Study to assess 3 exemption requests (one for mercury and two for lead) (Pack 13) – Final - amended

Under the Framework Contract: Assistance to the Commission on technical, socio-economic and cost-benefit assessments related to the implementation and further development of EU waste legislation

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Disclaimer

Oeko-Institut and Fraunhofer IZM have taken due care in the preparation of this report to ensure that all facts and analysis presented are as accurate as possible within the scope of the project. However, no guarantee is provided in respect of the information presented, and Oeko-Institut and Fraunhofer IZM are not responsible for decisions or actions taken on the basis of the content of this report.

EUROPEAN COMMISSION

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1. Executive summary – English

Under Framework Contract no. ENV.A.2/FRA/2015/0008, a consortium led by Oeko-Institut was requested by DG Environment of the European Commission to provide technical and scientific support for the evaluation of exemption requests under the new RoHS 2 regime. The work has been undertaken by the Oeko-Institut and Fraunhofer Institute IZM, and has been peer reviewed by the two institutes.

1.1. Background and objectives

The RoHS Directive 2011/65/EU entered into force on 21 July 2011 and led to the repeal of Directive 2002/95/EC on 3 January 2013. The Directive can be considered to have provided for two regimes under which exemptions could be considered, RoHS 1 (the former Directive 2002/95/EC) and RoHS 2 (the current Directive 2011/65/EU).

- The scope covered by the Directive is now broader as it covers all electrical and electronic equipment (EEE; as referred to in Articles 2(1) and 3(1));
- The former list of exemptions has been transformed in to Annex III and may be valid for all product categories according to the limitations listed in Article 5(2) of the Directive. Annex IV has been added and lists exemptions specific to categories 8 and 9;
- The RoHS 2 Directive includes the provision that applications for exemptions have to be made in accordance with Annex V. However, even if a number of points are already listed therein, Article 5(8) provides that a harmonised format, as well as comprehensive guidance – taking the situation of SMEs into account – shall be adopted by the Commission; and
- The procedure and criteria for the adaptation to scientific and technical progress have changed and now include some additional conditions and points to be considered. These are detailed below.

The new Directive details the various criteria for the adaptation of its Annexes to scientific and technical progress. Article 5(1)(a) details the various criteria and issues that must be considered for justifying the addition of an exemption to Annexes III and IV:

- The first criterion may be seen as a threshold criterion and cross-refers to the REACH Regulation (1907/2006/EC). An exemption may only be granted if it does not weaken the environmental and health protection afforded by REACH;
- Furthermore, a request for exemption must be found justifiable according to one of the following three conditions:
  - Substitution is scientifically or technically impracticable, meaning that a substitute material, or a substitute for the application in which the restricted substance is used, is yet to be discovered, developed and, in some cases, approved for use in the specific application;

  - The reliability of a substitute is not ensured, meaning that the probability that EEE using the substitute will perform the required function without failure for a period of time comparable to that of the application in which the original substance is included, is lower than for the application itself;
  - The negative environmental, health and consumer safety impacts of substitution outweigh the benefits thereof.
- Once one of these conditions is fulfilled, the evaluation of exemptions, including an assessment of the duration needed, shall consider the availability of substitutes and the socio-economic impact of substitution, as well as adverse impacts on innovation, and life cycle analysis concerning the overall impacts of the exemption; and
- A new aspect is that all exemptions now need to have an expiry date and that they can only be renewed upon submission of a new application.

Against this background, and taking into account that exemptions falling under the enlarged scope of RoHS 2 can be applied for since the entry into force of the Directive (21.7.2011), the consultants have undertaken evaluation of a range of exemptions in this work (new exemption requests and exemption renewal requests).

1.2. Key findings – Overview of the evaluation results

The exemption requests covered in this project and the applicants concerned, as well as the final recommendations and proposed expiry dates are summarised in Table 1-1. The reader is referred to the corresponding section of this report for more details on the evaluation results.

The – not legally binding – recommendations for the exemption requests for exemption renewal (Ex. 1(g)) and new exemptions (Ex. 2017-1 and Ex. 2017-2) were submitted to the EU Commission by Oeko-Institut and have already been published at the EU CIRCA website on 6 March 2019. So far, the Commission has not adopted any revision of the Annex to Directive 2011/65/EU based on these recommendations.

Table 1-1: Overview of the exemption requests, associated recommendations and expiry dates

Ex. Req. No.	Requested exemption wording	Applicant	Recommendation	Expiry date and scope
Existing exemptions				
Annex III, 1(g)	Mercury in single – capped (compact) fluorescent lamps for general lighting purposes < 30 W with a lifetime equal or above 20 000 h: 3,5 mg. 5 years (Max)	Lighting Europe	Ex. 1: Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):	
			1(g): For general lighting purposes < 30 W with a lifetime equal or above 20 000 h: 3,5 mg	The exemption should be revoked. A transition period of 18 months should be granted for Cat. 5
Requests for new exemption				
2017-1	Lead in solder used to make electrical connections to vacuum boards used in Mass Spectrometers. Boards designed to be used periodically under low pressure. 5 years	AB Sciex	Exemption request withdrawn	
2017-2	Use of lead in welds for soldering of certain printed circuit board assemblies in gas detectors	Oldham SAS	Exemption request denied	

Note: As in the RoHS legal text, commas are used as a decimal separator for exemption formulations appearing in this table, in contrast to the decimal point used throughout the rest of the report as a separator.

2. Executive summary: French - Note de synthèse: Français

Conformément aux termes du contrat-cadre ENV.A.2/FRA/2015/0008, un consortium mené par l'Oeko-Institut a été chargé par la direction générale (DG) de l'environnement de la Commission européenne afin d'apporter son concours technique et scientifique à l'évaluation des demandes d'exemption suivant le nouveau régime de la directive RoHS 2. Les travaux ont été réalisés par l'Oeko-Institut et le Fraunhofer IZM (Institut Fraunhofer pour la fiabilité et la micro-intégration), et fait l'objet d'un examen par des pairs des deux instituts.

2.1. Contexte et objectifs

La directive RoHS 2011/65/UE est entrée en vigueur le 21 juillet 2011, ce qui a entraîné l'abrogation de la directive 2002/95/CE le 3 janvier 2013. Il est possible de considérer que la directive a prévu deux régimes qui ont permis de prendre en compte les exemptions, à savoir le régime RoHS 1 (l'ancienne directive 2002/95/CE) et le régime RoHS 2 (la directive actuelle 2011/65/UE).

- Le champ d'application couvert par la directive est désormais plus large sachant qu'il englobe l'intégralité des équipements électriques et électroniques (EEE ; tel que mentionné dans les articles 2(1) et 3(1));
- L'ancienne liste d'exemptions a été transformée en annexe III et est susceptible de s'appliquer à toutes les catégories de produits conformément aux limitations énumérées dans l'article 5(2) de la Directive. L'annexe IV a été ajoutée et énumère les exemptions spécifiques aux catégories 8 et 9;
- La directive RoHS 2 inclut la disposition selon laquelle les demandes d'exemption doivent être déposées conformément aux termes de l'annexe V. Cependant, même si un certain nombre de points sont déjà énumérés dans cette annexe, l'article 5(8) prévoit qu'un format harmonisé et des lignes directrices détaillées prenant en compte la situation des PME, seront adoptés par la Commission européenne; et
- La procédure et les critères relatifs à l'adaptation au progrès scientifique et technique ont fait l'objet de modifications et comportent désormais certains points et conditions supplémentaires qu'il est nécessaire de prendre en considération. Ces derniers sont détaillés ci-dessous.

La nouvelle directive détaille les différents critères relatifs à l'adaptation de ses annexes au progrès scientifique et technique. L'article 5(1) énumère les différents critères et questions qui doivent être considérés pour justifier l'ajout d'une exemption aux annexes III et IV:

- Le premier critère est susceptible d'être perçu comme un critère de seuil et renvoie au règlement REACH (1907/2006/CE). Une exemption peut uniquement être accordée si elle ne fragilise pas la protection environnementale et sanitaire offerte par le règlement REACH;

- De plus, une demande d'exemption doit être déclarée légitime selon l'une des trois conditions suivantes:
  - Une substitution est irréalisable d'un point de vue scientifique ou technique. Autrement dit, un matériau de substitution ou un substitut pour l'application dans laquelle la substance faisant l'objet d'une restriction est utilisée, doit encore être découvert, développé et, dans certains cas, jugé apte à une utilisation dans l'application spécifique;
  - La fiabilité d'un substitut n'est pas garantie. En d'autres termes, la probabilité que les EEE recourant à un substitut assurent la fonction requise sans connaître de défaillance pendant une durée comparable à celle de l'application dans laquelle la substance d'origine est incluse, est inférieure à celle de l'application;
  - Les impacts négatifs de la substitution sur l'environnement, la santé, et la sécurité des consommateurs l'emportent sur ses avantages.
- Dès lors que l'une de ces conditions est remplie, l'évaluation des exemptions, estimation de la durée nécessaire comprise, devra tenir compte de la disponibilité des substituts et de l'impact socio-économique de la substitution, ainsi que les effets néfastes sur l'innovation et une analyse du cycle de vie concernant les impacts globaux de l'exemption; et
- Le fait que toutes les exemptions doivent désormais présenter une date d'expiration et qu'elles peuvent uniquement être renouvelées après soumission d'une nouvelle demande, constitue un aspect inédit.

Face à un tel contexte, et compte tenu du fait que les exemptions soumises au champ d'application élargi de la Directive RoHS 2 peuvent être demandées depuis l'entrée en vigueur de la directive (le 21 juillet 2011), les experts ont réalisé l'évaluation d'un éventail d'exemptions dans le cadre de la présente mission (nouvelles demandes d'exemption et demandes de renouvellement d'exemption).

2.2. Les principales conclusions – Synthèse des résultats de l'évaluation

Les demandes d'exemption couvertes dans le présent projet et les demandeurs concernés, de même que les recommandations finales et les dates d'expiration proposées, sont résumées dans le Tableau 2-1 ci-après. Le lecteur est invité à se référer à la section correspondante du présent rapport pour plus de détails sur les résultats de l'évaluation.

Les recommandations – non contraignantes d'un point de vue juridique– faites en relation avec les demandes de renouvellement d'exemptions (Ex. 1 (g)) et aux demandes de nouvelles exemptions (Ex. 2017-1 et Ex. 2017-2) ont été soumises à la Commission européenne par l'Oeko-Institut et ont déjà fait l'objet d'une publication le 6 mars 2019 sur la plateforme Internet « CIRCA » de l'UE. Jusqu'à présent, la Commission n'a pas procédé à de quelconque révision de l'annexe à la Directive 2011/65/UE sur la base de ces recommandations.

Tableau 2-1: Récapitulatif des demandes d'exemption, des recommandations associées et des dates d'expiration

Traduction en français fournie par souci de commodité. En cas de contradictions entre la traduction française et la version originale anglaise, cette dernière fait foi.

Dem. ex. n°	Termes de l'exemption demandée	Demandeur	Recommandation	Date d'expiration et champ d'application
Exemptions en vigueur				
Annexe III, 1(g)	Mercure à usage d'éclairage général de moins de 30 W et à durée de vie égale ou supérieure à 20 000 h: 3,5 mg. Max. 5 ans.	Lighting Europe	Ex. 1: mercure dans les lampes fluorescentes (compactes) à simple culot ne dépassant pas (par brûleur):	
			1(g) : À usage d'éclairage général de moins de 30 W et à durée de vie égale ou supérieure à 20 000 h: 3,5 mg	L'exemption devrait être annulée. Une période de transition de 18 mois devrait être accordée pour la catégorie 5.
Demandes de nouvelles exemptions				
2017-1	Plomb présent dans les fers à souder utilisés pour la mise en œuvre des raccordements électriques des planches sous vide présentes dans les spectromètres de masse Planches conçues pour une utilisation régulière en basse pression. 5 ans.	AB Sciex	Retrait de la demande d'exemption	
2017-2	Plomb présent dans les soudures réalisées dans les assemblages de certaines plaques et cartes conductrices imprimées se trouvant dans les détecteurs de gaz.	Oldham SAS	Demande d'exemption rejetée	

3. Introduction

3.1. Project scope and methodology

The scope of the project covers the evaluation of one existing exemption and two requests for new exemptions

- Mercury in single – capped (compact) fluorescent lamps for general lighting purposes
  < 30 W with a lifetime equal or above 20 000 h: 3,5 mg. (Annex III, 1 g).
- Lead in solder used to make electrical connections to vacuum boards used in Mass Spectrometers. Boards designed to be used periodically under low pressure. (Exemption Request 2017-1)
- Use of lead in welds for soldering of certain printed circuit board assemblies in gas detectors. (Exemption Request 2017-2)

For details of the exemption requests see Table 1-1 in the Executive Summary.

In the course of the project, a stakeholder consultation was conducted. The stakeholder consultation was launched on 26 September 2017 and held for the duration of 8 weeks, thus concluding on 7 November 2017.

The specific project website was used in order to keep stakeholders informed on the progress of work: http://rohs.exemptions.oeko.info. The consultation was carried out according to the principles and requirements of the European Commission. Stakeholders who had registered at the website were informed through email notifications about new steps within the project.

Information concerning the consultation was provided on the project website, including a general guidance document, the applicants' documents for each of the exemption requests, results of earlier evaluations where relevant, a specific questionnaire and a link to the EU CIRCA website. In the course of the study at hand, no contributions were made to any of the exemptions.

Following the stakeholder consultation, an in depth evaluation of the exemptions began. The requests were evaluated according to the relevant criteria laid down in the RoHS 2 Directive, as shown in the Executive Summary in Section 1.

Within this period, the applicants of Ex. Re. 2017-1 and Ex. Re. 2017-2 withdrew their requests. The evaluation of the two requests was discontinued, seeing as stakeholders had not submitted any contributions in favour of these requests, and it was concluded that the exemptions were not necessary for the applicants equipment of for that of other manufacturers.

The evaluation of exemption 1(g) of Annex III appears in section 5. The information provided by the applicants and by stakeholders is summarised in the first sections. This includes a general description of the application and requested exemption, a summary of the arguments made for justifying the exemption, information provided

concerning possible alternatives and additional aspects raised by the applicants and other stakeholders. The Critical Review follows these sections, in which the submitted information is discussed, to clarify how the consultants evaluate the various information and what conclusions and recommendations have been made. For more detail, the general requirements for the evaluation of exemption requests may be found in the technical specifications of the project.[1]

3.2. Project set-up

Assignment of project tasks to Oeko-Institut, started 30 June 2017. The overall project has been led by Yifaat Baron. At Fraunhofer IZM the contact person is Otmar Deubzer.

[1] Cf. http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_pack_13/Service_Request___ToR_17-3-2017_TechnicalSpecifications_pack13.pdf

4. Links from the Directive to the REACH Regulation

Article 5 of the RoHS 2 Directive 2011/65/EU on "Adaptation of the Annexes to scientific and technical progress" provides for the

> "*inclusion of materials and components of EEE for specific applications in the lists in Annexes III and IV, provided that such inclusion does not weaken the environmental and health protection afforded by Regulation (EC) No 1907/2006*".

RoHS 2 does not further elaborate the meaning of this clause.

Regulation (EC) No 1907/2006 regulates the safe use of chemical substances, and is commonly referred to as the REACH Regulation since it deals with **R**egistration, **E**valuation, **A**uthorisation and Restriction of **Ch**emical substances. REACH, for its part, addresses substances of concern through processes of authorisation and restriction:

- Substances that may have serious and often irreversible effects on human health and the environment can be added to the candidate list to be identified as Substances of Very High Concern (SVHCs). Following the identification as SVHC, a substance may be included in the Authorisation list, available under Annex XIV of the REACH Regulation: "List of Substances Subject to Authorisation". If a SVHC is placed on the Authorisation list, companies (manufacturers and importers) that wish to continue using it, or continue placing it on the market, must apply for an authorisation for a specified use. Article 22 of the REACH Regulation states that: *"Authorisations for the placing on the market and use should be granted by the Commission only if the risks arising from their use are adequately controlled, where this is possible, or the use can be justified for socio-economic reasons and no suitable alternatives are available, which are economically and technically viable."*
- If the use of a substance (or compound) in specific articles, or its placement on the market in a certain form, poses an unacceptable risk to human health and/or to the environment that is not adequately controlled, the European Chemical Agency (ECHA) may restrict its use, or placement on the market. These restrictions are laid down in Annex XVII of the REACH Regulation: "Restrictions on the Manufacture, Placing on the Market and Use of Certain Dangerous Substances, Mixtures and Articles". The provisions of the restriction may be made subject to total or partial bans, or other restrictions, based on an assessment of those risks.

The approach adopted in this report is that once a substance has been included into the regulation related to authorisation or restriction of substances and articles under REACH, the environmental and health protection afforded by REACH may be weakened in cases where, an exemption would be granted for these uses under the provisions of RoHS. This is essentially the same approach as has already been adopted for the re-evaluation of some existing RoHS exemptions 7(c)-IV, 30, 31 and 40,[2] as well as for

[2] See Zangl, S.; Blepp, M.; Deubzer, O. (2012): Adaptation to Scientific and Technical Progress under Directive 2011/65/EU - Transferability of previously reviewed exemptions to Annex III of Directive

the evaluation of a range of requests assessed through previous projects in respect of RoHS 2.[3] Substances for which an authorisation or restriction process is underway may be discussed in some cases in relation to a specific exemption, in order to check possible overlaps in the scope of such processes and of requested RoHS exemptions and to identify the need for possible alignments of these two legislations.

When evaluating the exemption requests, with regard to REACH compliance, we have checked whether the substance / or its substitutes are:

- on the Community Rolling Action Plan;
- on the list of substances of very high concern (SVHCs- the Candidate List);
- in the recommendations of substances for Annex XIV (recommended to be added to the Authorisation List);
- listed in REACH Annex XIV itself (the Authorisation List); or
- listed in REACH Annex XVII (the List of Restrictions).

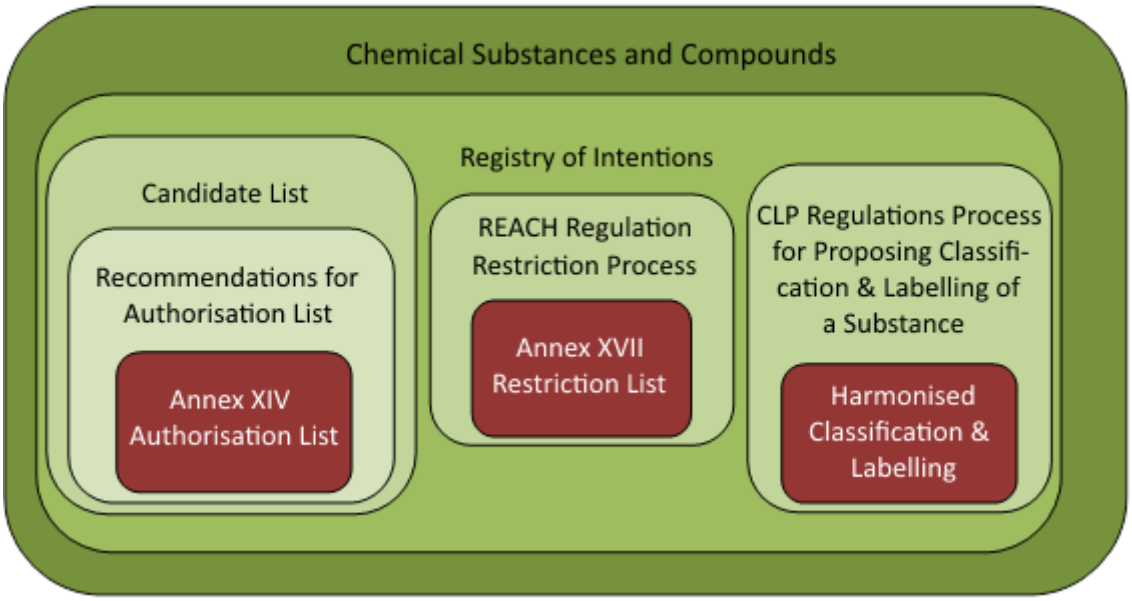
As the European Chemicals Agency (ECHA) is the driving force among regulatory authorities in implementing the EU's chemicals legislation, the ECHA website has been used as the reference point for the aforementioned lists, as well as for the exhaustive register of the amendments to the REACH Legal Text.

Figure 4-1 shows the relationship between the two processes under REACH as well as the process on harmonized classification and labelling under the CLP regulation (Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging). Substances included in the red areas may only be used when certain specifications and or conditions are fulfilled.

2011/65/EU, Final Report, Oeko-Institut e.V. and Fraunhofer IZM, February 17, 2012, http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Re-evaluations_transfer_RoHS_I_RoHS_II_final.pdf

[3] Gensch, C., Baron, Y., Blepp, M., Deubzer, O., Manhart, A.; Moch, K. (2012): Assistance to the Commission on technological, socio-economic and cost-benefit assessment related to exemptions from the substance restrictions in electrical and electronic equipment (RoHS Directive), Final Report, Oeko-Institut e.V. and Fraunhofer IZM, 21.12.2012, http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/RoHS_V_Final_report_12_Dec_2012_final.pdf

Figure 4-1: Relation of REACH Categories and Lists to Other Chemical Substances



Source: Own illustration

Prior to the Registry of Intentions shown in the figure above, there are additional activities and processes in order to identify substances of potential concern conducted by the ECHA together with the Member States and different ECHA Expert Groups.[4] If a Member State evaluates a certain substance to clarify whether its use possesses a risk to human health or the environment the substance is subject of a Substance Evaluation. The objective is to request further information from the registrants of the substance to verify the suspected concern. Those selected substances are listed by ECHA in the community rolling action plan (CoRAP).[5] If the Substance Evaluation concludes that the risks are not sufficiently under control with the measures already in place and if a Risk Management Option (RMO) analyses does not conclude that there are appropriate instruments in place through other legislation / actions, the substance will be notified in the Registry of Intentions.

The following bullet points explain in detail the above mentioned lists and where they can be accessed:

- Member States Competent Authorities (MSCAs) / the European Chemicals Agency (ECHA), on request by the Commission, may prepare Annex XV dossiers for identification of Substances of Very High Concern (SVHC), Annex XV dossiers for proposing a harmonised Classification and Labelling, or Annex XV dossiers proposing restrictions. The aim of the public Registry of Intentions is to allow

[4] For an overview of these activities and processes see the ECHA webpage under: https://echa.europa.eu/substances-of-potential-concern

[5] Updates and general information can be found under: https://echa.europa.eu/information-on-chemicals/evaluation/community-rolling-action-plan/corap-list-of-substances. The list can be found on the following page: https://echa.europa.eu/information-on-chemicals/evaluation/community-rolling-action-plan/corap-table

interested parties to be aware of the substances for which the authorities intend to submit Annex XV dossiers and, therefore, facilitates timely preparation of the interested parties for commenting later in the process. It is also important to avoid duplication of work and encourage co-operation between Member States when preparing dossiers. Note that the Registry of Intentions is divided into three separate sections: listing new intentions; intentions still subject to the decision making process; and withdrawn intentions. The registry of intentions is available at the ECHA website at: https://echa.europa.eu/registry-of-intentions;

- The identification of a substance as a Substance of Very High Concern and its inclusion in the Candidate List is the first step in the authorisation procedure. The Candidate List is available at the ECHA website at: https://echa.europa.eu/candidate-list-table;
- The last step of the procedure, prior to inclusion of a substance into Annex XIV (the Authorisation list), involves ECHA issuing a Recommendation of substances for Annex XIV. The ECHA recommendations for inclusion in the Authorisation List are available at the ECHA website at
  http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list;
- Once a decision is made, substances may be added to the Authorisation List available under Annex XIV of the REACH Regulation. The use of substances appearing on this list is prohibited unless an Authorisation for use in a specific application has been approved. The Annex can be found in the consolidated version of the REACH Legal Text (see below);
- In parallel, if a decision is made concerning the Restriction on the use of a substance in a specific article, or concerning the restriction of its provision on the European market, then a restriction is formulated to address the specific terms, and this shall be added to Annex XVII of the REACH Regulation. The Annex can be found in the consolidated version of the REACH Legal Text (see below); and
- As of 14 September, 2018, the last amendment of the REACH Legal Text (Appendices to Annex XVII) is dated from 02 May 2018 (Commission Regulation (EU) No 2018/675) and has been taken into consideration: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1532946798646&uri=CELEX:32018R0675. The most recent updated consolidated version of the REACH Legal Text, dated 9 May 2018, was used to check Annex XIV and XVII: The consolidated version is presented at the EUR-Lex website: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02006R1907-20180509

Relevant annexes and processes related to the REACH Regulation have been cross-checked to clarify:

- In what cases granting an exemption could "weaken the environmental and health protection afforded by Regulation (EC) No 1907/2006" (Article 5(1)(a), pg.1)
- Where processes related to the REACH regulation should be followed to understand where such cases may become relevant in the future;

In this respect, restrictions and authorisations as well as processes that may lead to their initiation, have been reviewed, in respect of where RoHS Annex II substances are mentioned (i.e. lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).[6]

Compiled information in this respect has been included, with short clarifications where relevant, in Tables 1-2, which appear in Appendix 1.

The information has further been cross-checked in relation to the various exemptions evaluated in the course of this project. This has been done to clarify that the Article 5(1)(a) pg. 1 threshold-criteria quoted above is complied with in cases where an exemption is to be granted / its duration renewed/ its formulation amended/ or where it is to be revoked and subsequently to expire as an exemption. The considerations in this regard are addressed in each of the separate chapters in which the exemption evaluations are documented (Chapter 5) under the relevant section titled "REACH compliance – Relation to the REACH Regulation" (Section 5.5.1).

[6] This review currently does not address the 4 phthalates, DEHP, BBP, DBP and DIBP, which according to Commission Delegated Directive (EU) 2015/863 of 31 March 2015, have been added to the Annex. Information regarding these substances shall be added in future reviews.

5. Annex III, Exemption 1(g)

"Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):

For general lighting purposes < 30 W with a lifetime equal or above 20 000 h: 3,5 mg"

Declaration

In the sections that precede the "Critical review", the phrasings and wordings of stakeholders' explanations and arguments have been adopted from the documents provided by the stakeholders as far as required and reasonable in the context of the evaluation at hand. Formulations were only altered in cases where it was necessary to maintain the readability and comprehensibility of the text. These sections are based exclusively on information provided by applicants and stakeholders, unless otherwise stated. Commas are used as a decimal separator when quoting/proposing exemption formulations (as in the RoHS legal text), in contrast to the decimal point used throughout the rest of the report as a separator.

Acronyms and definitions

BAU	Business as usual (scenario)
CFL	Single capped (compact) fluorescent lamps
CFLi	CFL with integrated ballast
CFLni	CFL with non-integrated ballast
EEE	Electrical and electronic equipment
EoL	End-of-life
Hg	Mercury
LE	LightingEurope
RoHS 2	Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment
SUB	Substitution (scenario)

5.1. Background

LightingEurope (LE) requests the renewal of exemption 1(g) of Annex III of the RoHS directive, for the maximum possible validity period (i.e. 5 years) proposing to maintain the current wording of the exemption. (LE 2016)

The exemption appears under Ex. 1 of Annex III of the directive as follows:

> *"Ex. 1: Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):*
>
> *[...]*
>
> *1(g) For general lighting purposes < 30 W with a lifetime equal or above 20 000 h: 3,5 mg Expires on 31 December 2017"*

Generally, in compact fluorescent lamps (CFL), mercury provides the function of emitting a spectral output which is then transferred into visible light. In this process, the mercury is consumed over the lifetime of the lamp and thus lamps are dosed with a certain amount of mercury to ensure a minimum service life. Lamps falling under the scope of Ex. 1(g) have "a lifetime equal or above 20 000 hours", which according to LE requires more mercury than standard CFL lamps. Up to 3.5 mg of mercury may be present in lamps placed on the market in the scope of this exemption. LE justifies the need for the exemption to remain valid with the lacking availability of substitutes. (LE 2016)

5.1.1. Amount of mercury used under the exemption

To estimate the amount of mercury placed on the European market per annum, LE (2016) provides the following data:

- The VHK report 'Preparatory Study on Light Sources for Ecodesign and/or Energy Labelling Requirements ('Lot 8/9/19'), Draft Interim Report, Task 2, indicates a total volume of CFL lamps in EU 28 of 342 million pieces in 2013. This volume includes all power ratings[7].
- Based on experience of the LE members, CFL lamps < 30 W with long life account for approximately 2-3% of the total CFL volumes in Europe.
- The maximum allowed mercury content for CFL lamps < 30 W with long-life is 3.5 mg. The average dose is below this value to ensure that all lamps meet the 3.5 mg boundary (see below).
- Combining these numbers indicates that in 2016 (3% * 222 Mpcs * 3.5 mg) a maximum of 23.3 kg of mercury has entered the EU market (market volume in pieces taken from VHK report for EU).

[7] LE (2016) provides the following reference to this statement: Preparatory Study on Light Sources for Ecodesign and/or Energy Labelling Requirements ('Lot 8/9/19'). Draft Interim Report, Task 2 by Prepared by VHK, in cooperation with VITO and JeffCott Associates Date: 19 Nov 2014, Table 1.

- The McKinsey study as used in the VHK report[8] gives a rough forecast of volumes in 2020. Using these volumes in the calculation of the maximum amount of mercury entering to EU market with CFLs < 30 W with long life gives the following result: 2020: (3% * 93 Mpcs * 3.5 mg) = 9.8 kg

LE emphasizes that this is an estimation based on the upper limit threshold value permitted through the existing exemption. In reality LE assumes that the amount entering the market will be lower as the average dose per lamp is most often below this threshold value. LE estimates the average mercury content per lamp to be roughly 20% below the threshold value. It is also noted that the total amounts shall decrease from year to year in light of the expected increase in the penetration of LED technologies to the EU market.

5.2. Description of requested exemption

A small amount of mercury is intentionally dosed in all fluorescent lamps as it is essential for the low-pressure gas discharge. When electric current flows through the lamp bulb (=burner), the mercury atoms inside are excited and produce UV radiation. This UV light is then converted into visible light by the fluorescent coating on the lamp bulb. Mercury is present in the so-called burner. The mercury is instrumental in the conversion of electrical energy into the UV radiation, which is converted subsequently by a phosphor into the emitted visible light. (LE 2016)

Mercury is dosed in the burner during lamp manufacturing as homogeneous material (pill, capsule) or as amalgam. The amount of mercury dosed per lamp depends on aspects like lamp dimensions (i.e. tube length and form), lamp power, optical performance and anticipated lamp life, etc. Furthermore, processing is explained to have an influence, because the actual dose per lamp scatters around the nominal dose, while the threshold value as set by RoHS directive sets a maximum limit. For single capped compact fluorescent lamps in the scope of the Exemptions 1(g), the maximum dosed mercury amount is set at 3.5 mg. Standard lifetime lamps (such as those covered under Ex. 1(a)[9]) can properly reach their defined lifetime with a dose of max 2.5 mg. Long life lamps require higher mercury dosing to realize the lifetime extension to prevent early failing during operation. In this case a max level of 3.5 mg (40% above the Ex. 1(a) threshold of 2.5 mg) ensures the long life lamp functionality throughout a lifetime between 20 000 hours and up to 60 000 hours. Compared to standard lifetime lamps, the mercury balance of long-life CFL per lumen*hour is thus explained to be equal or better. (LE 2016)

Most of the lamps covered by exemption 1(g) are used for professional applications in offices, public buildings, shops and street lighting, for general lighting. The use of

[8] LE 2016 provides the following reference to this statement: Preparatory Study on Light Sources for Ecodesign and/or Energy Labelling Requirements ('Lot 8/9/19'). Draft Interim Report, Task 2 by Prepared by VHK, in cooperation with VITO and JeffCott Associates; Date: 19 Nov 2014, Table 29.

[9] Ex. 1(a) of Annex III of the RoHS Directive is formulated as follows:
"Ex 1: Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):
1(a) For general lighting purposes < 30 W: 2.5 mg"

long-life lamps is directed to areas where lamp replacement is difficult and expensive due to high ceilings, special luminaire design for critical application requirements or in cases, where replacement of lamps could disturb for example continuously running production processes. Also applications where safety of people is at stake e.g. heavy duty industry halls, chemical industry and oil platforms requiring very reliable long life specifications. At locations with long operating times of the lighting equipment (24 hours a day), the CFL long-life lamps are also preferred. (LE 2016)

Further characteristics mentioned by LE in their application are detailed below.

- When asked whether all lamps covered by this exemption have a non-integrated ballast (CFLni), LE (2017a) responded that "there are also several types of CFLi lamps under the scope of this exemption. These lamps are used for instance in high ceilings, oil platforms, halls, stairways and emergency lights in luminaires with lightbulb fixtures of type E27 (see Figure 5-1). They are used in applications in which they are difficult, dangerous and expensive to reach [in case of replacement].
- In most compact fluorescent lamps < 30 W with a lifetime equal or above 20 000 hours the electronic control gear is not integrated in the product (self-ballasted CFLs or CFLi-s) but is separated from the lamp (plug-in CFLs or CFLni-s). (LE 2016)
- CFL lamps in general have a colour rendering index (CRI) above 80 and are available in a wide range of colour temperatures from extra warm white (2200K) to cool daylight (6500K). Some of the lamps have a higher CRI for specific applications. Lamps used in different applications have light output and energy efficiency in the range of 150-2500 lm, 50-80 lm/W. (LE 2016)

Figure 5-1 shows examples of typical lamps and illustrates the variety of possible lamp fixtures (CFLni and CFLi).

Figure 5-1: Typical lamps (left) and possible lamp fixtures (right)

Source: LE (2016)

5.3. Applicant's justification for exemption

In relation to the availability of substitutes, LE (2016) claims that the replacement of mercury in CFL is scientifically and technically impracticable:

- The potential to reduce the amounts of mercury needed per burner in various lamp types has been realised over the years, as the change in mercury thresholds of RoHS exemptions attests. Further reductions are not expected, also in light of the shift of research investments for new developments from discharge lamps to LED technologies.
- Though various attempts were made in the past to find substance level substitutes for mercury in discharge lamps (e.g., noble gases), none of these was found to be suitable in terms of the lamp performance provided (i.e., comparable lifetime, spectral output, energy consumption, etc.). Here too, research was discontinued once the first energy efficient LED white light sources came onto the market.
- The lighting market is rapidly changing from discharge lamp technology to LED technology.
  - LED based lamps are not fully compatible to replace conventional CFL lamps in existing applications, i.e. are not suitable drop-in replacements.
  - Alternatively, installed luminaires can be replaced with LED luminaires, however resulting in extra costs and environmental burden in relation to cases where lamp replacement is possible.

Both LED options are explained to require lead in materials and electronic applications currently exempted according to Annex III of the RoHS Directive.

In relation to reliability, LE (2016) states that the substitution of CFLs or the corresponding fixtures with LED-based solutions requires in most cases qualified professionals to perform the installation (i.e. where the luminaire needs to be rewired or converted in order to "accept" the LED alternative). Though lamp manufacturers cannot ensure the level of performance of such activities, LE admits that correctly installed LED based lamps and luminaires are considered to be reliable.

As for alternatives having possibly higher total negative environmental, health and consumer safety impacts, LE (2016) states that consumer safety is given if LED-based lamps are installed according to the manufacturers advise. LE claims that though recent life cycle analysis (LCA) studies show that LED based lamps have comparable energy efficiency, they cannot be considered as more beneficial to the environment in all situations. This is said to require analysis on a case by case basis to see whether a fluorescent lamp can be technically replaced and whether the substitute LED based lamp can fully fulfil all required functionalities. LE claims that removing CFL lamps from the market would force early refurbishment of the lighting system or even new luminaire investments, which would unnecessarily and dramatically increase the waste.

5.3.1. The availability of LED alternatives for long-life CFL

LE (2016) explains that CFL lamps are installed in a huge variety of types, shapes, sizes, wattages and colours. For just a few of these types, LED retrofit solutions are entering the market. It cannot be expected that LED retrofit solutions will be developed for the total of this complex and scattered landscape with often small series per type. New installations are nearly exclusively realized today in LED technology (i.e., with new LED luminaires with integrated light sources). Given this trend, the motivation to develop LEDs with standard lamp fixtures (see Figure 5-1) for the total portfolio is low.

LE raises various limitations regarding the properties of available LED alternatives to demonstrate why it is not practical to expect the available LED alternatives to be compatible with the full variety of lamps covered by the scope of Ex. 1(g). These are shortly summarised below – further details can be found in the application.

- CFL lamps are more of **omnidirectional** nature, while LEDs by nature emit their light more directionally, possibly affecting the light distribution of luminaires in which LED alternatives are installed;
- In existing luminaires, **reflectors** have been designed for the shape, dimensions and burning position of a CFL lamp to generate the desired light distribution and may **not be compatible** with LED alternatives;
- Some CFL luminaires are designed for 2 lamps. Differences in **size** of the LED alternatives can cause problems in fitting both lamps in the luminaire;
- Current lamp holders are designed to carry the **weight** of the existing CFL lamps. LED lamps can have a higher weight and bending moment than CFL lamps due to the necessary heat sink which needs to be close to the LEDs to remove the heat from the diodes, and thus their weight may exceed that of CFLs;
- Luminaires for CFL are designed for the **thermal** properties of a CFL lamp and not to control the heat as required for dedicated LED lamps. Particularly in closed and/or narrow CFL luminaires this could result in thermal problems;
- Possible **electric non-compatibility** of LED replacements with driver components, dimming function of existing luminaires, etc.;
- There is a **lack of standards** for LEDs which aim to replace CFLs with external ballast.

Where alternatives are not available to allow a drop – in replacement, additional substitution routes are named that could result in additional impacts in terms of costs and generated WEEE:

- In some cases a **rewiring/conversion** of the luminaire could allow it to "accept" LED alternatives as replacements. This shall require costs for a professional making the conversion as well as also resulting in some components becoming WEEE prior to the end of their expected lifetime;
- In cases where replacement is not possible with a lamp (drop-in/rewiring), the luminaire would need to be **replaced with a new luminaire** and can be expected to result in higher costs in light of the equipment costs as well as possible costs for

the de-installation of the original luminaire and installation of the new one (some luminaires are installed in recessed ceilings, in cases of an array a full replacement of the ceiling may be needed to produce the same lighting pattern, etc.). This would also result in an early end-of-life of the luminaire, i.e., in the generation of additional WEEE.

In particular LE (2016) raises concern as to the availability of substitutes for long-life CFL with a non-integrated ballast (CFLni), which are manufactured with a larger variety of fixtures and drivers, but in relatively small volumes. LE do not expect the development of LED substitutes for the complete product portfolio to be possible as "*there is no sufficient market for many of the lamp types to develop, qualify and certify the specific lamps in the quality needed in these mainly professional applications*".

Regarding long-life non-integrated CFLs, there is no single LED retrofit lamp available that addresses all the parameters of the original CFL in terms of wattage, colour temperature, socket, lumen output and switching cycles, not even within a 10% tolerance range. Therefore, in the case of CFLni, no LED retrofit (substitute) exists. (LE 2017a)

As regards the availability of long-life LEDs for replacing CFL covered by this exemption, LE states that long-life LED lamps exist, but frequently these are not a direct replacement for existing CFLi versions because of differences in shape factor, light distribution, weight of the lamp. LED retrofit equivalents are restricted to limited products of the portfolio that can address all the relevant parameters such as wattage, colour temperature, socket and lumen output of CFLs, within a 10% tolerance range. (LE 2017a)

The LED lifetime has still to be proven on a large scale in real applications as those described above, time is needed to build the confidence with the customers to make the transition to the new technology. For 98% of the CFL market there is no LED retrofit lamp available that could be plugged into the existing CFLni sockets. Only 2% of the CFL market has a socket into which a LED lamp can be plugged in, but in this case the lumen output is half of the original. (LE 2017a)

5.3.2. Environmental arguments

LE give reference to several LCA studies performed regarding lighting (see application for details). It is stated that there is general agreement, that the main environmental impact (i.e., related to lamps) is created during the use phase, meaning through electricity consumption when burning the lamp[10]. LE explains that at present there are various difficulties with LCA comparisons of lamps and particularly in relation to the comparison of CFLs and LEDs. Nonetheless, it is stated that LED sources are expected to have a real advantage in the total life cycle over time, at least if energy efficiency keeps improving at the same rate and expected long lifetime is proven. (LE 2016)

[10] LE 2016 provides the following reference to this statement: Enlighten report, Section 5, Ch. 3, fig.4 & 5, p. 111-112 http://www.learning.enlighten-initiative.org/ebook/en_lighten_english_complete.pdf

In relation to the possible impacts related to waste, LE explains that single capped (compact) fluorescent lamps are in the scope of EU Directive 2012/19/EU (WEEE) (Recast) and that take back systems are installed in all EU Member States to support the proper collection and recycling of lamps. The WEEE targets for minimum collection are set to 45% in 2016 and to 65% by 2020. LE states that current collection is 45% and higher. LE also points to the possible risk of additional WEEE being generated as a result of a forced phase-out of lamps covered by Ex. 1(g): in cases where LED alternatives shall not be compatible with existing luminaires, this may result in the luminaire being scrapped before it has reached its full lifetime. (LE 2016)

5.3.3. Road map to substitution

As regards the roadmap to substitution, it can be understood that in cases where users decide to replace their luminaires (or are installing new ones), that they already favour LED installations. The exemption is understood to be needed for owners of existing CFL luminaires to enable the replacement of lamps in the luminaire once these reach end-of-life. (LE 2016)

LE also states that in general, there is no generic incentive to develop 1:1 replacements in LED technology for every individual CFL lamp type, since the market decides between CFLs and LEDs based on the needed technical (electric, lighting etc.) specifications, the total cost of ownership, and/or based on other criteria e.g. environmental, design, company image considerations. (LE 2017a)

> "*In these kinds of applications, a changeover to LED technology is possible but it is only considered in case of a major overhaul i.e. replacing the entire infra-structure including its lighting. Our prediction is that at least a period of 10 years is expected, assuming a 10-15% annual rate of replacement, and although admittedly, the market is changing rapidly, we envisage a minimum of 5 years*.". (LE 2017a)

5.3.4. Socio-economic aspects

LE states that banning the energy efficient CFL lamps shall lead to increased expenses of EU consumers due to the forced usage of more expensive LED lamps (no cheaper alternative yet) and pre-mature refurbishment in professional applications. This also means a serious reduction of customer choice for energy efficient lighting solutions. Some CFL lamp families are still made in Europe. So not granting the exemption will lead to the closing of these factories in the EU with accompanying loss of jobs (LE 2016).

Within the context of the study on the impact of the new Single Lighting Regulation, the EU consultant VHK (2016) developed the Melissa model, in cooperation with stakeholders (among them LightingEurope). In this model, the CFL long-life lamps are not specified as a single product group, but included with other CFL (i.e. under the CFLi and CFLni sub-groups). A prediction of the stock of the total number of luminaires equipped with CFL long-life lamps might be made by taking 2-3% of the predicted total installed CFL luminaires extrapolated over the next years. (LE 2017a)

LE provide some general statements as to possible impacts of a forced substitution (LE 2017a):

- LE estimates that some of the lamps can be exchanged by LED replacement lamps, while in most cases a change of the luminaire is expected. Costs are caused by higher prices for LED lamps, costs of the luminaires and labour costs.
- For luminaires for long-life lamps, the replacement costs are more difficult to estimate since these luminaires are installed in places where even lamp replacement is difficult or dangerous and continuous operation is needed. In these cases availability of a full retrofit is important, since insurance and safety aspects are essential in these applications.
- A forced substitution is not advised, as there is a very high risk that customers, manufacturers and society would be significantly impacted in terms of technical feasibility, electrical compatibility, safety, waste generation and economic cost. Lack of a LED substitute impacts operations in for example a traffic tunnel, a chemical plant, an oil platform etc.

LE provides the data compiled in Table 5-1 below to provide an estimation of possible costs of a CFLni phase-out.

Table 5-1: Estimated costs of a CFLni forced substitution

Lamps on the market in the commercial, industrial and public sector:				
Lamp type	Lamps on the market		Lamps/fixture	Fixtures
CFLni	619,000,000		1.5	412,666,667
Replacement with LED retrofit, share and costs				
Lamp type	Retrofit share	Product costs	Labour costs	Total costs
CFLni	10%	12.5 €	20 €	30 €
Replacement with LED luminaire, share and costs:				
Lamp type	Retrofit share	Product costs	Labour costs	Total costs
CFLni	90%	75 €	25 €	100 €
Total replacement costs:				
Lamp type	Retrofit	LED luminaire	Total costs	
CFLni	1,341,166,667 €	37,140,000,000 €	38,481,166,667 €	

Source: LE (2017a)

The consultants understand the data to relate to all CFLni on the market and not just those covered by this exemption and furthermore to represent CFLni stock and not sales, as the initial number of lamps in the market (619 million) is almost twice as high as the annual CFL sales of 2013. To set these data in context, in their application, LE (2016) specified that based on experience of its members, CFL lamps < 30 W with long life account for approximately 2-3% of the total CFL volumes in Europe. The annual sales of CFL in 2013 are estimated to be approximately 342 million lamps (VHK 2014). According to the consultants calculations this would suggest that around 10 million CFL are placed on the market per annum through Ex. 1(g). Though they expect some of these lamps to be CFLi, LE states that in most long life CFL covered by Ex. 1(g) the electronic control gear is [...] separated from the lamp (plug-in CFLs or CFLni-s) (LE 2016).

In a later communication LE further specifies the total estimated costs for CFLni covered by exemption 1(g) on the basis of these general costs. "*Taking an estimated time frame of 5 years, we estimate annual costs of 46,103,013,333 € to the public and commercial sectors in the EU (office, retail, education, healthcare, hotels, restaurants, institutions, warehouse, transportation, production, etc.)*". The calculated figure is considered to represent a lower bound for the costs, since replacing the luminaires for long-life lamps is more expensive as they are located in places that are difficult to reach (LE 2017a).

It is not clear on the basis of what assumptions this estimation has been derived. 3% of the total costs specified in Table 5-1 are much lower than the provided estimation stated to be derived from the general costs specified in the table:

3% * 38,481,166,667 €= 1,154,435,000 €

Nonetheless the general costs are understood to relate to all lamps and fixtures on the market, i.e. in stock and not to be related to annual sales.

5.4. Stakeholder contributions

As part of the stakeholder consultation, the European Sign Federation (ESF 2017) submitted a contribution, stating that the renewal request "*shows all the right reasons why the exemption for these single cap CCFLs should be granted [...] we absolutely support the request of Lighting Europe and hope you will do so in your conclusion to the Commission, for a maximum period possible*". The contribution specifies the various reasons for the exemption justification (see document), however these are not reproduced here as they generally outline the various arguments already presented above through the documentation of arguments raised by LE.

5.5. Critical review

5.5.1. REACH compliance – Relation to the REACH Regulation

If granted, the exemption would allow the use of mercury in long-life CFL lamps.

Annex XVII of the REACH Regulation contains several entries restricting the use of mercury compounds:

Entry 18a restricts the use of mercury:

- in fever thermometers;
- in other measuring devices intended for sale to the general public;
- in a number of specified measuring devices intended for industrial and professional uses.

Seeing as the exemption for long-life CFL does not relate to these applications, it is concluded that a renewal of the exemption would not weaken the protection afforded by REACH through entry 18a.

Entry 62 restricts the use of various mercury compounds (see in the following) and prohibits their manufacture, placing on the market and use, as substances or in mixtures after 10 October 2017 if the concentration of mercury in the mixtures is equal to or greater than 0.01% by weight. Articles and parts thereof, containing one of the compounds in a concentration greater than 0.01% may also not be placed on the market after this date. The following mercury compounds are addressed by this entry:

- (a) Phenylmercury acetate
- (b) Phenylmercury propionate
- (c) Phenylmercury 2-ethylhexanoate
- (d) Phenylmercury octanoate
- (e) Phenylmercury neodecanoate

In the documentation of the consultation on the restriction process[11], it is explained that these substances are mainly used in the production of polyurethane coatings, adhesives, sealants and elastomers. At the time, only phenylmercury neodecanoate was said to be used in significant amounts in the EU. Reference to use in the manufacture of lamps was not made in the restriction process and the consultants thus conclude that this entry would not apply to long-life CFLs. Against this background, it is concluded that a renewal of the exemption would not weaken the protection afforded by REACH through entry 62.

Appendix 1 of this report lists entry 30 in Annex XVII of the REACH Regulation, stipulating that mercury compounds shall not be placed on the market, or used, as substances, constituents of other substances, or in mixtures for supply to the general public. A prerequisite to granting the requested exemption would therefore be to

[11] See consultation document under: https://echa.europa.eu/documents/10162/6b06a424-b250-4818-bf71-28be0a18a9d5

establish whether the intended use of mercury in this exemption request might weaken the environmental and health protection afforded by the REACH regulation. In the consultants' opinion, assuming use according to intended purpose, the presence of mercury in long-life CFLs is not a supply of mercury compounds as a substance, mixture or constituent of other mixtures to the general public. Mercury is part of an article and as such, entry 30 of Annex XVII of the REACH Regulation would not apply.

No other entries, relevant for the use of mercury in the requested exemption could be identified in Annex XIV and Annex XVII (status April 2018). Based on the current status of Annexes XIV and XVII of the REACH Regulation, the requested exemption would not weaken the environmental and health protection afforded by the REACH Regulation. An exemption could therefore be granted if other criteria of Art. 5(1)(a) apply.

5.5.2. Scientific and technical practicability of substitution

LE provides information regarding the potential to reduce the amounts of mercury in long-life CFL and regarding its possible substitution:

LE explains that the potential for reducing the amount of mercury dosed in lamps covered by the exemption has been implemented. This can be followed by the consultants, as has also been addressed in past evaluations of the CFL lamp exemptions (Gensch et al. 2016) and in the recommendations for their renewal with decreasing mercury allowances.

It is also apparent that though an effort was made in the past to find substitutes on the substance level (e.g., noble gases), that such alternatives have not been found to be feasible due to e.g., limitations to service life, increased energy consumption, etc.

Nonetheless, alternatives on the technology level have become available in the form of LED lamps and LED luminaires that can provide suitable alternatives for CFL lamps, should such lamps be phased out. From the provided information, the consultants understand that the availability of alternatives differs for lamps covered by the exemption with an integrated ballast (CFLi) and lamps with a non-integrated ballast (CFLni). LE also claims that the implementation of available alternatives as substitutes for long-life CFL covered by Ex. 1(g) may result in high costs for users and manufacturers, while also resulting in the generation of additional amounts of waste (luminaires scrapped prior to their end-of-life). Indicative information as to the range of such costs is discussed in section 5.5.4. Assuming that in some cases the costs of substitution would outweigh the benefits thereof, it would be important to understand where LED replacement lamps are not available as drop-in replacements or as lamps that could be used for replacement through a rewiring route in which existing luminaires remain in use.

For the CFLni sub-group, LE explains that there is no single LED retrofit lamp available that addresses all the parameters of the original CFL. From the experience of the consultants, the availability of LED replacements for CFL with non-integrated ballast is generally very limited and in that sense it is plausible that for CFLni covered by exemption 1(g) this is also the case.

As for CFLi, in this case LE claims that LED retrofit equivalents are restricted to limited products of the portfolio that can address all the relevant parameters such as wattage, colour temperature, socket and lumen output of CFLs, within a 10% tolerance range. Though it can be followed that this statement could apply in some cases, LE did not provide examples for such limitations in relation to specific lamps nor was detail provided to allow a clearer understanding of CFLi lamps in the scope of the exemption. As the consultants are aware that there is a relatively wide range of LED alternatives that can be used as replacements for CFLi lamps, an attempt was made to compare between models for which information was found in publicly available information (manufacturer data available on the internet) – i.e., between long-life CFLi and LED alternatives with a service life above 20 000 hours.

Despite assistance of LE in the provision of links to publicly available material, all CFLi lamps that are understood to fall under ex. 1(g) and that were found in various manufacturer catalogues and websites had a lifetime of 20 000 hours. CFLi lamps with a higher lifetime were not found, though it cannot be excluded that such lamps may exist. In contrast, LED replacements were found to be available for lifetimes between 20 000 to 50 000 hours. The following table provides a comparison of the main parameters.

Table 5-2: Comparison of lamp specifications and prices for CFLi and LED retrofits therefor

	CFLi	LED
Lifetimes found	20 000 hours	20 000 – 50 000 hours
Power ratings found (range)	10-18 W	3.9-21 W
Caps available	Mainly E27, one E14 model found	Both E27 and E14 have been found.
Colour temperature	2500-2700 °K	2100-4500 °K
Colour rendering CRI (Ra)	80-82	80-97
Price (€)	9.5-18 €	7.49-33.48 €

Note: The ranges specified above are based on 5 long-life CFLi and 10 LED alternatives.

Source: own compilation based on data from Philips and Osram websites, www.mercateo.com (in relation to CFLi prices, last accessed 02.04.2018) and EcoTopTen data base (LED replacements)

Though this comparison does not allow understanding the compatibility of available LEDs with existing CFLi luminaires, the wide variety should suffice to provide substitutes that could be used in relevant luminaires. Though in specific cases LEDs may be more expensive than CFLi (higher lumen packages, non-conventional lamp forms), in other cases the opposite is true and prices are also constantly changing as the availability increases. For some of the parameters mentioned, the arguments raised by LE cannot be followed. For example, though LED are in themselves not omnidirectional, LED lamps have been developed with omnidirectional output and the fact that they are being applied by a constantly growing number of consumers shows that even if the output is not identical, the tolerance is acceptable to consumers. As

for electric compatibility, LE themselves admit that where rewiring is performed by qualified professionals that the reliability of the luminaire is comparable.

The main area of concern in relation to the comparability of parameters is related to possible thermal problems. LEDs are known to be sensitive to heat. Their exposure to temperatures above recommended performance levels can result in a reduction in service life which, depending on the temperatures and exposure time, may be significant. Though there have been improvements for LEDs in the removal of waste heat from the body of the lamp, there is a certain dependency for this performance on the luminaires in which lamps are to be installed. The technical specifications of the existing stock of luminaires, in which long-life CFL are currently in use, is not known and can be expected to vary. Though in some cases lamps could be installed in luminaires in which ventilation results in build-up of thermal heat, this is assumed to be more of a problem in lamps with higher power ratings. LE has not provided data to support thermal incompatibility argument and it is thus not possible to confirm or refute the claims made in relation to possible thermal problems.

5.5.3. Environmental arguments

Though LE refers to a number of LCA, it is explained that the comparison of CFL and LFL is not straightforward. From the consultant's knowledge such studies do not specifically focus on the comparison of these technologies in relation to long-life applications. Publicly available study results, of which the consultants are aware, furthermore refer to LEDs available a few years ago, whereas the development of such technologies is understood to be very dynamic. It can already be understood from studies that LED sources are expected to have a real advantage in the total life cycle over time in comparison to CFL in light of their generally longer lifetimes and the related energy savings. It is assumed that in light of the developments of the past few years that this tendency has increased.

As for possible impacts related to waste, a lack of lamp replacements may result in early end-of-life of luminaires in some cases. However, this needs to be seen in context, given that a phase-out of CFL shall also reduce the amounts of mercury to come on the market annually, subsequently also reducing problems related to mercury content in the waste phase. Given that at present, most Member States do not achieve a collection rate above 50% for CFL, there is particular concern related to the fate of mercury from lamps that are not collected. Data from Denmark (Gensch et al. 2016) also shows that the business sector does not necessarily achieve higher collection rates than the residential sector. In that sense it cannot be assumed that the collection rates of Ex. 1(g) lamps (mainly non-residential uses) are higher than average rates.

5.5.4. Socio-economic aspects

LE provides some information on socio-economic impacts of a scenario in which the exemption is not renewed and long-life CFL are phase out. A rough estimation (lower bound), of the costs of a forced phase out, is also provided: "*Taking an estimated time frame of 5 years, we estimate annual costs of 46,103,013,333 € to the public and commercial sectors in the EU*" (LE 2017a). However, based on LE's statements that

long-life CFL covered under exemption 1(g) account for 2-3% of the total CFL market, this estimation does not seem plausible:

- In the requests for renewal of ex. 1(a-e), estimations were provided by LE specified that in 2013, a total of 342 million CFL (CFLi and CFLni) were sold on the EU, based on an estimation by VHK (2014) . 3% of this number translates into around 10,000 lamps expected to have been placed on the EU market in 2013 (specified as mostly CFLni).
- The estimation that LE provide (see Table 5-1) is based on the CFLni market amounting to a total of 619 million lamps used in 413 fixtures. The number of lamps is almost twice as high as the annual CFLi sales and it thus needs to be assumed that it accounts for the total stock of all CFLni and not for annual sales of CFLni or a sub-group thereof.
- Even if it were assumed that lamps covered under Ex. 1(g) account for 2-3% of all CFLni, this would still only translate into between 12.4 and 18.6 million lamps in total. 2-3% of the costs estimated for all CFLni lamps amount to between 770 million and 1,155 million €. Even if LE has assumed that phase-out costs may include renovation costs where luminaires are built into ceiling or wall recesses, it cannot be followed that the costs would account for an annual sum of 46,103,013,333 €.

5.5.5. Scope of the exemption

From the information specified by LE, it becomes clear that a distinction can be made in relation to CFL under the scope of the exemption between a few groups:

- Compact fluorescent integrated lamps (CFLi) – in theory this group includes two fixtures as specified in Figure 5-1, though the available information suggests that mainly E27 fixtures are actually in use. A further distinction may also be relevant in relation to lamps for which LED substitute replacements are available for use in existing installations (drop-in or rewiring) and those that shall require a luminaire replacement; this, depends on the compatibility of available LED alternatives to existing installations and can only be estimated;
- Compact fluorescent non-integrated lamps (CFLni) – there is a wide variety of lamp fixtures in use (see Figure 5-1). All lamps can be included in one sub-group in relation to the availability of alternatives;

LE was asked whether the exemption could be limited to CFLni, but claims that despite the availability of LED replacement lamps with a growing variety of sizes and parameters (wattage, spectral output, etc.), these cannot be applied in all cases: "*There are also several types of CFLi lamps under the scope of this exemption. These lamps are used [...] in luminaires with E27 cap*" (LE 2017a).

As reference to other CFLi fixtures was not made, LE was further asked if the exemption could be limited to E27 fixtures in relation to this sub-group. LE neither agreed nor disagreed to the proposed limitation, merely stating that "*all CFLi lamps have an E type cap*" (LE 2018). Based on available market data, the consultants could confirm that though most CFLi have an E27 cap, that at least one long-life CFLi with

an E14 cap is also still made available on the market. Nonetheless, LED alternatives for CFL lamps are also available with both E14 and E27 caps.

5.5.6. Conclusions

Article 5(1)(a) provides that an exemption can be justified if at least one of the following criteria is fulfilled:

- their elimination or substitution via design changes or materials and components which do not require any of the materials or substances listed in Annex II **is scientifically or technically impracticable**;
- the **reliability** of substitutes is not ensured;
- the total negative **environmental, health and consumer safety impacts** caused by substitution are likely to outweigh the total environmental, health and consumer safety benefits thereof.

From the available information it is observed that **substitutes** have become available on the market on the technological level in the form of LED light sources. Substitutes can either be applied as retrofits (drop-in or with rewiring) or through a luminaire replacement. In that sense they are considered to be **technically reliable**.

LE points out that where CFL **luminaires** reach end-of-life, the current trend is to replace them with LED luminaires and in such cases substitution is thus also understood by the consultants to be **reliable**. As for **LED retrofits**, where CFL luminaires remain in use, concern is raised that LED replacement lamps shall not be compatible with existing installations in all cases:

- Where **CFLni lamps** are concerned, the consultants can follow that LED replacement lamps are at least **in most cases not compatible** with existing installations. A revoke of the exemption would lead to a forced phase-out of CFLni lamps. This is understood to lead to a replacement of all CFLni luminaires and subsequently to their early scraping. Such lamps are understood to account for most lamps covered by this exemption (LE 2016) though LE did not provide information as to the actual market share. Thus a phase-out scenario would affect most of the 6.7 million lamps estimated on the basis of VHK data to be on the market in 2016 (see 5.1.1), i.e. most of the 2.8 million lamps estimated based on the McKinsey data to be on the market in 2020.
- For **CFLi lamps**, understood to account for the smaller share of these lamps, the situation is different. Here replacement LED lamps are expected to be available in more cases (as drop-in replacements or requiring a rewiring or conversion of the luminaire), also considering the small market share and the small product diversity in relation to lamp fixture type (mainly E27 and possibly E14 in some cases). Where this is not the case, replacement of the luminaire is possible as explained above. From available data as to actual CFLi lamps of relevance to this exemption, it seems that in most areas, alternatives could be found that are compatible with luminaires or that can be rewired to achieve compatibility (dimensions, weight, electrical, etc.). Though, where thermal impacts are concerned, data did not allow confirming if LED replacement lamps would be compatible or not, the consultants

assume that in most cases (as with standard CFL with a power rating < 30 W) that lamps would be suitable. In other cases **rewiring or luminaire replacement are also accessible substitutes**, though associated with an additional investment for the consumer. As shall be demonstrated below, for CFLi this investment is understood to be acceptable as long life LEDs are usually related with higher energy savings than CFLni, ensuring a return on investment within a shorter term. As such LED phase-in is assumed to usually be in the interest of the consumer.

In the consultants opinion, the case of long life CFLi needs to be observed in perspective of normal life CFLi. For lamps of Ex. 1(a), Gensch et al. (2016) recommended discontinuing the exemption, with the understanding that it mainly covered CFLi lamps.

The third Article 5(1)(a) criteria concerns **environmental and health impacts**. In the context of CFL, three main aspects are discussed in this respect: mercury placed on the market and its possible emissions, energy consumption and the possible early generation of waste (i.e. prior to expected end-of-life of installations). To better understand the development of impacts relating to these aspects, it is important to understand the use patterns of long-life CFL and their respective market. Though these lamps have a longer lifetime in terms of total operation hours, their actual operation period can be expected to be shorter in years than that of standard CFL, depending on the lamp specifications and its use pattern. The life-expectancy that VHK (2016) estimate for standard CFLi in both residential and non-residential uses is 12 years, based on a 6 000 hour lifetime and a 500 hour annual operation period and between 14.3 and 6.3 years for non-residential uses (10.000 hour lifetime; 700-1,600 operation hours per annum). For long-life CFL:

- Given a lamp with a 20 000 hour lifetime used between 8 and 24 hours a day, the lamp life expectancy is estimated to be between 6.8 to 2.3 years, respectively.
- Given a lamp with a 50 000 hour lifetime used between 8 and 24 hours a day, the lamp life expectancy increases to between 17.1 and 5.7 years, respectively.

In other words, the more intensive use pattern translates into a more intensive energy consumption (higher watt consumption per operating hour) and a more frequent replacement. Where lamps are replaced more often, more mercury is placed on the market. The more intensive the use, the faster benefits are expected to incur from a phase-out (lower energy consumption and prevention of mercury being placed on the market). Though in the case of luminaire replacement, waste is to be generated prematurely, this is a one-time cost expected to occur in any case in the future and only advanced in time through the phase-out. The benefits in contrast are of recurring nature. Where lamps are in use for a longer period (e.g. lamps with 50 000 hour lifetime operated for 8 hours a day), a longer period shall be required for the benefits to offset costs (investments as well as waste) and vice versa. Furthermore, where retrofit lamps are available, costs of the phase-out are lower and thus covered more rapidly by the expected benefits (see Table 5-3).

Table 5-3: Comparison of purchase prices, energy savings and energy costs of various CFLi and CFLni lamps and LED retrofits therefor

General lamp specifications and use pattern:

Lamp	Lifetime hours	Hours operated daily	Hours operated annually	Lifetime in years
CFLi standard	6 000	1.4	500	12
CFLi LL 1a	20 000	8	2 920	6.8
CFLi LL 1b	20 000	24	8 760	2.3
CFLi LL 2a	50 000	8	2 920	17.1
CFLi LL 2b	50 000	24	8 760	5.7
LED 1a	20 000	8	2 920	6.8
LED 1b	20 000	24	8 760	2.3
LED 2a	40 000	8	2 920	13.7
LED 2b	40 000	24	8 760	4.6
CFLni LL 1a	36 000	8	2 920	12.3
CFLni LL 1b	36 000	24	8 760	4.1

Cost estimations:

Lamp	Lifetime (years)	Total energy consump-tion (kWh)	Total energy costs	Lamp purchase price	Costs	
					Total	p/a
CFLi standard	12.0	66	9.24 €	4.39 €	14 €	1 €
CFLi LL 1a	6.8	300	42.00 €	9.48 €	51 €	8 €
CFLi LL 1b	2.3	300	42.00 €	9.48 €	51 €	23 €
CFLi LL 2a	17.1	700	98.00 €	18.00 €	116 €	7 €
CFLi LL 2b	5.7	700	98.00 €	18.00 €	116 €	20 €
LED 1a	6.8	140	19.60 €	7.20 €	27 €	4 €
LED 1b	2.3	140	19.60 €	7.20 €	27 €	12 €
LED 2a	13.7	260	36.40 €	16.99 €	53 €	4 €
LED 2b	4.6	260	36.40 €	16.99 €	53 €	12 €
CFLni LL 1a	12.3	396	55.44 €	12.99 €	68 €	6 €
CFLni LL 1b	4.1	396	55.44 €	12.99 €	68 €	17 €

Note: Lamps annotated with the same number (LED 1a, LED 1b) refer to the same lamp, but where a different daily operation time has been assumed (annotated with the reference to a and b).
Source: Own compilation. LED prices based on lamps appearing in EcoTopTen data base. CFL LL based on http://www.assets.lighting.philips.com/is/content/PhilipsLighting/fp929745199901-pss-global, Long Life Unique-S 11 Watt 840 Compact-Aura and on www.Mercateo.com prices in April 2018 for CFLi and in August 2018 for CFLni. CFL standard lamp based on VHK data.

For example, the purchase costs of a LED replacement for a long-life CFLi of 20.000 hours lifetime are 7.20 € in comparison to 9.48 € for the corresponding CFLi type. Where the LED can be used as a drop-in replacement, the purchase alone will have already saved the consumer costs, whereas the energy savings of the LED amount to an additional benefit of 22.40 €. Where a rewiring is needed, an additional 32.50 € have been estimated by LE to be needed for equipment and labour. These costs shall be set-off shortly after the second replacement in this case. Based on data from the

MELISA model (VHK 2016) and from the survey of available CFLi, CFLni and LED with a lifetime of 20 000 hours and above, a comparison is presented below between energy costs and savings and purchase costs of CFL and LED replacements for such long-life lamps.

Table 5-4: Comparison of purchase prices, energy savings and energy costs of various CFLi and CFLni lamps and LED retrofits therefor

General lamp specifications and use pattern

Lamp	Lifetime hours	Hours operated daily	Hours operated annually	Lifetime in years
CFLi standard	6 000	1.4	500	12
CFLi LL 1a	20 000	8	2 920	6.8
CFLi LL 1b	20 000	24	8 760	2.3
CFLi LL 2a	50 000	8	2 920	17.1
CFLi LL 2b	50 000	24	8 760	5.7
LED 1a	20 000	8	2 920	6.8
LED 1b	20 000	24	8 760	2.3
LED 2a	40 000	8	2 920	13.7
LED 2b	40 000	24	8 760	4.6
CFLni LL 1a	36 000	8	2 920	12.3
CFLni LL 1b	36 000	24	8 760	4.1

Cost estimations:

Lamp	Lifetime (years)	Total energy consump-tion (kWh)	Total energy costs	Lamp purchase price	Costs	
					Total	p/a
CFLi standard	12.0	66	9.24 €	4.39 €	14 €	1 €
CFLi LL 1a	6.8	300	42.00 €	9.48 €	51 €	8 €
CFLi LL 1b	2.3	300	42.00 €	9.48 €	51 €	23 €
CFLi LL 2a	17.1	700	98.00 €	18.00 €	116 €	7 €
CFLi LL 2b	5.7	700	98.00 €	18.00 €	116 €	20 €
LED 1a	6.8	140	19.60 €	7.20 €	27 €	4 €
LED 1b	2.3	140	19.60 €	7.20 €	27 €	12 €
LED 2a	13.7	260	36.40 €	16.99 €	53 €	4 €
LED 2b	4.6	260	36.40 €	16.99 €	53 €	12 €
CFLni LL 1a	12.3	396	55.44 €	12.99 €	68 €	6 €
CFLni LL 1b	4.1	396	55.44 €	12.99 €	68 €	17 €

Note: Lamps annotated with the same number (LED 1a, LED 1b) refer to the same lamp, but where a different daily operation time has been assumed (annotated with the reference to a and b).

Source: Own compilation. LED prices based on lamps appearing in EcoTopTen data base. CFL LL based on http://www.assets.lighting.philips.com/is/content/PhilipsLighting/fp929745199901-pss-global, Long Life Unique-S 11 Watt 840 Compact-Aura and on www.Mercateo.com prices in April 2018 for CFLi and in August 2018 for CFLni. CFL standard lamp based on VHK data.

As can be observed, the LED retrofits tend to have similar prices to the CFL, however they consume less energy throughout their lifetime, meaning that the related savings

provide at least a partial return for costs of rewiring of existing installations (estimated by LE to account for 32.50 €) and somewhat slower for luminaire replacement (estimated by LE to account for 100 €). For example, in relation to lamps of 20.000 hrs, costs of both the CFLi lamp and its operation account for 51 €, whereas an LED retrofit with the same lifetime shall only generate costs of 27 €. Though the CFLi 50.000 hrs lamp and the LED 40.000 hrs lamp are not exactly comparable, the cost savings in this case are around 60 €; rewiring costs would be easily covered by these savings. Where long-life CFLi lamps can be retrofitted (with or without rewiring), the consumer could expect benefits, following the second lamp replacement. It is assumed that for most CFLi this should be possible. Even if a share of such lamps should require a luminaire replacement, investments would also not be expected to have a long term return in many cases, seeing as in such cases, replacements would be expected to be realized with LEDs with longer lifetimes, thus resulting in savings covering the investment within the first few lamp replacement cycles[12].

For CFLni (36.000 hrs lifetime), the difference in costs in comparison with the LED (40.000 hrs) is much less significant, at around 10 €, meaning that return on investments is longer, particularly as here it is assumed that all luminaires shall require replacement in lack of retrofits.

In this sense, in the consultants view, the benefits of substitution can be expected to cover costs of a phase-out of long-life CFLi lamps, whereas for CFLni the case is less clear.

Substitution of CFL lamps, which contain mercury, is also understood to have benefits in terms of avoiding the placing of additional mercury on the market and dealing with this substance in the waste stream at end-of-life (including with emissions of lamps broken or improperly disposed of). LE provides an upper limit estimation that around 23 kg of mercury were placed on the market in 2016 through Ex. 1(g) lamps and that close to 10 kg shall be placed on the market in 2020. This is considered an upper limit as it was calculated using the maximum threshold, though in reality lamps are expected to contain a lower amount. To give perspective to this statement, in their application for the renewal of Ex. 1(a) for CFL lamps of both types with a standard lifetime and with a power rating below 30 W, LE estimated that in 2013, 727 kg of mercury were placed on the market through such lamps (LE 2015).

To further investigate this conclusion, it is worth considering the number of lamps expected to be affected should the exemption be revoked. For this purpose, the McKinsey data has been used as a reference for calculating the expected number of lamps covered by the exemption to be placed on the EU market in 2020 and for subsequent estimations. Based on McKinsey expectations, in 2020, total sales of CFL shall account for only 92 million pieces with Ex. 1(g) said to have a market share of 3%, i.e. 2.8 million lamps are estimated to still be sold per year for this market segment.

[12] A replacement cycle is assumed to be between 2.3 to 6.8 years for lamps with a 20 000 hrs lifetime. The length of a cycle increases for lamps with longer lifetimes, as do the energy savings.

The CFLi share of lamps covered under Ex. 1(g) is understood to be smaller than the CFLni share. In this respect, LE (2016) have stated that in most CFL covered by Ex. 1(g), the electronic control gear is separated from the lamp, i.e. most lamps are CFLni. The consultants have thus assumed that 90 % of the lamps covered under this exemption are CFLni, with the other 10 % assumed to be CFLi. This assumption is further supported by the understanding that lamps covered under Ex. 1(g) are understood to be used mostly for professional applications in offices, public buildings, shops and street lighting, for general lighting (LE (2016)). Based on prior experience (Gensch et al. 2016), there is a high correlation between CFLni and lamps used in professional applications for general lighting, whereas as CFLi are more common in residential applications. Summarising these assumptions, the expected sales in 2020 would be as follows:

- CFLi: 0.29 million lamps
- CFLni: 2.5 million lamps

Table 5-6 below presents calculated costs related to a CFLi and CFLni phase out, incurring from the substitution of CFL expected to be sold in 2020.

The analysis of these tables is performed on the basis of assumptions as to the number of lamps to be retrofitted (with or without rewiring) and replaced with luminaires in each case. Assumptions as to the availability of drop-in substitutes (also known as plug and play alternatives) for CFL lamps are based on information provided by LE (2017b) in relation to CFL substitute availability, cf. Table 5-5 below. Though the LED market is of a dynamic nature and constantly improving, for simplification, further development of the availability of substitutes in relation to the 2017 status specified by LE has been disregarded.

Table 5-5 The availability of plug and play substitutes in terms of coverage of the relevant product range (%) according to LightingEurope

	P < 12W	12 W <= P < 30 W	30 W <= P < 50 W	P >= 50 W
CFLi plug and play	98 – 100 %	61 – 100%	20 – 100%	0 – 57%
CFLni plug and play	0%	0 - 55%	0%	0%
CFLni limited	0 - 29%	0 – 44%	0 – 13%	0%

Note: It is borne in mind that the figures above are ranges from LightingEurope members whereby the lowest and highest values are taken. Furthermore, plug and play is used when neither safety nor functionality (dimmability, light distribution) is compromised. "Limited" is used (replaceability) when safety is not compromised but one or more functionality parameters are missing.

Source: LE (2017b)

Information from LE suggests that there is a wide variety of LED retrofit alternatives that could be used as drop-in substitutes for CFLi with a power rating below 30 W or in some cases through the rewiring of the existing luminaire. It has thus been assumed in the base scenario that retrofits would be available for at least 60% and that these

are distributed equally between the drop-in route and the retrofitted route. This assumption is estimated to be conservative, seeing as the availability of retrofits is higher below 30 W (between 61% and 100%). A sensitivity test is performed for an availability of 75% retrofits, also distributed equally between drop-in and rewiring (referred to in the following as the sensitivity scenario).

For CFLni, LE specify in the relevant power wattage rating that between 0 to 55% plug and play (i.e., drop-in) substitutes are available, however limitations to the use of these retrofits is specified, suggesting that in most cases, retrofits available (if at all) would require a rewiring of the luminaire. Here availability is understood to be limited and thus a conservative assumption is applied along with the understanding that where retrofits are available, they would require rewiring in any case. The base case assumes a mere 2% availability of retrofits, all requiring rewiring. The sensitivity scenario assumes 15% retrofits with only 20% (3% of the total) of these being drop-in.

Table 5-6: Comparison of phase-out costs for CFLi and CFLni on the basis of 2020 sales and differing substitute availability for replacing phased out lamps

Long-life lamp sales in 2020	Difference in costs – drop-in retrofit	Difference in costs – rewired retrofit	Difference in costs lumi-naire replace-ment	Costs due to energy savings	Total	Net costs per lamp
CFLi – Base scenario Distribution of drop-in retrofits: rewired retrofits: luminaire replacements: 30%: 30%: 40%						
279,000 lamps	-0.08 Mill. €	2.64 Mill. €	9.15 Mill. €	14.65 Mill. €	-2.95 Mill. €	-11 €
CFLi – Sensitivity scenario Distribution of drop-in retrofits: rewired retrofits: luminaire replacements: 37.5%: 37.5%: 25%						
279,000 lamps	-0.11 Mill. €	3.29 Mill. €	5.72 Mill. €	14.65 Mill. €	-5.74 € Mill. €	-21 €
CFLni – Base scenario Distribution of drop-in retrofits: rewired retrofits: luminaire replacements: 0%: 2%: 98%						
2,511,000 lamps	0.00 Mill. €	1.58 Mill. €	201.78 Mill. €	131.83 Mill. €	71.54 Mill. €	28 €
CFLni – Sensitivity scenario Distribution of drop-in retrofits: rewired retrofits: luminaire replacements: 3%: 12%: 85%						
2,511,000 lamps	-0.08 Mill. €	9.49 Mill. €	175.02 Mill. €	131.83 Mill. €	52.60 Mill. €	21 €

Notes: Negative values represent benefits.
Retrofit lamps are assumed to have a 40.000 hrs lifetime and to cost 16.99 € and an additional 32.5 € when requiring rewiring. Replacement luminaires are assumed to cost 100 €, to include a lamp and to have a 50.000 hrs lifetime. The costs of a CFLi lamp with a lifetime of 50.000 hrs (18 €) are subtracted from the costs calculated for the specific route as is its energy consumption.

The calculation above shows that under both scenarios, a **forced phase-out of CFLi** shall result in benefits (2.9 million € and 5.7 million € respectively). These are understood to be a result of the energy savings (14.6 million € in both cases), which suffice to cover the costs of substitution. On average, the net costs of substitution per

lamp, or in this case the benefits, are estimated at 11 € in the base scenario and 21 € in the sensitivity scenario. It is however noted that the net costs differ depending on the substitution route. Lamps that can be replaced with a drop-in substitute are expected to provide higher benefits, whereas for lamps that shall require the luminaire to be rewired or to be replaced, the net cost shall be lower and possibly negative (costs) where only a single replacement cycle is considered as in this analysis. As can be seen in the Table 5-4 analysis, differences can also be expected in relation to lamp specifications (purchase costs, lifetime, etc.).

For CFLni, the case is opposite. The analysis shows that a forced phase-out of CFLni shall result in costs both in the base scenario and the sensitivity scenario (71.5 million € and 52.6 million € respectively). These costs appear to be of a much higher order than the benefits related to CFLi. The fact that the CFLni substitution generates costs and not benefits is related to the high rate of lamps that have no retrofit substitutes and thus require a luminaire replacement. Nonetheless, it should be kept in mind that the number of lamps in this sub-group is also nine times higher than the share of CFLi, thus regardless of the impacts being negative, the total sum is of a higher order. This is supported by the average net costs of substitution per lamp, which for CFLni are in the order of 28 € in the base scenario and 21 € in the sensitivity scenario. In the base scenario, the substitution of almost all lamps requires a luminaire replacement (in the sensitivity scenario 85 % of lamps), meaning that the average costs are considered to be representative for most lamps, though certain differences shall apply in relation to lamp specifications.

In relation to luminaire replacement, it is worth noting two aspects:

- The first concerns the actual costs of luminaire replacement. LE have specified that luminaire replacement may be higher than the luminaire costs alone. In some case the replacement may also require changes to the environment of the luminaire - to adapt recessed ceiling or walls to built-in luminaires or to adapt street lighting patterns through the introduction of additional lighting poles to name a few. Such costs have not been included here and could affect the numbers above, particularly for CFLni, where a large share of lamps is assumed to require a luminaire replacement.
- In this respect, it is also worth noting that luminaire costs can differ significantly, with some being sold for as little as 20-30 € and others being sold for some hundreds of €. In some cases, these luminaires shall have an integrated light source that cannot be replaced, meaning that once the luminaire malfunctions, it shall need to be replaced in its entirety. As the LED luminaire market is still developing, it is not possible to speculate in what range the costs of long-life luminaires would be, nor if light source replaceability shall limit the lifetime of such products. However, as it is assumed that there would be a preference here towards luminaires with an interchangeable light source, it is assumed that the LED specified average cost of 100 € per luminaire is more representative and that significantly less expensive luminaires would not be suitable.

The consultants conclude that for both types of long-life CFL, CFLi as well as CFLni, substitutes are available and technically reliable (either on the lamp replacement level

or the luminaire replacement level) for long-life CFL. Based on the information available for environmental and health aspects, in relation to **substitution** (i.e. with LEDs) it **cannot be concluded that the negative impacts** (premature scrapping of non-compatible lighting equipment) **would outweigh the benefits thereof** (energy savings, prevention of mercury related impacts).

To summarise, it cannot be concluded that the Article 5(1)(a) main criteria to justify the renewal of the exemption are fulfilled.

Article 5(1)(a), however, also stipulates that decisions on exemptions and their duration shall take into account socio-economic impacts of substitution. The analyses presented in Table 5-4 and Table 5-6 provide some detail in this respect based on available data. These investigations show that for **CFLi**, the required investments in substitution (luminaire rewiring or replacement) can be expected to result in benefits for end-users, if not within the first lamp cycle than in future cycles. In this sense, the investigation shows that the socio-economic impacts of substitution are positive (benefits through electricity savings).

For **CFLni**, the investigations show that costs are to be expected for most if not all end-users. The estimated costs can be expected to amount to a net cost of 28 € per lamp (base scenario). Furthermore, it has to be taken into account that the costs for CFLni substitution are not additional costs but costs that appear ahead of time, considering that they are expected to incur in any case in the future (natural phase-out). The sales values that LE presents for 2016 and 2020 (6.7 million and 2.8 million lamps respectively) show that a natural phase-out is already underway, suggesting that these costs are in part already incurring, though at a more gradual rate than in the case of a phase-out. An exemption revoke would thus only accelerate the rate of natural phase-out and thus the rate at which these costs incur. The same is true regarding the premature creation of scrap and use of resources for new luminaires in the case of a revoke. In contrast, impacts related to the use of mercury in CFL lamps would be avoided altogether once the exemption were to be revoked, whereas a renewal would allow this substance to come on to the market in CFL replacement lamps. Taking the use pattern of long-life lamps into account is also relevant in this respect. Though lamps with a 50 000 hour lifetime will be in operation for 5.7 years when operated 24 hours a day, lamps with a 20 000 hour lifetime operated continuously are replaced on average every 2.3 years. A 5 year renewal of the exemption would allow at least two lamps to come on to the market for a single luminaire in the latter case, also allowing up to 7 mg mercury to be placed on the market via these two lamps. In contrast, revoking the exemption would at worst allow one replacement within the transition period, resulting in prevention of mercury impacts. Impacts related to energy savings are also of a similar nature; they are not future benefits to incur prematurely but of an additive nature.

5.6. Recommendation

LED alternatives have become available and in general are understood to provide reliable alternatives, though the costs of their application differ significantly for long-life CFLi and long-life CFLni. Existing information and data shows that in terms of environmental, health and consumer safety impacts, substitution shall prevent the placing on the market of mercury contained in long-life CFL, while also reducing energy consumed for lighting. These benefits are additional to a scenario in which the exemption is renewed. Though certain negative impacts can also be expected (early scrapping of lighting equipment and earlier use of resources for producing their replacements), these impacts are also to incur where the phase-out is allowed to take place naturally. In other words, the negative impacts can only be considered to be advanced on the time line by a forced phase-out and are not to be regarded as additional impacts introduced by the phase-out.

On this basis, it cannot be concluded that either of the Article 5(1)(a) main criteria is fulfilled and that an exemption would be justified.

In parallel, socio-economic impacts of substitution have been looked into. Though the estimation of impacts is understood to be partial, it shows that in the case of CFLi, substitution shall result in benefits for end-users, further supporting that the exemption is not justified (11 € per lamp in the base scenario or a total net benefit of 2.95 million €). For CFLni, costs are expected, estimated to be 28 € per lamp in the base scenario or a total net cost of 71.54 million €. Though these costs can be seen as a negative impact, they are only expected to incur prematurely in comparison with costs expected from the natural phase-out already underway and are not to be perceived as additional costs generated through a forced phase-out. Against this background, the exemption is understood not to be justified and a revoke would be recommended, granting an 18 month transition period:

Ex. 1: Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):		**Exemption duration**
1(g)	For general lighting purposes < 30 W with a lifetime equal or above 20 000 h: 3,5 mg	The exemption should be revoked. A transition period of 18 months should be granted for Cat. 5

6. Request 2017-2

"Use of lead in welds for soldering of certain printed circuit board assemblies in gas detectors"

Declaration

In the sections that precede the "Critical review" the phrasings and wordings of stakeholders' explanations and arguments have been adopted from the documents provided by the stakeholders as far as required and reasonable in the context of the evaluation at hand. Formulations were only altered or completed in cases where it was necessary to maintain the readability and comprehensibility of the text. These sections are based exclusively on information provided by applicants and stakeholders, unless otherwise stated.

Acronyms and definitions

Cat. 9 industrial	Industrial monitoring and control instruments, listed as category 9 in Annex I of RoHS 2
EoL	End of life
Pb	Lead
RoHS, RoHS 2	Directive 2011/65/EU on the restriction of hazardous substances in electrical and electronic equipment
Sn	Tin

6.1. Summary of the exemption request

Oldham SAS (2016) requests an exemption until July 2018 for "*Use of lead in welds for gas detectors*", which are used in industrial monitoring and control instruments (Cat. 9 industrial) that need to comply with the substance restrictions of RoHS Art. 4(1) from 22 July 2017 on.

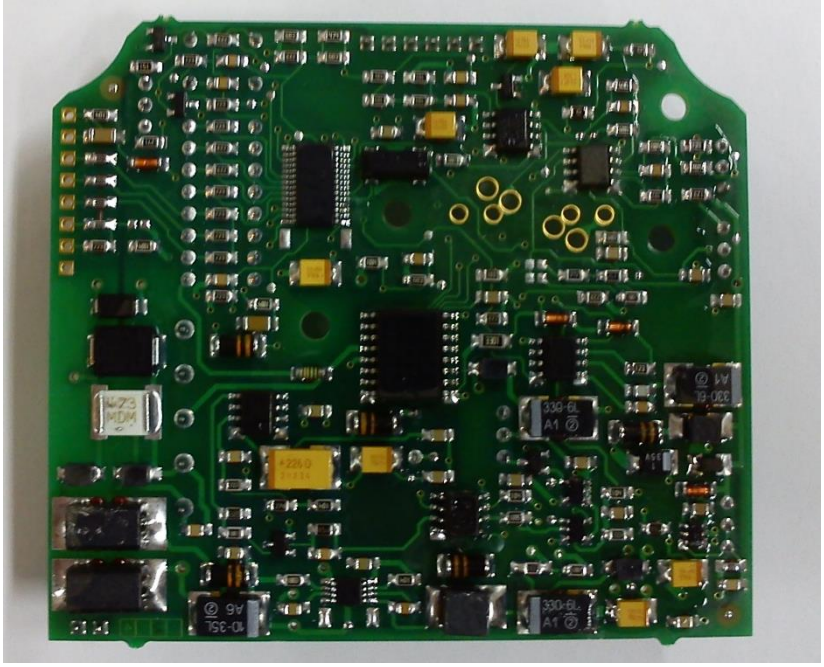
Oldham SAS (2017) must invest in a RoHS-compliant line to eliminate the use of lead in its welds of the gas sensor's card, or alternatively subcontract the electronic cards manufacturing with lead-free solders to a supplier. Oldham SAS (2017) requires time beyond 21 July 2017 to modify the card's accordingly.

6.2. Technical description of the requested exemption

According to Oldham SAS (2016), the gas sensors detect mostly hydrocarbons like methane, propane and butane, as well as H_2S, CO, NH_3, etc. The detectors are used in industrial monitoring and control instruments (Cat. 9 industrial of RoHS Annex I). The surface-mounted devices and around 50 % of the through-hole components on the

main board (c.f. Figure 6-1) of the gas detection device are soldered with a tin-lead solder with around 40 % of lead, the other around 50 % of the through-hole components are selectively soldered onto the board with lead-free solder.

Figure 6-1: Main board of the gas detectors partially soldered with lead-free solder



Source: (Oldham SAS 2017)

The board therefore contains lead in most of its solder joints and thus is not RoHS compliant from 22 July 2017 on.

6.2.1. Amount of lead used under the exemption

Oldham SAS (2017) estimates that the lead in the gas sensors makes up around 3 % of the weight of the gas detector. The around 16 t of these detectors being produced every year result in around 500 kg of lead that would be used annually should the exemption be granted, from which 75 %, around 380 kg, would enter the EU market.

6.3. Applicant's justification for the requested exemption

Oldham SAS (2017) explains that it must invest in a RoHS-compliant line to completely eliminate the use of lead in the main board's (cards') solder joints. The option of subcontracting the assembly of the electronic cards to a supplier equipped with a lead-free soldering process is also possible. The decision will be taken in January 2017, whereupon the modification of Oldham's about 100 cards to enable the use of lead-free solders will take at least 12 months so that RoHS compliance cannot be achieved in July 2017.

6.3.1. Environmental arguments

Oldham SAS (2016) describes general impacts of lead on the environment and health such as

- the bioaccumulation potential in body tissue of aquatic and soil organisms.
- the adverse impacts on the synthesis of haemoglobin and the resulting anaemia, impacts on kidneys, brain damages, etc.

6.4. Critical review

6.4.1. REACH compliance – Relation to the REACH Regulation

If granted, the exemption would allow the use of lead in gas detectors used in industrial monitoring and control instruments (cat. 9). Annex XIV of the REACH Regulation contains several entries for lead compounds, the use of which requires authorization:

- 10. Lead chromate
- 11. Lead sulfochromate
- 12. Lead chromate molybdate sulphate red

None of the above listed substances is relevant for this case, neither as directly added substance nor as substance that can reasonably be assumed to be generated in the course of the manufacturing process or thereafter. In the applications in the scope of the reviewed exemption, the lead becomes part of articles as an alloy of elemental metals.

The same applies to the lead compounds restricted in Annex XVII of the REACH Regulation, and adding to this, the restriction refers to paints and not to solder alloys:

- 16. Lead carbonates in paints
- 17. Lead sulphate in paints

Appendix 1 of this report lists entry 28 and entry 30 in Annex XVII of the REACH Regulation, stipulating that lead and its compounds shall not be placed on the market, or used, as substances, constituents of other substances, or in mixtures for supply to the general public. A prerequisite to granting the requested exemption would therefore be to establish whether the intended use of lead in this exemption request might weaken the environmental and health protection afforded by the REACH regulation.

In the consultants' understanding, the restrictions for substances under entry 28 and entry 30 of Annex XVII do not apply. The use of lead in gas detectors in the consultants' point of view is not a supply of lead and its compounds as a substance, mixture or constituent of other mixtures to the general public. Lead in the form of a lead alloy is part of an article and as such, entry 30 of Annex XVII of the REACH Regulation would not apply.

Entry 63 of Annex XVII stipulates that lead and its compounds…

- "shall not be placed on the market or used in any individual part of jewelry articles if the concentration of lead (expressed as metal) in such a part is equal to or greater than 0.05 % by weight."
- "shall not be placed on the market or used in articles supplied to the general public, if the concentration of lead (expressed as metal) in those articles or accessible parts thereof is equal to or greater than 0.05 % by weight, and those articles or accessible parts thereof may, during normal or reasonably foreseeable conditions of use, be placed in the mouth by children."
  This restriction does, however, not apply to articles within the scope of Directive 2011/65/EU (RoHS 2). Nor is lead in gas detectors expected to be accessible to children under normal or reasonably foreseeable conditions of use.

The restrictions of lead and its compounds listed under entry 63 thus do not apply to the applications in the scope of this requested exemption.

No other entries, relevant for the use of lead in the requested exemption could be identified in Annex XIV and Annex XVII (status January 2018). Based on the current status of Annexes XIV and XVII of the REACH Regulation, the requested exemption would not weaken the environmental and health protection afforded by the REACH Regulation. An exemption could therefore be granted if other criteria of Art. 5(1)(a) apply.

6.4.2. Scientific and technical practicability of substitution

The applicant's justification for the exemption request does not mention any arguments as to the principal scientific or technical impracticability of applying lead-free solders on the gas detectors' main boards/cards. The core argument is that the time from January 2017, when a lead-free soldering line will be available, is too short to achieve RoHS compliance until July 2017. It is technically plausible that it requires time to modify and qualify the cards for lead-free solders. However, RoHS 2, which integrated industrial monitoring and control instruments into the scope, was officially published in 2011 already. The question necessarily arises why the applicant has not made available the lead-free soldering line and started the indispensable modifications of the cards early enough to achieve RoHS-compliance in time.

Oldham SAS (2017) concedes that the main reason why RoHS compliance has not yet been achieved since 2011 is that the company has faced four changes of ownership since 2013. Actions were put on hold due to some changes in strategy and the freeze of investments as part of successive shareholder changes.

Oldham SAS (2017) presents a list of several competitors which manufacture fixed gas detectors for the EU market (c.f. section 6.4.4 on page 50). Oldham SAS (2017) states that "[…] *our understanding is that many of them do not require the exemption*."

The applicant thus does not justify the exemption request with arguments as to the insufficient scientific and technical practicability of substituting or eliminating lead in

the solder joints of the main boards. Although lead-free soldering requires modifications of the boards, the substitution of lead solders by lead-free ones is scientifically and technically practicable and Art. 5(1)(a)(I) in the consultants' interpretation does not justify granting an exemption. The fact that none of the other manufacturers of fixed gas detectors supports the exemption request underlines the consultants' conclusion. The applicant assumes that most of its competitors do not require the exemption, and there are no arguments that the applicant's gas detectors would provide functionalities, which other manufacturers' products cannot fulfil, which could justify an exemption in line with Art. 5(1)(a)(I).

The company did not start its efforts in time to be in the position to place RoHS-compliant products on the EU market by July 2017, which passed around 6 months ago already (status January 2018). The applicant wants to achieve RoHS compliance until July 2018. Assuming the exemption would be granted, the applicant would hardly benefit from it. Since July 2017, the company is not legally allowed to place RoHS-compliant products on the market as the exemption is not in place. Furthermore, it must be assumed that even if granted, the exemption would not be officially published and enacted before July 2018, and possibly even later.

6.4.3. Environmental arguments

Oldham SAS (2016) lists general adverse effects of lead on the environment and on human health, but does not mention specific negative environmental and health impacts of lead-free solders in the context of the products in the scope of the exemption request. It can therefore not be concluded that the total negative environmental, health and consumer safety impacts caused by lead substitution in Oldham's gas detector devices are likely to outweigh the total environmental, health and consumer safety benefits thereof, as stipulated in Art. 5(1)(a)(III). Granting the exemption would thus not be in line with Art. 5(1)(a)(III).

6.4.4. Socioeconomic Impacts

According to Oldham SAS (2016), there are several other manufacturers of gas detectors and controllers besides Oldham:

- Honeywell
- MSA
- Det-Tronics
- Dräger
- GMI
- Scott
- RKI
- RAE

Oldham SAS (2016) sells around 35,000 gas detectors and 8,000 gas controllers on the market every year, from which 75 % are placed on the EU market. Oldham SAS (2016) has about 15 to 20 % of the EU market share in fixed gas detection systems. The overall market for gas detection accounts for about 600 million USD, and about

150 million USD in the EU. At Oldham SAS (2016), the electronic boards manufacturing represents 11 employees. Should the exemption not be granted, the resulting business discontinuity, according to Oldham SAS (2016), would have also an impact on distributors' business and overall Oldham business which represents about 200 jobs in the EU. Oldham SAS (2016) will have to invest around 300,000 Euro to achieve RoHS compliance, and the applicant does not expect additional waste to be generated should the exemption not be granted.

6.4.5. Conclusions

For company-internal reasons, the applicant began too late to convert the card/board designs to enable lead-free soldering in order to achieve RoHS compliance. There is no evidence that lead-free soldering is scientifically and technically impracticable for the products in the scope of the exemption request. Neither does the applicant present specific environmental arguments that would plausibly support the conclusion that the continued use of lead in the boards/cards might be likely to outweigh the environmental and health benefits of lead substitution. Art. 5(1)(a) therefore is not applicable to justify an exemption. Additionally, the applicant would hardly, if at all, benefit from the exemption should it be granted because it is not expected to be officially published before July 2018, when the applicant wants to have achieved RoHS compliance anyway.

The socioeconomic impacts which the applicant describes do not support the assumption that, in case the exemption is not granted, the manufacturing and supply of RoHS compliant gas detectors and controllers would be affected in the EU. An interruption of supplies of gas detectors and controllers on the EU market is not to be expected since there are several other manufacturers of such equipment. As none of these manufacturers support the exemption request, it can be assumed that they can supply RoHS compliant gas detectors and controllers to the EU market. According to Oldham SAS (2016), no additional waste will be generated should the exemption not be granted.

Oldham SAS (2016) argues that at Oldham and its suppliers, around 200 jobs might be affected. Since no other manufacturers of gas detectors and controllers in the scope of the requested exemption support the request, and given the fact that the substitution of lead scientifically or technically is not impracticable, it can be assumed that no jobs at other manufacturers will be adversely affected. In contrast, in case Oldham temporarily cannot continue putting monitoring and control instruments for gas detection on the market, it is possible that other producers would be able to increase their market share and thus create new jobs.

In the consultants' interpretation of Art. 5(1)(a) based on the exemption review practices of the past years since 2011, there are no scientific, technical or environmental reasons that would justify recommending an exemption. The possible socioeconomic impacts are limited and do not support a recommendation to grant the exemption.

6.5. Recommendation

It is recommended not to grant the exemption. The applicant did not undertake sufficient efforts to achieve RoHS compliance by 22 July 2017. There are no scientific, technical or reliability-related reasons that would make the substitution of lead in the boards/cards of gas detectors and controllers impracticable. There are neither environmental and health arguments nor socio-economic impacts that would justify to recommend an exemption in line with the requirements of Art. 5(1)(a).

7. Literature

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Appendices

A.1.0 Appendix 1: Aspects relevant to the REACH Regulation

Relevant annexes and processes related to the REACH Regulation have been cross-checked to clarify:

- In what cases granting an exemption could "weaken the environmental and health protection afforded by Regulation (EC) No 1907/2006" (Article 5(1)(a), pg.1)
- Where processes related to the REACH regulation should be followed to understand where such cases may become relevant in the future;

Compiled information in this respect has been included, with short clarifications where relevant, in the following tables:

Table A-1 lists those substances appearing in Annex XIV, subject to Authorisation, which are relevant to the RoHS substances dealt with in the requests evaluated in this project. As can be seen, at present, exemptions have not been granted for the use of these substances.

Table A-1: Relevant entries from Annex XIV: List of substances subject to authorization

Designation of the substance, of the group of substances, or of the mixture	Transitional arrangements		Exempted (categories of) uses
	Latest application date (1)	Sunset date (2)	
4. Bis(2-ethylhexyl) phthalate (DEHP) EC No: 204-211-0 CAS No: 117-81-7	21 August 2013 (*)	21 February 2015 (**)	Uses in the immediate packaging of medicinal products covered under Regulation (EC) No 726/ 2004, Directive 2001/82/EC, and/or Directive 2001/83/EC
5. Benzyl butyl phthalate (BBP) EC No: 201-622-7 CAS No: 85-68-7	21 August 2013 (*)	21 February 2015 (**)	
6. Dibutyl phthalate (DBP) EC No: 201-557-4 CAS No: 84-74-2	21 August 2013 (*)	21 February 2015 (**)	
7. Diisobutyl phthalate (DIBP) EC No: 201-553-2 CAS No: 84-69-5	21 August 2013 (*)	21 February 2015 (**)	
10. Lead chromate EC No: 231-846-0 CAS No: 7758-97-6	21 Nov 2013 (*)	21 May 2015	-
11. Lead sulfochromate yellow (C.I. Pigment Yellow 34) EC No: 215-693-7 CAS No: 1344-37-2	21 Nov 2013 (*)	21 May 2015	-

Designation of the substance, of the group of substances, or of the mixture	Transitional arrangements		Exempted (categories of) uses
	Latest application date (1)	Sunset date (2)	
12. Lead chromate molybdate sulphate red (C.I. Pigment Red 104) EC No: 235-759-9 CAS No: 12656-85-8	21 Nov 2013 (*)	21 May 2015	-
16. Chromium trioxide EC No: 215-607-8 CAS No: 1333-82-0	21 Mar 2016 (*)	21 Sep 2017	-
17. Acids generated from chromium trioxide and their oligomers Group containing: Chromic acid EC No: 231-801-5 CAS No: 7738-94-5 Dichromic acid EC No: 236-881-5 CAS No: 13530-68-2 Oligomers of chromic acid and dichromic acid EC No: not yet assigned CAS No: not yet assigned	21 Mar 2016 (*)	21 Sep 2017	-
18. Sodium dichromate EC No: 234-190-3 CAS No: 7789-12-0 10588-01-9	21 Mar 2016 (*)	21 Sep 2017 (**)	-
19. Potassium dichromate EC No: 231-906-6 CAS No: 7778-50-9	21 Mar 2016 (*)	21 Sep 2017 (**)	-
20. Ammonium dichromate EC No: 232-143-1 CAS No: 7789-09-5	21 Mar 2016 (*)	21 Sep 2017 (**)	-
21. Potassium chromate EC No: 232-140-5 CAS No: 7789-00-6	21 Mar 2016 (*)	21 Sep 2017 (**)	
22. Sodium chromate EC No: 231-889-5 CAS No: 7775-11-3	21 Mar 2016 (*)	21 Sep 2017 (**)	
28. Dichromium tris(-chromate) EC No: 246-356-2 CAS No: 24613-89-6	22. Jul 2017 (*)	22 Jan 2019 (**)	
29. Strontium chromate EC No: 232-142-6 CAS CAS No: 7789-06-2	22 Jul 2017 (*)	22 Jan 2019 (**)	
30. Potassium hydroxyoctaoxodizincatedichromate EC No: 234-329-8 CAS No: 11103-86-9	22 Jul 2017 (*)	22 Jan 2019 (**)	

Designation of the substance, of the group of substances, or of the mixture	Transitional arrangements		Exempted (categories of) uses
	Latest application date (1)	Sunset date (2)	
31. Pentazinc chromate octahydroxide EC No: 256-418-0 CAS No: 49663-84-5	22 Jul 2017 (*)	22 Jan 2019 (**)	

(*) 1 September 2019 for the use of the substance in the production of spare parts for the repair of articles the production of which ceased or will cease before the sunset date indicated in the entry for that substance, where that substance was used in the production of those articles and the latter cannot function as intended without that spare part, and for the use of the substance (on its own or in a mixture) for the repair of such articles where that substance on its own or in a mixture was used in the production of those articles and the latter cannot be repaired otherwise than by using that substance.

(**) 1 March 2021 for the use of the substance in the production of spare parts for the repair of articles the production of which ceased or will cease before the sunset date indicated in the entry for that substance, where that substance was used in the production of those articles and the latter cannot function as intended without those spare parts, and for the use of the substance (on its own or in a mixture) for the repair of such articles, where that substance was used in the production of those articles and the latter cannot be repaired otherwise than by using that substance.

For the substances currently restricted according to RoHS Annex II: cadmium, hexavalent chromium, lead, mercury, polybrominated biphenyls and polybrominated diphenyl ethers and their compounds, we have found that some relevant entries are listed in Annex XVII of the REACH Regulation. The conditions of restriction are presented in Table A-2 below.

Table A-2: Conditions of Restriction in REACH Annex XVII for RoHS Substances and Compounds

Designation of the substance, group of substances, or mixture	Conditions of restriction
8. Polybromobiphenyls; Polybrominatedbiphenyls (PBB) CAS No 59536-65-1	1. Shall not be used in textile articles, such as garments, undergarments and linen, intended to come into contact with the skin. 2. Articles not complying with paragraph 1 shall not be placed on the market.
16. Lead carbonates: (a) Neutral anhydrous carbonate (PbCO 3) CAS No 598-63-0 EC No 209-943-4 (b) Trilead-bis(carbonate)-dihydroxide 2Pb CO 3 -Pb(OH) 2 CAS No 1319-46-6 EC No 215-290-6	Shall not be placed on the market, or used, as substances or in mixtures, where the substance or mixture is intended for use as paint. However, Member States may, in accordance with the provisions of International Labour Organization (ILO) Convention 13, permit the use on their territory of the substance or mixture for the restoration and maintenance of works of art and historic buildings and their interiors, as well as the placing on the market for such use. Where a Member State makes use of this derogation, it shall inform the Commission thereof.
17. Lead sulphates: (a) PbSO 4 CAS No 7446-14-2 EC No 231-198-9 (b) Pb x SO 4 CAS No 15739-80-7 EC No 239-831-0	Shall not be placed on the market, or used, as substances or in mixtures, where the substance or mixture is intended for use as paint. However, Member States may, in accordance with the provisions of International Labour Organization (ILO) Convention 13, permit the use on their territory of the substance or mixture for the restoration and maintenance of works of art and historic buildings and their interiors, as well as the placing on the market for such use. Where a Member State makes use of this derogation, it shall inform the Commission thereof.
18. Mercury compounds	Shall not be placed on the market, or used, as substances or in mixtures where the substance or mixture is intended for use: (a) to prevent the fouling by micro-organisms, plants or animals of: the hulls of boats, cages, floats, nets and any other appliances or equipment used for fish or shellfish farming, any totally or partly submerged appliances or equipment; (b) in the preservation of wood; (c) in the impregnation of heavy-duty industrial textiles and yarn intended for their manufacture; (d) in the treatment of industrial waters, irrespective of their use.

Designation of the substance, group of substances, or mixture	Conditions of restriction
18a. Mercury CAS No 7439-97-6 EC No 231-106-7	1. Shall not be placed on the market: (a) in fever thermometers; (b) in other measuring devices intended for sale to the general public (such as manometers, barometers, sphygmomanometers, thermometers other than fever thermometers). 2. The restriction in paragraph 1 shall not apply to measuring devices that were in use in the Community before 3 April 2009. However Member States may restrict or prohibit the placing on the market of such measuring devices. 3. The restriction in paragraph 1(b) shall not apply to: (a) measuring devices more than 50 years old on 3 October 2007; (b) barometers (except barometers within point (a)) until 3 October 2009. 5. The following mercury-containing measuring devices intended for industrial and professional uses shall not be placed on the market after 10 April 2014: (a) barometers; (b) hygrometers; (c) manometers; (d) sphygmomanometers; (e) strain gauges to be used with plethysmographs; (f) tensiometers; (g) thermometers and other non-electrical thermometric applications. The restriction shall also apply to measuring devices under points (a) to (g) which are placed on the market empty if intended to be filled with mercury. 6. The restriction in paragraph 5 shall not apply to: (a) sphygmomanometers to be used: (i) in epidemiological studies which are ongoing on 10 October 2012; (ii) as reference standards in clinical validation studies of mercury-free sphygmomanometers; (b) thermometers exclusively intended to perform tests according to standards that require the use of mercury thermometers until 10 October 2017; (c) mercury triple point cells which are used for the calibration of platinum resistance thermometers. 7. The following mercury-using measuring devices intended for professional and industrial uses shall not be placed on the market after 10 April 2014: (a) mercury pycnometers; (b) mercury metering devices for determination of the softening point.

Designation of the substance, group of substances, or mixture	Conditions of restriction
	8. The restrictions in paragraphs 5 and 7 shall not apply to: (a) measuring devices more than 50 years old on 3 October 2007; (b) measuring devices which are to be displayed in public exhibitions for cultural and historical purposes.
23. Cadmium CAS No 7440-43-9 EC No 231-152-8 and its compounds	For the purpose of this entry, the codes and chapters indicated in square brackets are the codes and chapters of the tariff and statistical nomenclature of Common Customs Tariff as established by Council Regulation (EEC) No 2658/87 (1). 1. Shall not be used in mixtures and articles produced from the following synthetic organic polymers (hereafter referred to as plastic material): • polymers or copolymers of vinyl chloride (PVC) [3904 10] [3904 21] • polyurethane (PUR) [3909 50] • low-density polyethylene (LDPE), with the exception of low-density polyethylene used for the production of coloured masterbatch [3901 10] • cellulose acetate (CA) [3912 11] • cellulose acetate butyrate (CAB) [3912 11] • epoxy resins [3907 30] • melamine-formaldehyde (MF) resins [3909 20] • urea-formaldehyde (UF) resins [3909 10] • unsaturated polyesters (UP) [3907 91] • polyethylene terephthalate (PET) [3907 60] • polybutylene terephthalate (PBT) • transparent/general-purpose polystyrene [3903 11] • acrylonitrile methylmethacrylate (AMMA) • cross-linked polyethylene (VPE) • high-impact polystyrene • polypropylene (PP) [3902 10] Mixtures and articles produced from plastic material as listed above shall not be placed on the market if the concentration of cadmium (expressed as Cd metal) is equal to or greater than 0,01% by weight of the plastic material. By way of derogation, the second subparagraph shall not apply to articles placed on the market before 10 December 2011. The first and second subparagraphs apply without prejudice to Council Directive 94/62/EC (13) and acts

Designation of the substance, group of substances, or mixture	Conditions of restriction
	adopted on its basis. By 19 November 2012, in accordance with Article 69, the Commission shall ask the European Chemicals Agency to prepare a dossier conforming to the requirements of Annex XV in order to assess whether the use of cadmium and its compounds in plastic material, other than that listed in subparagraph 1, should be restricted. 2. Shall not be used or placed on the market in paints with codes [3208] [3209] in a concentration (expressed as Cd metal) equal to or greater than 0,01 % by weight. For paints with codes [3208] [3209] with a zinc content exceeding 10 % by weight of the paint, the concentration of cadmium (expressed as Cd metal) shall not be equal to or greater than 0,1 % by weight. Painted articles shall not be placed on the market if the concentration of cadmium (expressed as Cd metal) is equal to or greater than 0,1 % by weight of the paint on the painted article.' 3. By way of derogation, paragraphs 1 and 2 shall not apply to articles coloured with mixtures containing cadmium for safety reasons. 4. By way of derogation, paragraph 1, second subparagraph shall not apply to: — mixtures produced from PVC waste, hereinafter referred to as 'recovered PVC', — mixtures and articles containing recovered PVC if their concentration of cadmium (expressed as Cd metal) does not exceed 0,1% by weight of the plastic material in the following rigid PVC applications: — (a) profiles and rigid sheets for building applications; (b) doors, windows, shutters, walls, blinds, fences, and roof gutters; (c) decks and terraces; (d) cable ducts; (e) pipes for non-drinking water if the recovered PVC is used in the middle layer of a multilayer pipe and is entirely covered with a layer of newly produced PVC in compliance with paragraph 1 above. Suppliers shall ensure, before the placing on the market of mixtures and articles containing recovered PVC for the first time, that these are visibly, legibly and indelibly marked as follows: '*Contains recovered PVC*' or with the following pictogram:  In accordance with Article 69 of this Regulation, the derogation granted in paragraph 4 will be reviewed, in particular with a view to reducing the limit value for cadmium and to reassess the derogation for the applications listed in points (a) to (e), by 31 December 2017.

Designation of the substance, group of substances, or mixture	Conditions of restriction
	5. For the purpose of this entry, 'cadmium plating' means any deposit or coating of metallic cadmium on a metallic surface. Shall not be used for cadmium plating metallic articles or components of the articles used in the following sectors/applications: (a) equipment and machinery for: — food production [8210] [8417 20] [8419 81] [8421 11] [8421 22] [8422] [8435] [8437] [8438] [8476 11] — agriculture [8419 31] [8424 81] [8432] [8433] [8434] [8436] — cooling and freezing [8418] — printing and book-binding [8440] [8442] [8443] (b) equipment and machinery for the production of: — household goods [7321] [8421 12] [8450] [8509] [8516] — furniture [8465] [8466] [9401] [9402] [9403] [9404] — sanitary ware [7324] — central heating and air conditioning plant [7322] [8403] [8404] [8415] In any case, whatever their use or intended final purpose, the placing on the market of cadmium-plated articles or components of such articles used in the sectors/applications listed in points (a) and (b) above and of articles manufactured in the sectors listed in point (b) above is prohibited. 6. The provisions referred to in paragraph 5 shall also be applicable to cadmium-plated articles or components of such articles when used in the sectors/applications listed in points (a) and (b) below and to articles manufactured in the sectors listed in (b) below: (a) equipment and machinery for the production of: — paper and board [8419 32] [8439] [8441] textiles and clothing [8444] [8445] [8447] [8448] [8449] [8451] [8452] (b) equipment and machinery for the production of: — industrial handling equipment and machinery [8425] [8426] [8427] [8428] [8429] [8430] [8431] — road and agricultural vehicles [chapter 87] — rolling stock [chapter 86] — vessels [chapter 89] 7. However, the restrictions in paragraphs 5 and 6 shall not apply to: — articles and components of the articles used in the aeronautical, aerospace, mining, offshore and nuclear sectors whose applications require high safety standards and in safety devices in road and agricultural

Designation of the substance, group of substances, or mixture	Conditions of restriction
	vehicles, rolling stock and vessels, — electrical contacts in any sector of use, where that is necessary to ensure the reliability required of the apparatus on which they are installed. 8. Shall not be used in brazing fillers in concentration equal to or greater than 0,01% by weight. Brazing fillers shall not be placed on the market if the concentration of cadmium (expressed as Cd metal) is equal to or greater than 0,01% by weight. For the purpose of this paragraph brazing shall mean a joining technique using alloys and undertaken at temperatures above 450 °C. 9. By way of derogation, paragraph 8 shall not apply to brazing fillers used in defence and aerospace applications and to brazing fillers used for safety reasons. 10. Shall not be used or placed on the market if the concentration is equal to or greater than 0,01% by weight of the metal in: (i) metal beads and other metal components for jewellery making; (ii) metal parts of jewellery and imitation jewellery articles and hair accessories, including: — bracelets, necklaces and rings, — piercing jewellery, — wrist-watches and wrist-wear, — brooches and cufflinks. 11. By way of derogation, paragraph 10 shall not apply to articles placed on the market before 10 December 2011 and jewellery more than 50 years old on 10 December 2011.
28. Substances which are classified as carcinogen category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 1 or Appendix 2, respectively: Cadmium carbonate Cadmium chloride Cadmium dihydroxide Cadmium dinitrate Cadmium fluoride Cadmium hydroxide Cadmium (pyrophoric)	Without prejudice to the other parts of this Annex the following shall apply to entries 28 to 30: 1. Shall not be placed on the market, or used, — as substances, — as constituents of other substances, or, — in mixtures, for supply to the general public when the individual concentration in the substance or mixture is equal to or greater than: — either the relevant specific concentration limit specified in Part 3 of Annex VI to Regulation (EC) No 1272/2008, or, — the relevant concentration specified in Directive 1999/45/EC where no specific concentration limit is set out in Part 3 of Annex VI to Regulation (EC) No 1272/2008. Without prejudice to the implementation of other Community provisions relating to the classification, packaging and labelling of substances and mixtures, suppliers shall ensure before the placing on the

Designation of the substance, group of substances, or mixture	Conditions of restriction
Cadmium nitrate Cadmium oxide Cadmium Sulphate Cadmium sulphide Chromium (VI) trioxide Zinc chromates including zinc potassium chromate Nickel Chromate Nickel dichromate Potassium dichromate Ammonium dichromate Sodium dichromate Chromyl dichloride; chromic oxychloride Potassium chromate Calcium chromate Strontium chromate Chromium III chromate; chromic chromate Sodium chromate Lead Chromate Lead hydrogen arsenate Lead Nickel Salt Lead sulfochromate yellow; C.I. Pigment Yellow 34; Lead chromate molybdate sulfate red; C.I. Pigment Red 104;	market that the packaging of such substances and mixtures is marked visibly, legibly and indelibly as follows: 'Restricted to professional users'. 2. By way of derogation, paragraph 1 shall not apply to: (a) medicinal or veterinary products as defined by Directive 2001/82/EC and Directive 2001/83/EC; (b) cosmetic products as defined by Directive 76/768/EEC; (c) the following fuels and oil products: — motor fuels which are covered by Directive 98/70/EC, — mineral oil products intended for use as fuel in mobile or fixed combustion plants, — fuels sold in closed systems (e.g. liquid gas bottles); (d) artists' paints covered by Directive 1999/45/EC; (e) the substances listed in Appendix 11, column 1, for the applications or uses listed in Appendix 11, column 2. Where a date is specified in column 2 of Appendix 11, the derogation shall apply until the said date.
29. Substances which are classified as germ cell mutagen category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 3 or Appendix 4, respectively:	

Designation of the substance, group of substances, or mixture	Conditions of restriction
Cadmium carbonate Cadmium chloride Cadmium dihydroxide Cadmium dinitrate Cadmium fluoride Cadmium hydroxide Cadmium nitrate Cadmium Sulphate Chromium (VI) trioxide Potassium dichromate Ammonium dichromate Sodium dichromate Chromyl dichloride; chromic oxychloride Potassium chromate Sodium chromate	
30. Substances which are classified as reproductive toxicant category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 5 or Appendix 6, respectively: Cadmium chloride Cadmium fluoride Cadmium Sulphate Potassium dichromate Ammonium dichromate Sodium dichromate Sodium chromate Nickel dichromate Lead compounds with the exception of those specified elsewhere in this	

Designation of the substance, group of substances, or mixture	Conditions of restriction
Annex	
Lead Arsenate	
Lead acetate	
Lead alkyls	
Lead azide	
Lead Chromate	
Lead di(acetate)	
Lead hydrogen arsenate	
Lead 2,4,6-trinitroresorcinoxide, lead styphnate	
Lead(II) methane- sulphonate	
Trilead bis- (orthophosphate)	
Lead hexa-fluorosilicate	
Mercury	
Silicic acid, lead nickel salt	

Designation of the substance, group of substances, or mixture	Conditions of restriction
47. Chromium VI compounds	1. Cement and cement-containing mixtures shall not be placed on the market, or used, if they contain, when hydrated, more than 2 mg/kg (0,0002%) soluble chromium VI of the total dry weight of the cement. 2. If reducing agents are used, then without prejudice to the application of other Community provisions on the classification, packaging and labelling of substances and mixtures, suppliers shall ensure before the placing on the market that the packaging of cement or cement-containing mixtures is visibly, legibly and indelibly marked with information on the packing date, as well as on the storage conditions and the storage period appropriate to maintaining the activity of the reducing agent and to keeping the content of soluble chromium VI below the limit indicated in paragraph 1. 3. By way of derogation, paragraphs 1 and 2 shall not apply to the placing on the market for, and use in, controlled closed and totally automated processes in which cement and cement-containing mixtures are handled solely by machines and in which there is no possibility of contact with the skin. 4. The standard adopted by the European Committee for Standardization (CEN) for testing the water-soluble chromium (VI) content of cement and cement-containing mixtures shall be used as the test method for demonstrating conformity with paragraph 1. 5. Leather articles coming into contact with the skin shall not be placed on the market where they contain chromium VI in concentrations equal to or greater than 3 mg/kg (0,0003% by weight) of the total dry weight of the leather. 6. Articles containing leather parts coming into contact with the skin shall not be placed on the market where any of those leather parts contains chromium VI in concentrations equal to or greater than 3 mg/kg (0,0003% by weight) of the total dry weight of that leather part. 7. Paragraphs 5 and 6 shall not apply to the placing on the market of second-hand articles which were in end-use in the Union before 1 May 2015.

Designation of the substance, group of substances, or mixture	Conditions of restriction
51. The following phthalates (or other CAS and EC numbers covering the substance): (a) Bis (2-ethylhexyl) phthalate (DEHP) CAS No 117-81-7 EC No 204-211-0 (b) Dibutyl phthalate (DBP) CAS No 84-74-2 EC No 201-557-4 (c) Benzyl butyl phthalate (BBP) CAS No 85-68-7 EC No 201-622-7	1. Shall not be used as substances or in mixtures, in concentrations greater than 0,1 % by weight of the plasticised material, in toys and childcare articles. 2. Toys and childcare articles containing these phthalates in a concentration greater than 0,1 % by weight of the plasticised material shall not be placed on the market. 4. For the purpose of this entry 'childcare article' shall mean any product intended to facilitate sleep, relaxation, hygiene, the feeding of children or sucking on the part of children.
62. (a) Phenylmercury acetate EC No: 200-532-5 CAS No: 62-38-4 (b) Phenylmercury propionate EC No: 203-094-3 CAS No: 103-27-5 (c) Phenylmercury 2-ethylhexanoate EC No: 236-326-7 CAS No: 13302-00-6 (d) Phenylmercury octanoate EC No: - CAS No: 13864-38-5 (e) Phenylmercury neodecanoate EC No: 247-783-7 CAS No: 26545-49-3	1. Shall not be manufactured, placed on the market or used as substances or in mixtures after 10 October 2017 if the concentration of mercury in the mixtures is equal to or greater than 0,01 % by weight. 2. Articles or any parts thereof containing one or more of these substances shall not be placed on the market after 10 October 2017 if the concentration of mercury in the articles or any part thereof is equal to or greater than 0,01 % by weight.
63. Lead CAS No 7439-92-1 EC No 231-100-4 and its compounds	1. Shall not be placed on the market or used in any individual part of jewellery articles if the concentration of lead (expressed as metal) in such a part is equal to or greater than 0,05% by weight. 2. For the purposes of paragraph 1:

Designation of the substance, group of substances, or mixture	Conditions of restriction
	(i) 'jewellery articles' shall include jewellery and imitation jewellery articles and hair accessories, including: (a) bracelets, necklaces and rings; (b) piercing jewellery; (c) wrist watches and wrist-wear; (d) brooches and cufflinks; (ii) 'any individual part' shall include the materials from which the jewellery is made, as well as the individual components of the jewellery articles. 3. Paragraph 1 shall also apply to individual parts when placed on the market or used for jewellery-making. 4. By way of derogation, paragraph 1 shall not apply to: (a) crystal glass as defined in Annex I (categories 1, 2, 3 and 4) to Council Directive 69/493/EEC (*); (b) internal components of watch timepieces inaccessible to consumers; (c) non-synthetic or reconstructed precious and semiprecious stones (CN code 7103, as established by Regulation (EEC) No 2658/87), unless they have been treated with lead or its compounds or mixtures containing these substances; (d) enamels, defined as vitrifiable mixtures resulting from the fusion, vitrification or sintering of minerals melted at a temperature of at least 500 °C. 5. By way of derogation, paragraph 1 shall not apply to jewellery articles placed on the market for the first time before 9 October 2013 and jewellery articles articles produced before 10 December 1961. 6. By 9 October 2017, the Commission shall re-evaluate paragraphs 1 to 5 of this entry in the light of new scientific information, including the availability of alternatives and the migration of lead from the articles referred to in paragraph 1 and, if appropriate, modify this entry accordingly. 7. Shall not be placed on the market or used in articles supplied to the general public, if the concentration of lead (expressed as metal) in those articles or accessible parts thereof is equal to or greater than 0,05% by weight, and those articles or accessible parts thereof may, during normal or reasonably foreseeable conditions of use, be placed in the mouth by children. That limit shall not apply where it can be demonstrated that the rate of lead release from such an article or any such accessible part of an article, whether coated or uncoated, does not exceed 0,05 µg/cm 2 per hour (equivalent to 0,05 µg/g/h), and, for coated articles, that the coating is sufficient to ensure that this release rate is not exceeded for a period of at least two years of normal or reasonably foreseeable conditions of use of the article. For the purposes of this paragraph, it is considered that an article or accessible part of an article may be placed in the mouth by children if it is smaller than 5 cm in one dimension or has a detachable or protruding part of that size. 8. By way of derogation, paragraph 7 shall not apply to: (a) jewellery articles covered by paragraph 1; (b) crystal glass as defined in Annex I (categories 1, 2, 3 and 4) to Directive 69/493/ EEC;

Designation of the substance, group of substances, or mixture	Conditions of restriction
	(c) non-synthetic or reconstructed precious and semi-precious stones (CN code 7103 as established by Regulation (EEC) No 2658/ 87) unless they have been treated with lead or its compounds or mixtures containing these substances; (d) enamels, defined as vitrifiable mixtures resulting from the fusion, vitrification or sintering of mineral melted at a temperature of at least 500 ° C; (e) keys and locks, including padlocks; (f) musical instruments; (g) articles and parts of articles comprising brass alloys, if the concentration of lead (expressed as metal) in the brass alloy does not exceed 0,5% by weight; (h) the tips of writing instruments; (i) religious articles; (j) portable zinc-carbon batteries and button cell batteries; (k) articles within the scope of: (i) Directive 94/62/EC; (ii) Regulation (EC) No 1935/2004; (iii) Directive 2009/48/EC of the European Parliament and of the Council (**); (iv) Directive 2011/65/EU of the European Parliament and of the Council (***) 9. By 1 July 2019, the Commission shall re-evaluate paragraphs 7 and 8(e), (f), (i) and (j) of this entry in the light of new scientific information, including the availability of alternatives and the migration of lead from the articles referred to in paragraph 7, including the requirement on coating integrity, and, if appropriate, modify this entry accordingly. 10. By way of derogation paragraph 7 shall not apply to articles placed on the market for the first time before 1 June 2016. --- (*) OJ L 326, 29.12.1969, p. 36. (**) Directive 2009/48/EC of the European Parliament and of the Council of 18 June 2009 on the safety of toys (OJ L 170, 30.6.2009, p. 1). (***) Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (OJ L 174, 1.7.2011, p. 88).
67. Bis(pentabromophenyl)ether (decabromodiphenyl ether; decaBDE) CAS No 1163-19-5 EC No 214-604-9	1. Shall not be manufactured or placed on the market as a substance on its own after 2 March 2019. 2. Shall not be used in the production of, or placed on the market in: (a) another substance, as a constituent; (b) a mixture; (c) an article, or any part thereof, in a concentration equal to or greater than 0,1% by weight, after 2 March 2019.

Designation of the substance, group of substances, or mixture	Conditions of restriction
	3. Paragraphs 1 and 2 shall not apply to a substance, constituent of another substance or mixture that is to be used, or is used: (a) in the production of an aircraft before 2 March 2027. (b) in the production of spare parts for either of the following: (i) an aircraft produced before 2 March 2027; (ii) motor vehicles within the scope of Directive 2007/46/EC, agricultural and forestry vehicles within the scope of Regulation (EU) No 167/2013 of the European Parliament and of the Council (*) or machinery within the scope of Directive 2006/42/EC of the European Parliament and of the Council (**), produced before 2 March 2019 4. Subparagraph 2(c) shall not apply to any of the following: (a) articles placed on the market before 2 March 2019; (b) aircraft produced in accordance with subparagraph 3(a); (c) spare parts of aircraft, vehicles or machines produced in accordance with subparagraph 3(b); (d) electrical and electronic equipment within the scope of Directive 2011/65/EU. 5. For the purposes of this entry 'aircraft' means one of the following: (a) a civil aircraft produced in accordance with a type certificate issued under Regulation (EU) No 216/2008 of the European Parliament and of the Council (***) or with a design approval issued under the national regulations of a contracting State of the International Civil Aviation Organisation (ICAO), or for which a certificate of airworthiness has been issued by an ICAO contracting State under Annex 8 to the Convention on International Civil Aviation; (b) a military aircraft. (*) Regulation (EU) No 167/2013 of the European Parliament and of the Council of 5 February 2013 on the approval and market surveillance of agricultural and forestry vehicles (OL L 60, 2.3.2013, p. 1). (**) Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (OJ L 157, 9.6.2006, p. 24). (***) Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79 19.3.2008, p. 1).

As of 14 September 2018, the REACH Regulation Candidate list includes various substances of relevance for RoHS. Proceedings concerning the addition of these substances to the Authorisation list (Annex XIV) have begun and shall be followed by the evaluation team to determine possible discrepancies with future requests of exemption from RoHS (new exemptions, renewals and revokes).