technical feasibility in its recommendation. That is why this opinion is of the highest importance in the regulatory process and should not be excluded in the report.

On the basis of the SCOEL recommendation and the ACSH opinion, the EU institutions ultimately adopted a binding EU OEL for beryllium and its inorganic compounds of 0.6 µg/m^3 – inhalable fraction 8-hour TWA which applies for a seven-year transitional period (until 11 July 2026), to be lowered to 0.2 µg/m^3 – inhalable fraction 8-hour TWA after 11 July 2026.[11]

BeST firmly stresses that the measures implemented in line with BAuA's RMOA conclusions, – the EU wide binding OEL and the voluntary worker protection programme launched by industry - have the objective of addressing the occupational risks associated with the processing of beryllium-containing materials so as to allow the continued use of the material in its very important applications. BAuA's recommendation for the voluntary product stewardship programme does **not** include a recommendation to phase out the use of beryllium by manufactures, on the contrary it aims to allow the continued use and safe handling of the material by workers.

In response to BAuA's request, the beryllium industry, through the Beryllium Science & Technology Association (BeST), has developed the Be Responsible Voluntary Product Stewardship Programme –

[6] Ref. page 14 of the report
[7] BAuA RMOA Beryllium 2016
[8] Ref. page 39 of the report
[9] Ref. page 14 of the report
[10] ACSH opinion on Beryllium and Compounds
[11] Carcinogens and Mutagens Directive – EU Official Journal – 20 June 2019

www.berylliumsafety.eu - to formally engage employers, workers, trade unions and governmental authorities in a cooperative arrangement that seeks to continuously improve workers safety during the production and processing of beryllium-containing materials.[12] The Be Responsible Programme was launched in March 2017 and, as requested by BAuA, BeST is continually evaluating its effectiveness.

By exclusively referencing the SCOEL recommended value of 0.02 µg/m^3 – inhalable fraction 8-hour TWA in the narrative of the report and not citing the OEL value for beryllium recommended by the ACSH and ultimately adopted by the EU in the frame of the CMD, the report portrays an incomplete and incorrect regulatory status quo which misinforms the reader and negatively impacts the public perception of the material.

BeST therefore urges Öko Institut to update sections 1.3.1 and 1.3.2. respectively dedicated to "*Regulation of the substance under REACH*" and "*Occupational Exposure Limits (OELs)*" to include the above information in order to portray the complete and accurate regulatory situation of beryllium.

3. The report should refer to official or scientific data. Reference to or the use of non-governmental lists should be excluded as these are not based on sound scientific evidence and evaluation and therefore may be biased, incorrect and misleading.

As already commented in the previous stakeholder consultations in the frame of study Pack15, it is of pivotal importance to implement a hierarchy of the sources used in the assessment of substances for their potential restriction under the RoHS Directive. The relevance of non-governmental lists, such as NGO lists – i.e. the SIN list – should be limited, if not considered completely irrelevant, as these lists are not based on sound scientific evidence and evaluation.[13]

In addition, in the interest of accuracy, BeST urges the Öko Institut to clarify that beryllium is included in the Global Automotive Declarable Substance List (GADSL) as a declarable substance (D), not a prohibited substance,[14] and information is collected for non-regulatory purposes (FI). [15] The lack of the mentioned specifications induces the reader to erroneously assume that the substance is prohibited under GADSL.

4. Beryllium metal and beryllium-containing alloys (in particular CuBe – copper beryllium alloys) feature different unique properties, consequently these are used in different applications on the basis of the desired performance of the product. These properties are confused in the report and generally associated indistinctively to both beryllium metal and beryllium-containing alloys.

When discussing the function of the substances and its properties in the report,[16] the different properties of beryllium metal and of beryllium-containing alloys are confused. Indeed, the excellent electrical conductivity, non-magnetic and non-sparking properties, the excellent formability, machinability and joinability as well as the good corrosion and oxidation resistance refer to beryllium containing alloys, in particular copper beryllium, while X-Ray Transparency, light weight, stiffness, and stability at high temperatures (melting point 1 284°C) are properties of pure beryllium metal.

BeST therefore would greatly appreciate the correction of the above in the report.

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[12] Be Responsible Programme – www.berylliumsafety.eu

[13] Ref. page 15 of the report, section 1.3.4 "*Non-governmental initiatives*"

[14] Ref. page 15 of the report, section 1.3.4 "*Non-governmental initiatives*"

[15] Declarable substance classification – "***P = Prohibited*** *- A substance designated "P" is prohibited for all automotive uses in at least one region / market, or may not exceed a regulated threshold limit for all automotive uses in at least one region / market.*
D = Declarable *- A substance designated "D" must be declared if it exceeds the defined threshold limits.*
D/P = Declarable or Prohibited *- A substance designated as "D/P" has both allowed uses and prohibited uses in at least one region/market."* Moreover, "*When a substance is classified D three reason codes are possible: D/LR: reporting is required by a regulation; D/FA: it is being assessed by a regulatory agency for possible but not necessarily probable restriction or; D/FI: information is being collected for non-regulatory process.*" Beryllium has a classification code "D" and a reason code "FI"

[16] Ref. page 16 of the report, section 2.1 "*Function of the substance*"

5. The beryllium industry, the REACH registration dossier and the Be Responsible Voluntary Product Stewardship Programme advise against the use of beryllium in dental prothesis.

The report identifies dental prothesis as an application example of the use of beryllium and BeO[17] in the Bio-Medical and Industrial Devices Sector (RoHS categories 8,9). This application is strongly discouraged. Indeed, BeST brings to Öko Institut's attention that the Beryllium industry advises against the use of beryllium in dental prothesis and a similar recommendation is present in the REACH registration dossier.[18]

It is therefore unclear why the report would refer to an application that is clearly advised against by both industry and regulators.

Consequently, the inclusion of dental protheses as example of a medical and industrial device application of beryllium should be removed, even if not in the scope of RoHS.[19]

6. BeST endorses the confirmation that the scope of the substance assessment should be limited to beryllium metal and BeO.

BeST is fully supportive of the statement "*beryllium metal and beryllium oxide represent the only scope significant for the RoHS directive".*[20] Indeed these are the only two forms of beryllium present in EEE.

BeST highlights that the reference to the lack of data on possible applications of beryllium as intermediary material use in production processes in the course of EEE supply chains is not relevant to this assessment as it falls outside the scope of RoHS.[21]

7. Chronic Beryllium Disease (CBD) is the only adverse health effect associated with occupational overexposure to beryllium airborne particulates. Moreover, as mentioned above, the largest and most recent scientific study has demonstrated that the insoluble forms of beryllium are not carcinogenic. Therefore, when assessing the human health hazard profile of beryllium, the report should exclusively refer to CBD as the associated adverse health effect.

The SCOEL recommendation, referenced throughout the report, erroneously identifies beryllium sensitisation (BeS) as the adverse critical health effect linked to occupational overexposure to beryllium. Indeed, scientific evidence established by medical researchers and government agencies concludes that BeS has no symptoms, no health effects and no illness.[22] This is also confirmed by the fact that BeS occurs in approximately 1% of the general population that is not occupationally exposed to beryllium and that is able to conduct their lives without any health consequences. Therefore, the critical health effect to be controlled at the workplace, through the recently adopted EU binding OEL, is CBD and not BeS.

In section 3 of the report, dedicated to "*Human health hazard profile*", there are several references to "*CBS*" as a potential health issue associated to exposure to airborne beryllium. However, the acronym is not explained in the text.[23] Indeed, reference to chronic beryllium sensitisation (CBS) is incorrect and is not a term used or defined in the scientific literature. This terminology and speculative inference should be removed from the report.

[17] Ref. page 19 of the report, section 2.2 "*Types of applications/types of materials*", Table 2-1 "*Overview of relevant application areas of beryllium and beryllium oxide"*, sector (bio-)Medical and industrial devices (RoHS categories 8,9)
[18] REACH registration dossier – Manufacture, use and exposure - uses advised against
[19] Ref. page 19 of the report, section 2.2 "*Types of applications/types of materials*", Table 2-1 "*Overview of relevant application areas of beryllium and beryllium oxide"*, sector (bio-)Medical and industrial devices (RoHS categories 8,9)
[20] Ref. page 23 of the report, section 2.2 "*Types of applications/types of materials"*
[21] Ref. page 23 of the report, section 2.2 "*Types of applications/types of materials"*
[22] NIOSH: "No health symptoms are associated with beryllium sensitization." NIOSH Alert, "Preventing Sensitization and Disease from Beryllium Exposure" (Feb. 2011)
[23] Ref. page 26-28 of the report, section 3.1 "*Critical end point"*

On carcinogenicity and genotoxicity of beryllium, BeST would like to submit to Öko Institut's attention the already mentioned recent scientific studies (Boffetta 2014, 2016, 2019) demonstrating that the insoluble forms of beryllium are not carcinogenic. In particular, this applies to beryllium metal and BeO, the only two forms of beryllium commercialized in the EU.[24]

In addition, the statement "*single exposure to high beryllium concentrations (>100 µ/m³) can cause acute beryllium disease (ABD) in humans"* is incorrect as ABD can only be caused by high exposures to soluble compounds of beryllium during the extraction processes at the primary producers. Soluble beryllium compounds are not imported to the EU.[25]

8. The number of potentially exposed workers is overestimated in the report.

The report states that "[i]n the EU, 65, 000 workers are potentially exposed to beryllium."[26] This number is vastly overestimated compared to the assessment of the beryllium industry. Indeed, between 2014 and 2015 BeST conducted surveys of member states, Norway and Switzerland to assess the extent of employee exposure to beryllium metal and BeO. According to the outcome of the survey, BeST estimates that approximately 15 000 workers are potentially exposed to beryllium airborne particles in the EU, due to the intentional use of beryllium containing materials.

9. The existing guidance values included in the report, such as OELs, should not include recommendations that were never implemented into actual regulation.

In the overview of existing OELs for beryllium and beryllium compounds in EU countries, the ANSES recommendation was never adopted as regulation.[27] Similarly, both NIOSH and ACGIH are also recommendations that were never adopted as regulation.[28] In fact, the ACGIH clearly states that its TLVs should only be viewed "as an expression of scientific opinion".

When conducting the assessment of materials for potential restriction under RoHS, updated, correct and governmental information should be identified and included in the report in order to reflect correctly the current regulatory situation and avoid misinformation.

Finally, BeST would like to draw Öko Institut's attention to the fact that OELs for beryllium exist in other countries outside the EU and is some cases have been recently revised - i.e. China.[29] Therefore, even in the case of amounts of beryllium exported in second-hand EEE to non-EU countries, quantities of beryllium are very small, and workers are expected to be effectively protected by the existing OELs.[30]

10. In response to the specific stakeholder question on amounts and concentration of beryllium and BeO incorporated in specific EEE components, please refer to the below table as an example.

Application	Alloy	Weight CuBe (g)	Weight Be (g)
Relays	CuNi2Be	7	0.042
Switches. sensors	CuBe2	6	0.120
Connectors	CuBe2	18	0.360
Total for a 1000kg vehicle		31g	0.522g/T (ppm)

[24] Ref. page 28 of the report, section 3.1 "*Critical end point"*
[25] Ref. page 27 of the report, section 3.1 "*Critical end point"*
[26] Ref. page 28 of the report, section 3.2 "*Existing Guidance values (DNELs, OELs)"*
[27] Ref. page 28 of the report, section 3.2 "*Existing Guidance values (DNELs, OELs)"*
[28] Ref. page 29 of the report, section 3.2 "*Existing Guidance values (DNELs, OELs)"*
[29] China's National Health Commission updated OELs
[30] Ref. page 32 of the report, section 5.1 "*Description of waste streams"*

11. In response to the specific stakeholder question on the recycling of beryllium, BeST recalls its comments submitted in the frame of the 2018 1st RoHS stakeholder consultation and refers to the BeST recycling infographic[31] available on the BeST Website

In general, it is highly unusual for pure beryllium metal and beryllium oxide ceramic to directly enter the normal metals recycling stream, mostly because of its relatively small use and high monetary value as a clean scrap metal. It should be noted that the applications of beryllium metal and BeO ceramics are highly specialised, and highly technological, rather than commercial or consumer in nature.

Pure beryllium metal components used in technological applications have extremely long lifetimes, and therefore return to the recycle stream very slowly or do not return at all (e.g. applications in space). When pure beryllium components do finally return, they can be easily recycled. Production scrap from operations such as machining or stamping of copper beryllium alloys is gathered and returned for recycling. In all cases, the recycling of beryllium metal results in a significant energy saving of over 70% compared to extracting beryllium from ore.

Recovery of beryllium metal from beryllium-containing alloys in EEE (for example, the copper beryllium components included in end of life electronics) is not performed because of the small size of the components and the relatively low beryllium content per device (less than 40 ppm, even in devices with the highest beryllium alloy content).

The most prevalent use of beryllium in the EU occurs in copper beryllium alloys (CuBe), which contain between 0.2% and 2% beryllium, offering the best possible combination of mechanical strength and electrical conductivity in EEE. CuBe alloys that are not able to be separated because it is embedded in a device that is not disassembled at the end of its product life is normally processed in the copper waste recovery process. The processing of low beryllium content electronic/electrical devices in the general copper waste stream is usually done via melting which results in forming slag containing most of the beryllium content from the melt, and the dilution of any remaining beryllium to levels comparable to new copper metal.

A study on the recycling of beryllium and the occupational exposure of workers to beryllium in the electronic recycling industry was published in 2014. The report presents the results of a quantitative airborne metal exposure survey conducted on workers shredding, picking and separating WEEE in a specialized, modern recycling facility in the United Kingdom. The results of personal lapel samples collected and analyzed for beryllium during shredding, picking and separating operations were below the level of analytical detection (0.007 microgram/sample) and therefore well below the current and future EU OELs. The results of the occupational exposure assessment coupled with the analysis of the beryllium content of the electrical and electronic equipment demonstrate that processing WEEE utilising modern processing techniques represents minimal risk of exposure to beryllium.[32]

In light of the above, BeST would like to bring to Öko Institut's attention that recycling of Be, BeO and CuBe alloys from EEE present a low potential impact to the health of workers, the environment or the purity of the recycled material, i.e. copper.

Furthermore, BeST notes that its members directly recover through buy back programs production scrap from their customers. This scrap is collected, sorted, and sent back to US or Japan to be recycled into new strips, rods, wires or master alloys used by the industry. The recovery activity is growing in the EU and contributes to an environmentally friendly circular economy. These recovery and recycling activities are generally conducted by organisations that are aware of the potential inhalation risk in the workplace and which implement efficient

[31] BeST recycling infographic

[32] Theodore l. Knudson, CIH Materion Brush Inc. and Huw Wilkins, LFOH Huw Wilkins Associates LLC, An Evaluation of Airborne Beryllium Exposures during recycling of waste electrical and electronic equipment (WEEE), Published in the Proceeding of the 13th International Electronic Recycling Congress (IERC), Salzburg, Austria, January 23, 2014 - Link

and effective risk management measures. This recycling process is therefore a way for BeST members to better control the exposure risk by avoiding external recycling operators.

12. The report should only use information and statements that can be supported by sound scientific evidence. Statements that are theoretical, speculative, or inaccurate should be removed.

As an example, BeST highlights that sliding contact brushes are enclosed in (closed) protective boxes. Therefore, any potential exposure due to abrasion, would be very limited. This is confirmed by the lack of any objections from CuBe users of this kind of applications. The quote from the Argibay et al (2010) study cited in the report has been taken out of context and is not the reflective of the study's outcome which concluded that CuBe has an excellent abrasion resistance.[33] This is confirmed by the WEILAND patent which states that "*the use of copper–beryllium (UNS C17200) was demonstrated as a low wear, highly compliant material for the construction of high current density metal fiber brushes… Relatively clean contact resistance data at the end of the test is indicative of the robustness of the brush design and the ability of the fiber tips to remain in contact with the evolving slip-ring surface*".[34]

In section 5.4., the statement "*mechanical-physical shredding and sorting under badly controlled operation regime could distribute traces of Be-alloys and BeO across several output fractions. This may also include fractions that are not usually expected to contain beryllium (such as separated plastics (ABS, PVC).*"[35] is not supported by any of the scientific data referenced in the report and therefore is of speculative nature.

Similarly, the below statements included in Section 5.5. are presumptions, not supported by data and highly unlikely given the small amounts of beryllium contained in EEE and that, given the melting point of CuBe, it is very unlikely that it would be melted in "open burning".

"*Workers are hardly protected against skin contact to chemicals and residues and airborne fumes. Thus, human and environmental exposure to soluble and insoluble beryllium compounds appears likely to occur. Specific information on quantities of WEEE processed under circumstances described above is not available nor is there any data on releases of beryllium and Be-compounds. It can be assumed that beryllium, among other hazardous chemicals emerging in the course of uncontrolled open burning and chemical leaching might be only a relatively small contributor to the serious health and environmental problems related to crude WEEE recycling*" [36]

In addition, the statement included in section 6. "*The release occurs usually in form of airborne dust which can cause occupational exposure and environmental pollution of soil and water bodies*"[37] is not supported by science. The report does not refer nor mention any scientific study supporting the above statement.

Several unsupported assumptions are also contained in the sections 6.1. and 6.2[38].

Finally, the statement "*it can be concluded that exposure to airborne beryllium might occur during the use phase of consumer EEE that contain high power electrical motors due to wear and tear of beryllium bearing sliding brushes*"[39] is speculative as this single, very specific and **unverified** use of CuBe is not representative of an actual risk for the consumer of EEE containing beryllium. Similarly, the statement "*short term exposure peaks cannot be ruled out and depend on the processing technology and safeguard measures applied*"[40] is highly speculative

[33] Ref. page 35-26 of the report, section 5.4 "*Releases from WEEE treatment processes"*
[34] Weiland patent sliding contacts
[35] Ref. page 35 of the report, section 5.4 "*Releases from WEEE treatment processes"*
[36] Ref. page 36 of the report, section 5.5 "*Releases from WEEE treatment processes in developing countries"*
[37] Ref. page 37 of the report, section 6 "*Exposure estimation during WEEE treatment"*
[38] Ref. page 37 of the report, section 6.1 "*Basis of exposure estimation"* and page 38 of the report, section 6.2 *"Human exposure estimation"*
[39] Ref. page 39 of the report, section 7 "*Impact and risk evaluation"*
[40] Ref. page 39 of the report, section 7 "*Impact and risk evaluation"*

and not supported by science. In particular, BeST would like to draw Öko Institut's attention to the lack of any STEL recommendation for beryllium and compounds under the CMD.[41]

All statements contained in this report should be scientifically supported or otherwise removed.

13. BeST is supportive of the several statements in the report highlighting the high functional reliability of beryllium containing alloys.

When addressing alternatives, BeST highlights that by not using Beryllium in EEE, manufacturers are likely to produce products that will fail prematurely which is contrary to other regulatory initiatives such as the Circular Economy. Where commercial issues (i.e. competitive pricing) overtake the performance measures (i.e. long life), manufacturers will choose the less expensive option even when not in the best interest of society. Therefore, substitution is possible, however, this can result in an inferior product, loss of performance and is contrary to good environmental management of our natural resources.

The statement "*[a]s compared to potential substitutes, beryllium is a relatively expensive raw material and necessitates the implementation of expensive measures for occupational safety and pollution reduction throughout the production chain*"[42] is erroneous in terms of "pollution reduction" as beryllium does not have a negative impact on the environment. It is to note that small and medium enterprises working with copper beryllium alloys generally work with a large range of metals and alloys (nickel, cadmium, lead etc..) which also require "measures for occupational safety" such as exhaust ventilation systems. Therefore, the related cost is not only due to the use of beryllium.

14. The recently adopted EU wide binding OEL for beryllium and its inorganic compounds and the implementation of the industry-led voluntary product stewardship programme already fulfill the final recommendations of the report and have the objective of ensuring the continued safe use and handling of beryllium in its important applications.

According to the report, "*SCOEL and DG Employment are encouraged to prioritize setting an OEL for beryllium. This implies the adoption of emission controls and exposure reduction measures in the WEEE recycling industry throughout, as suggested by BAUA (2016). The SCOEL (2017) suggested 8-hour TWA (Time weighted averages) 0.02 µg/m inhalable beryllium fraction should be endorsed by EU".*[43]

BeST brings to Öko Institute's attention that beryllium was already considered for regulation under the EU Carcinogen and Mutagen Directive (CMD) and an EU wide binding OEL for Beryllium was adopted and published on the EU Official Journal on 20 June 2019.[44] Indeed, as mentioned several times above in these comments and in the report, the EU adopted a binding OEL for beryllium and compounds of 0.2 µg/m^3 – inhalable fraction 8 Hour Time Weighted Average with a transitional OEL of 0.6 µg/m^3 applicable until 11 July 2026 in order to aid industry to comply with the new occupational exposure limit.

BeST also draws your attention, once again, to the EU procedure for setting a binding OEL where the recommendation of the SCOEL is subsequently followed by additional scientific review and evaluation, including a socio-economic impact assessment and the opinion of the ACSH. By exclusively referencing the SCOEL recommended value of 0.02 µg/m^3 – inhalable fraction 8-hour TWA and not citing the OEL value for beryllium recommended by the ACSH and ultimately adopted by the EU in the frame of the CMD, the report portrays an incomplete and incorrect regulatory status quo which negatively impacts the public perception of the material by circulating erroneous information.

[41] Carcinogens and Mutagens Directive – EU Official Journal – 20 June 2019
[42] Ref. page 41 of the report, section 7.1 "*Availability of substitutes/alternative technologies*"
[43] Ref. page 45 of the report, section 9 "*Rationale for inclusion of the substances in Annex II of RoHS*"
[44] Carcinogens and Mutagens Directive – EU Official Journal

The report also recommends that "*EEE manufacturers should commit to a voluntary reduction of beryllium in products. The development and implementation of a voluntary product stewardship program towards a phase out of beryllium was suggested by BAUA (2016) as a way to avoid the classification of beryllium and compounds as SVHC under REACH. A similar approach is recommended here to avoid restriction under RoHS. The beryllium content in many EEE products can be lowered to below 1,000 ppm as numerous large EEE manufacturer in the sector of consumer electronics have demonstrated (see Table 0-2). The voluntary measures should be adopted by the whole EEE sector, at least OEM and industrial EEE suppliers should reconsider possible alternatives to beryllium in the light of functional and design requirements*".[45]

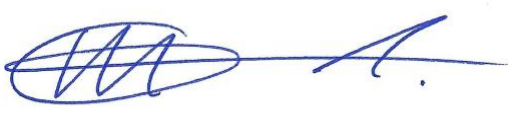
As mentioned above, the measures already adopted – the EU wide binding OEL and the voluntary worker protection programme launched by industry - have the objective of adequately addressing the occupational risks associated with the processing of beryllium-containing materials so **as to allow the continued use** of the material in its very important applications. BAuA's recommendation for the voluntary product stewardship programme does **not** include a recommendation to phase out the use of beryllium by manufacturers, on the contrary it aims to allow the continued use and safe handling of the material by workers.

In addition, in reference to the policy of various smartphones manufacturers[46], the long-term reliability and environmental benefits of EEE containing beryllium is not considered by most manufacturers who prefer short product cycles. This marketing decision has led to the phase out of beryllium from many of these products. The reality is that presumed environmental and health issues has little or, even, no impact on their marketing strategies.

This is confirmed by the report's conclusions, stating that substitution of beryllium is possible but generally translates to reduced performance, higher energy consumption or unsuitable alternatives in a given application context.[47] Overall, the Öko Institute did not evaluate the beneficial performance characteristics of using beryllium alloys in EEE. Therefore, Öko Institute should remove its broad statements giving general guidance as to the appropriate use of beryllium-containing alloys, or concentrations of beryllium in EEE.

In past RoHS reviews of beryllium in EEE, BeST was given the opportunity to proactively meet with the Öko Institute to help ensure a sound scientific basis for its final report. That opportunity was not provided in this review. We respectfully request that BeST be provided an opportunity to meet with the Öko Institute to further explain these comments and to provide any additional scientific evidence as needed. We look forward to scheduling such a meeting with the Öko Institute in the near future.

Respectfully submitted,



Maurits Bruggink
Director EU Affairs
Beryllium Science & Technology Association

[45] Ref. page 45 of the report, section 9 "*Rationale for inclusion of the substances in Annex II of RoHS"*

[46] Ref. page 26 of the report, section 7.1 "*Availability of substitutes/alternative technologies"*, Table 0-2 "*Overview of various EEE manufacturers and their corporate policies regarding substitution of beryllium"*

[47] Ref. page 44 of the report, section 7.3 "*Data basis for alternatives and uncertainties"*