Socio-economic analysis of the impacts of the proposed REACH restriction on intentionally added microplastics on the detergents and maintenance products sector

International Association for Soaps, Detergents and Maintenance Products (A.I.S.E.)

Final report

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Important note for the reader - Use of decimal marks in this report
In this report: • 10,000 refers to ten thousand rather than ten; and • 100.25 refer to one hundred and a quarter.

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The study team would also like to thank and acknowledge the contribution of those authors that worked on the previous SEA study in 2018 (conducted by eftec for AISE) as this report is essentially an update of the 2018 report.

Disclaimer

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Executive summary

This SEA report has been provided to ECHA in the 2nd public consultation process on the proposed REACH restriction on intentionally added microplastics to help SEAC finalise their opinion. For the purposes of the SEA analysis, it is assumed in the restriction scenario that an 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products.

The data underlying the analysis presented in this SEA report has been gathered through consultation with A.I.S.E. members in July 2020 in the form of an excel-based questionnaire. Therefore the analysis presented reflects the expected costs and benefits of the latest restriction scope published in the 2nd public consultation (PC). This builds on from previous surveys and interviews carried out in April 2019 based on the scope of the proposed restriction published during the 1st public consultation. The main differences in the key results are presented in **Table 1**.

Table 1: Comparison of impacts based on different restriction scopes (1st PC vs 2nd PC restriction scope)

	Unit	Old scope (1st PC)	Latest / revised scope (June 2020 for 2nd PC)
Volume of polymers affected	Tonnes per year	16,900	13,700
Number of reformulations required	Number	22,000	17,000
Total costs	€ million (NPV over 20 years)	€3,067	€1,627
Avoided emissions from restriction	Tonnes over 20 years	117,470	66,320
Cost per kg avoided	€/kg	26	25

There is a lack of studies that have identified and assessed the suitability of possible alternatives to the use of polymers potentially qualifying as microplastics in detergent and maintenance products. To date, alternatives identified within existing literature have directly been ruled out as not being suitable by the same authors. Reformulation is expected to be at least the *initial* response of the majority of companies in the detergents and maintenance industry to a restriction on microplastics based on the ECHA definition. This is an initial response because whether reformulation will be successful or not is uncertain, and this will determine whether further action (and hence investment) is required to comply with the restriction.

The findings from the interviews and questionnaires continue to support the need for a 10 year transition period for encapsulated fragrances (rather than 8 years), in order to allow for a full reformulation of all affected products. Furthermore, a longer timeline is expected to foster greater innovation, a key driver for business, and allow for a better choice of alternatives thereby avoiding

regrettable substitutions.

A sensitivity analysis was undertaken on cost and benefit components to identify to what extent changes in certain components have an influence on the findings. The main findings are that:

- Reducing the transition period from 8 years to 5 years encapsulated fragrances would only reduce emissions avoided by 1% but would increase the costs of the proposed restriction by around a quarter, assuming there were suitable alternatives to enable a full transition within 5 years.
- Maintaining a transition period of 8 years encapsulated fragrances and giving all other detergent and maintenance products a transition period of 6 years would reduce the costs by a quarter, whilst only reducing emissions avoided by 4%.
- Moving away from using a conservative unit cost for reformulation (i.e. simple reformulation) to what was reported by companies taking part in an interview and/or questionnaire would triple the expected costs of the proposed restriction (i.e. costs of €6.6 billion NPV).

Based on the findings in this SEA report a key conclusion is that **maintaining a transition period of 8 years for encapsulated fragrances is justified.** The longer transition period is essential to enable sufficient time for research and testing of suitable alternatives in order to avoid negative impacts on the environment and on customer satisfaction. This is supported by information submitted by the International Fragrance Association (IFRA) into the 2nd public consultation. Reducing the transition period to 5 years would trigger changes in consumer fabric washing behaviour and increase unintentional releases of additional microfibres form the additional washing of synthetic clothing. A reduction in the transition period would only reduce emissions avoided by 1% but increase the costs of the proposed restriction (on the sector) by around a third.

It would also seem **justified to extend the transition period for all other detergent and maintenance products to 6 years**. It is important to remember that there is currently a lack of alternatives and time is required to conduct major reformulations for 17,000 formulations. The costs of reformulation used by ECHA assumes that all reformulations are 'simple'. If this assumption is not true (which is not realistic), it is expected triple the costs of the proposed restriction. Therefore granting additional time at least allow for more innovative solutions to be found in a more cost-effective way that links to other targets (e.g. reduced packaging) rather than reverting to old technology or possible regrettable substitution in order meet the 5 year transition period.

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Abbreviations & acronyms

A.I.S.E.	International Association for Soaps, Detergents and Maintenance Products
°C	Degree Celsius – a measure of temperature
CfE	Call for Evidence
ECDC	European Centre for Disease Prevention and Control
ECHA	European Chemicals Agency
EiF	Entry into force
EU	European Union
GVA	Gross Value Added
HAI	Healthcare-associated infection
kPa	Kilopascal – a measure of pressure
NPV	Net Present Value
PC&H	Professional cleaning & hygiene
PV	Present Value
RAC	Committee for Risk Assessment
PAMs	Polyacrylamides
R&D	Research & Development
REACH	Regulation on the Registration, Evaluation, Authorisation & Restriction of Chemicals
RMO	Risk Management Option
SEA	Socio-economic analysis
SEAC	Committee for Socio-Economic Analysis
SMEs	Small and medium-sized enterprises
w/w	Weight by weight

1. Introduction

This report analyses the impacts of changes made by the Risk Assessment Committee (RAC) and the Socio Economic Analysis Committee (SEAC) as set out in the published SEAC draft opinion in June 2020 on the proposed REACH restriction on intentionally added microplastics by ECHA (as dossier submitter) in their Annex XV dossier[1].

The results presented in this report relate to the impacts on the detergents and maintenance products sector based on new information provided by A.I.S.E. members through questionnaires in July 2020 as well as the SEA report prepared in 2018 (which was submitted to ECHA during the Call for Evidence) and the revised SEA report in 2019.

Section 1.1 describes the background of this study, while Section 1.2 summarise the updated definition of microplastics and the proposed restriction as set out in the Annex XV dossier. In relation to the definition and proposed derogations, Section 1.3 highlights the parts which require further clarification according to interviews with affected parties. The scope and objectives of this study, the applied approach for carrying out the analysis and the content of subsequent chapters are described in the latter parts of the chapter, i.e. Section 1.4 to 1.6.

1.1 Background

1.1.1 What is the problem?

According to a study carried out by Eunomia on behalf of the European Commission, marine litter, of which plastic makes up a large proportion, is a significant global problem with negative environmental and socio-economic impacts (European Commission, 2016). Eunomia (2016) estimated that approximately 10 million tonnes of plastic originating from land-based sources enter the marine environment annually. The amount of primary microplastics, i.e. plastic particles released to the marine environment in this small size, entering the marine environment annually is estimated at 0.95 million tonnes per year.

Primary microplastics as well as small plastic particles originating from the break-up of large plastics items, i.e. secondary microplastics, are described as an environmental and human health concern. There is in fact a high potential for ingestion by marine animals throughout the food chain including species destined for human consumption (European Commission, 2016).

A study on intentionally added microplastics carried out by AMEC Foster Wheeler and its partners on behalf of the European Commission, which was published in October 2017, analysed the use of microplastics in personal care products, paints and coatings, detergents and industrial abrasives amongst others. Based on a review of definitions used in existing and proposed national bans and a review of key concepts deemed relevant, the study defined microplastics as particles consisting of man-made conventional plastics, biodegradable plastics, bio-based analogue plastics or bio-based alternative plastics. To be considered a microplastic, these particles needed to be solid, water-insoluble and have a size below 5 millimetres. Based on this definition, it was estimated that approximately 195 tonnes of microplastics were used in the

[1] For more information, see: ECHA webpage: https://echa.europa.eu/registry-of-restriction-intentions/-/dislist/details/0b0236e18244cd73

detergents and maintenance products sector at an average concentration of 4% as of 2016 (European Commission, 2017a).

1.1.2 Regulatory process in the European Union and A.I.S.E.'s past activities

In light of the availability of scientific evidence indicating that microplastics pose a threat to the aquatic environment, the European Commission requested the European Chemicals Agency (ECHA) to prepare "*an Annex XV dossier in view of a possible restriction of synthetic water-insoluble polymers of 5mm or less in any dimension (i.e., microplastics particles)*" (European Commission, 2017b, p.1) in November 2017. In its mandate, the Commission also requested an assessment of the need to add additional criteria, e.g. biodegradability and a solid state in the aquatic environment, to the definition of microplastics particles (European Commission, 2017b). In response, ECHA formally declared its intentions to prepare a REACH Annex XV dossier "*for intentionally added microplastic particles to consumer or professional use products of any kind*" (ECHA, 2018a) in January 2018.

In the same month, the European Commission officially launched its plastic strategy in an effort to transition to a more circular economy and tackle the problem of plastic pollution in land and marine environments. In addition to the restriction of the intentional use of microplastics, key objectives of the strategy include a reduction of single-use plastics and making 100% of plastic packaging recyclable by 2030 (European Commission, 2018).

To support its efforts in preparing an Annex XV dossier, a Call for Evidence (CfE) was launched by ECHA on 1 March 2018 (ECHA, 2018b). A broad 'working definition' defining microplastic particles as "*any polymer-containing solid or semi-solid particle having a size of 5mm or less in at least one external dimension" (*ECHA, 2018c, p.3*)* was underlying this Call for Evidence. At the time, ECHA specifically sought input on (i) the appropriateness and clarity of the adopted working definition and (ii) the uses of intentionally added microplastics. In-depth information was requested on the identity and volume of polymers used, the concentration in products, the particle size distribution as well as their physicochemical properties and biodegradability. Further topics of interest to ECHA were (iii) the technical function of the polymers falling under the microplastic definition, (iv) potential alternatives, (v) the socio-economic impacts on society, i.e. the cost and benefits of a regulation on affected actors, as well as (vi) available analytical methods for detecting microplastics in products (ECHA, 2018c).

An alternative definition was proposed by A.I.S.E. which suggested to define microplastic particles as "water-insoluble solid plastic particles with a size less than 5 millimetres that can be found as aquatic litter" in order to ensure that policy actions are effective and their impacts limited to substances contributing to aquatic litter problem and the associated risks.

To support A.I.S.E. to better understand the impacts of the potential restriction, eftec carried out a socio-economic analysis (SEA) of a potential restriction of intentionally added microplastics in May 2018. This report was submitted to ECHA during the Call for Evidence public consultation. The main objective of that study as to carry out an analysis specifically for the detergent and maintenance sector based on both (i) ECHA's working definition, and (ii) A.I.S.E.'s definition of microplastics.

Combining desk research and a survey among A.I.S.E. members, eftec's analysis provided information on

(i) the substances used by companies in the detergents and maintenance products sector falling under the different microplastics definitions, (ii) their role and the societal benefit of their use, (iii) the availability of adequate alternatives including their technical and economic feasibility and (iv) the socio-economic impacts of a potential restriction on industry and consumers. The broad categories at risk in the detergents and maintenance products included opacifiers, pearling agents, ingredients used for waxes and polishes as well as encapsulated ingredients such as fragrances.

Following an assessment of the information provided during the Call for Evidence and its own research, ECHA published its Annex XV dossier on 30 January 2019. In the dossier, ECHA concludes that an EU-wide restriction is justified. More specifically, the restriction proposal concludes that *"microplastics should be treated as a non-threshold substances [sic] for the purposes of risk assessment, similar to PBT/vPvB substances under the REACH regulation, with any release to the environment assumed to result in a risk"* (ECHA, 2019a, p.73). It further concludes that the risks arising from intentional uses are not adequately controlled.

As a consequence, ECHA proposes three different measures, i.e. a restriction of putting microplastics – on their own or in mixtures – on the market, a instructions for use obligation and a reporting obligation. To ensure the proportionality of the restriction, the Annex XV dossier also proposes derogations (ECHA, 2019a).

1.1.3 Regulatory process post publication of Annex XV dossier

First public consultation on Annex XV dossier

Following the publication of the Annex XV dossier and the successful conformity check, a public consultation opened from March until September 2019 seeking feedback on the proposed restriction (ECHA, 2019b). In addition to general comments on the proposed restriction, this was specifically requesting feedback or information on a number of issues, e.g.:

- The methods and criteria proposed for establishing whether a polymer can be considered to be biodegradable;
- The minimum concentration of microplastics required for fulfilling the technical function; and
- Analytical methods for detecting and quantifying microplastics in products (ECHA, 2019b).

The information provided during the public consultation was taken into account by the Committee for Risk Assessment (RAC) and Committee for Socio-Economic Analysis (SEAC) during the opinion-forming process. Factors that were discussed by the two committees when forming their opinion on the proposed restriction included the costs and benefits of the proposed restriction and whether the risk is appropriately controlled.

Second public consultation on draft SEAC opinion

On the 1st July 2020, the SEAC's draft opinion was published, and stakeholders have the opportunity to provide written comments on the opinion within 60 days of the publication (by 1st of September 2020). Comments received will then be reviewed with the intention to finalise the SEAC opinion in December 2020. Following the receipt of RAC's and SEAC's final opinions (ECHA, n.d.), the European Commission has three months to submit a draft amendment to REACH Annex XVII".

1.2 Proposed restriction (2nd PC version)

The proposed REACH restriction on intentionally added microplastics includes three different measures, i.e. a restriction of putting microplastics – on their own or in mixtures – on the market, an instructions for use obligation and a reporting obligation. It is presented in Box 1.1, and it is based on Table 17 of the Annex XV dossier, as revised in SEAC's draft opinion.

Table 17 Proposed restriction on the use of microplastics	**Box 1.1: Proposed REACH restriction on intentionally added microplastics**
Polymers within the meaning of Article 3(5) of Regulation (EC) No 1907/2006)	1. Shall not, from [entry into force (EiF)], be placed on the market as a substance on its own or in a mixture as a microplastic in a concentration equal to or greater than [0.01]% w/w. 2. For the purposes of this entry: a. 'microplastic' means particles containing solid polymer, to which additives or other substances may have been added, and where ≥ 1% w/w of particles have (i) all dimensions 0.1µm ≤ x ≤ 5mm, or (ii), for fibres, a length of 0.3µm ≤ x ≤ 15mm and length to diameter ratio of >3. b. 'microbead' means a microplastic used in a mixture as an abrasive i.e. to exfoliate, polish or clean. c. 'particle' is a minute piece of matter with defined physical boundaries; a defined physical boundary is an interface. Single molecules are not particles. d. 'particles containing solid polymer' means either (i) a particle of any composition with a continuous solid polymer surface coating of any thickness or (ii) particles of any composition with a solid polymer content of ≥ 1% w/w. e. 'solid' means a substance or a mixture which does not meet the definitions of liquid or gas. f. 'gas' means a substance which (i) at 50 °C has a vapour pressure greater than 300 kPa (absolute); or (ii) is completely gaseous at 20 °C at a standard pressure of 101.3 kPa. g. 'liquid' means a substance or mixture which (i) at 50 °C has a vapour pressure of not more than 300 kPa (3 bar); (ii) is not completely gaseous at 20 °C and at a standard pressure of 101.3 kPa; and (iii) which has a melting point or initial melting point of 20 °C or less at a standard pressure of 101.3 kPa; or (b) fulfilling the criteria in ASTM D 4359-90; or (c) the fluidity test (penetrometer test) in section 2.3.4 of Annex A of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). 3. Paragraph 2a and 2b shall not apply to:

	a. Natural polymers (as defined in REACH Guidance on monomers and polymers) that have not been chemically modified (as defined in REACH Article 3(40)). b. Polymers that are (bio)degradable, as set out in the criteria in Appendix X. c. Polymers with a solubility > 2 g/L, according to the criteria in Appendix Y. 4. Paragraph 1 shall not apply to the placing on the market of: a. Substances or mixtures containing microplastics for use at industrial sites. b. Medicinal products for human or veterinary use as defined in EU Directives 2001/83/EC and 2001/82/EC. c. Substances or mixtures that are regulated in the EU under Regulation (EC) No. 2019/1009 on Fertilising Products. d. Substances or mixtures containing food additives as defined in EU Regulation (EC) No. 1333/2008. e. In vitro diagnostic devices f. Sewage sludge (as defined in Directive XXX/XXX) and compost g. Food and feed h. [OPTION A: granular infill used on synthetic sports surfaces where risk management measures are used to ensure that annual releases of microplastic do not exceed 7g/m^2] 5. Paragraph 1 shall not apply to the placing on the market of: a. Substances or mixtures containing microplastic where the microplastic is contained by technical means to prevent releases to the environment during end use. b. Substances or mixtures containing microplastic where the physical properties of the microplastic are permanently modified during end use, such that the polymers no longer fulfil the meaning of a microplastic given in paragraph 2(a). c. Substances or mixtures containing microplastics where microplastics are permanently incorporated into a solid matrix when used. 6. Paragraph 1 shall apply from: a. EiF for cosmetic products (as defined in Article 2(1)(a) of regulation (EC) No 1223/2009) and other mixtures containing microbeads. b. EiF + 6 years for medical devices as defined in Directive 93/42/EEC or in the classification rule 21 set in Annex VIII to Regulation (EU) 2017/745. c. EiF + 4 years for 'rinse-off' cosmetic products (as defined in regulation (EC) No 1223/2009) not already included in paragraph 6(a).

	d. EiF + [5/8] years for the encapsulation of fragrances in detergents (as defined in Regulation (EC) No 648/2004), cosmetic products (as defined in Regulation (EC) No 1223/2009) or other mixtures. e. EiF + 5 years for detergents (as defined in Regulation (EC) No 648/2004), waxes, polishes and air care products not already included in paragraphs 6(a) or 6(d). f. EiF + 5 years for fertilising products not regulated in the EU as fertilising products under Regulation (EC) No 2019/1009 that do not meet the requirements for biodegradability contained in that Regulation. g. EiF + 8 years for plant protection products as defined in Regulation (EC) No 1107/2009 and biocides as defined in Regulation (EU) 528/2012. h. EiF + 5 years for other agricultural and horticultural uses including seed treatments i. EiF + 6 years for 'leave-on' cosmetic products (as defined in regulation (EC) No 1223/2009). j. [Either i. EiF + 3 years for granular infill used on synthetic sports surfaces (if 4(h) retained – OPTION A) or, ii. EiF + 6 years for granular infill used on synthetic sports surfaces (if 4(h) not retained– OPTION B)] 7. From [EiF + 24 months] any supplier of a substance or mixture containing a microplastic derogated from paragraph 1 on the basis of paragraphs 4(a), 4(b), 4(d), 4(e) or 5 shall ensure that, where applicable, either the label and/or SDS and/or 'instructions for use' (IFU) and/or 'package leaflet' provides, in addition to that required by other relevant legislation, any relevant instructions for use to avoid releases of microplastic to the environment, including at the waste life-cycle stage. The instructions shall be clearly visible, legible and indelible. Instructions may be in the form of pictograms. Where written instructions are given, these shall be in the official language(s) of the Member State(s) where the substance or mixture is placed on the market, unless the Member State(s) concerned provide(s) otherwise. In addition, any supplier of a substance or mixture containing a microplastic derogated from paragraph 1 on the basis of paragraph 4(a) shall identify, where applicable, either on the label and/or SDS and/or 'instructions for use' (IFU) and/or 'package leaflet' that (i) the substance or mixture is subject to the conditions of this restriction (ii) the quantity (or concentration) of microplastic in the substance or mixture and (iii) sufficient information on the polymer(s) contained in the substance or mixture for downstream users or suppliers to comply with paragraph 8.

	8. 2. From [EiF + 36 months], any [industrial] downstream user using microplastic(s) derogated from paragraph 1 on the basis of paragraph 4(a) shall send to ECHA in the format required by Article 111 of REACH, by 31 January of each calendar year: a) a description of the use(s) of microplastic in the previous calendar year, b) For each use, generic information on the identity of the polymer(s) used, c) For each use, an estimate of the quantity of microplastic released to the environment in the previous calendar year. Any supplier placing a microplastic derogated from paragraph 1 on the market for the first time on the basis of paragraphs 4(b), 4(d), 4(e), or 5 shall send to ECHA in the format required by Article 111 of REACH, by 31 January of each calendar year: d) a description of the intended end use(s) of microplastic placed on the market in the previous calendar year, e) For each intended end use, generic information on the identity of the polymer(s) placed on the market, f) For each intended end use, an estimate of the quantity of microplastic released to the environment in the previous calendar year. ECHA shall publish a report summarising the information received by 30 June every year.

1.3 Stakeholder feedback on the definition and derogations

It is important that all affected parties clearly understand which polymers falls under the definition of microplastics and under the proposed derogations as set out in the Annex XV dossier.

A.I.S.E. developed a position paper submitted during the 1st publication that outlines four important issues related to the proposed definition currently in the draft Annex XV REACH restriction and explained why the restriction would be problematic for both economic operators and enforcement authorities (A.I.S.E., 2019a) In summary, A.I.S.E considers:

- **The scope of the restriction unclear**. Firstly, ECHA does not clearly substantiate why all solid polymers particles below 5 mm are considered (micro) plastics. Although all plastics are polymers, not all polymers are plastics (including microplastics). Furthermore, the accepted international definition for "plastic" (ISO 472) and the upcoming definition on Microplastics under finalization by ISO/TC 61/SC 14/WG 4 "*Solid plastic particles insoluble in water with any dimension between 1 µm and 1 000 µm (= 1 mm)*" has not been considered in the proposed definition.[2]

- **The substance identity is ambiguous**. The draft Annex XV dossier is based on the REACH

[2] *The ISO working group ISO/TC 61/SC 14/WG 4 is finalizing a Technical Report on the "Characterization of plastics leaked into the environment, including microplastics". This report is expected to be published in the course of 2019 and contains the current definition of microplastics: "Solid plastic particles insoluble in water with any dimension between 1 µm and 1 000 µm (= 1 mm)" and of large microplastic "solid plastic particle insoluble in water with any dimension between 1 mm and 5 mm". For additional information see* https://www.iso.org/committee/6578018.html

definition of a polymer (Art. 3 (5)) and the term 'microplastic'. In A.I.S.E.'s view, this approach creates confusion and ambiguity on the scope of the restriction and does not provide the required legal certainty in the identification of the targeted substances.

- **There is a lack of proportionality**. As mentioned in the recent 2019 Independent Expert Report by the EU Commission Group of Scientific Advisors on Microplastic Pollution, materials which pose the highest potential risks should be targeted first (e.g. high volume, high persistency, high release). However, beyond the proposed derogation on biodegradability, the current draft restriction lacks any consideration related to the solid polymers of highest concern and their related prioritization. This could result in a restriction affecting all polymers irrespective of their environmental impact.

- **The labelling and reporting obligation is problematic**. These requirements will result in a significant burden for economic operators that will have to report and potentially re-label a very high number of products, in particular polymers derogated as "microplastics for use at industrial sites" (paragraph 4a) and microplastics "where the physical properties of the microplastic are permanently modified when the substance or mixture is used" (paragraph 5b). More importantly, this may also lead to the market stigmatization of products that need to comply with the labelling requirement. Given the nature of the polymers that fall under these two derogations, it is considered more appropriate to exempt these from the scope of the restriction.

A.I.S.E.'s views were mirrored during the interviews with manufacturers of detergent and maintenance products and suppliers of polymers in April 2019, as all interviewees commented on the need for greater clarity from ECHA (as the dossier submitter) on both the definition of microplastics and each of the proposed derogations as they currently can be interpreted differently and therefore there are serious concerns over the enforceability and ability of companies to prove compliance.

Given that ECHA held a Q&A session on the interpretation of the proposed restriction that required different experts within ECHA to attempt to answer specific questions (with varying degrees of clarity or lack of in some cases) clearly highlights that the draft of the dossier lacks the clarity required for companies (who may not have the same level of expertise available as ECHA does) to collectively understand the extent to which they are affected and therefore the scale of any reformulation effort required.

Recently, the SEAC's draft opinion was published, which includes the revised scope of the restriction. It is evident that numerous issues with the proposed restriction have been resolved and some of the uncertainties associated with the interpretation of the restriction have been clarified.

Nevertheless, depending on how each polymer is purchased, how it is used and what else is in the product, it may or may not fall under a derogation, and this creates too much complexity and uncertainty. Further guidance and clarifications as a minimum are needed from ECHA with regards to the scope and derogations of the proposed restriction, as some aspects remain open to interpretation. For instance, water treatment products may be exempt under the "use at industrial sites" derogation, as these are professional or industrial products mainly used at industrial sites or may be exempt under the "permanently incorporated into a solid matrix when used" derogation.

Moreover, it is still not clear how the regulation will be implemented, and how ECHA and/or Member State Competent Authorities or any other enforcement authority can check whether a product is compliant in the market. Much more Information and guidance from ECHA (as dossier submitter) is required so that companies understand how to comply, as well as to ensure that different enforcement agencies / Member State Competent Authorities interpret the definition and derogations in the same way.

With regard to the changes in the derogations, although some of the derogations were not considered clear by stakeholders during the previous consultation (April 2019). these are now considered to be moving towards the right direction, based on scientific research and stakeholder consultations. ,Stakeholders were further consulted on how the revised derogations impact their businesses (July 2020 A.I.S.E. survey).

Overall, numerous respondents view the changes positively, a few changes are considered to have made the restriction worse, whilst a number of companies have not been affected by the changes or the impact of the changes is considered minimal.

Most importantly, the sector previously considered soluble polymers derogated under paragraph 5b. However, paragraph 5b did not explicitly mention solubility (nor did it include a threshold), therefore there was a lot of uncertainty on whether certain substances or mixtures were considered microplastics, for example, it was not clear whether thickeners, and water swellable materials were derogated under paragraph 5b. As such, **the industry has welcomed the inclusion of a derogation for soluble polymers**.

This is reflected in the responses to the most recent A.I.S.E survey (July 2020), where all respondents have indicated that they benefit from the inclusion of soluble polymers as a derogation. In particular the derogation has reduced considerably the impact of the restriction on many companies' product portfolio, as numerous polymers are now derogated. Some respondents also noted that the explicit mention of soluble polymers clarifies uncertainties around whether these are considered microplastics, but most importantly, companies do not have to report soluble polymers as microplastics to ECHA, which does not compromise the overall environmental benefits the restriction aims to achieve. Nevertheless, one respondent commented that a solubility cut off of 100 mg/L would be more appropriate.

In addition to this, **the majority of respondents (85%) view a transition period of eight years for the encapsulation of fragrances in detergents positively**. More specifically, respondents highlighted that so far there are no suitable alternatives available, and that an eight year transition allows for the selection of better, long-term alternatives, leading to better and more cost-effective reformulations. A shorter transition period could result in regrettable substitutions (with an adverse environmental, societal and business impact) and loss of market share. Therefore, five years are not considered a viable transition period. More evidence to support the eight transition period for encapsulation of fragrances in detergents is presented in Section 3.

1.4 Project scope and objectives

The main objective of this study was to carry out a socio-economic analysis (SEA) based on the refined definition used in the SEAC draft opinion of Annex XV dossier – as set out in Section 1.2 of this report – which can then be submitted to the public consultation for SEAC's consideration during the finalisation of their opinion-.

SEAC will consider whether the proposed restriction can be deemed proportionate and whether any changes to the derogations are needed (ECHA, 2019b). The study therefore attempts to provide updated information on the costs and benefits of the regulation specifically for the detergent and maintenance products sector and additional evidence to support a 8 year transition period for encapsulated fragrances.

1.5 SEA approach

The socio-economic analysis (SEA) has been carried out in accordance with ECHA's SEA Guidance (ECHA 2008). It seeks to assess the impacts of the proposed restriction based on ECHA's refined definition by estimating the 'net' impacts relative to the baseline scenario, which is the current situation in the absence of a restriction. As per ECHA's Guidance, the analysis has been carried out from society's perspective rather than the perspective of the detergent and maintenance sector.

The work has been carried out in three phases to align with the timing of ECHA's request to provide specific data in accordance with RAC's and SEAC's meeting schedules and the focus topics of each of the meetings. As SEAC's first meeting – after the conformity check – in June 2019 focused on the verification of the scope and the costs of the proposed restriction (ECHA, 2019b), these points were the focus of the first work phase. The second phase delivered results in time for the first deadline for comments on the Annex XV dossier on 20 May 2019. This third phase aims to deliver results in time for the second public consultation, ending on the 1st of September 2020.

As a first step – to support the development of questions targeted at stakeholders by identifying points of special concern – a rapid evidence review of the Annex XV dossier was carried out. This was followed by the stakeholder consultation process, which lies at the basis of the analysis.

The analysis is based on information collected from A.I.S.E. members through an excel based questionnaire in April 2019 and July 2020. Interviews were carried out in April 2019 with both large companies as well as an SME and covered companies active in both the household care and professional cleaning & hygiene sector. The purpose of these interviews was to enable more in-depth exchange of information on specific issues such as the process of reformulation and challenges faced by the companies in this respect, as well as the clarity of the applied definition and proposed regulation.

The most recent excel questionnaire in July 2020 focused on gathering data on how the sector is affected following changes in the scope of the proposed restriction and any of the revised derogations, and the extent of reformulation now required. This aimed at creating an understanding of how the proposed restriction affects companies' products and the costs and impacts associated with reformulation. The questionnaire also sought to understand how long companies required to transition from polymers affected by the revised scope of the restriction.

It is important to note that the latest questionnaire in 2020 only targeted companies that previously responded to the previous survey in April 2020 (n=14), as we were interested in understanding how the proposed restriction changes the data previously provided by these fourteen respondents. As illustrated in **Figure 1.1**, 7 responses were received to the excel questionnaire. These seven companies were all large companies and the information provided was aggregated to preserve the confidentiality of individual

responses.

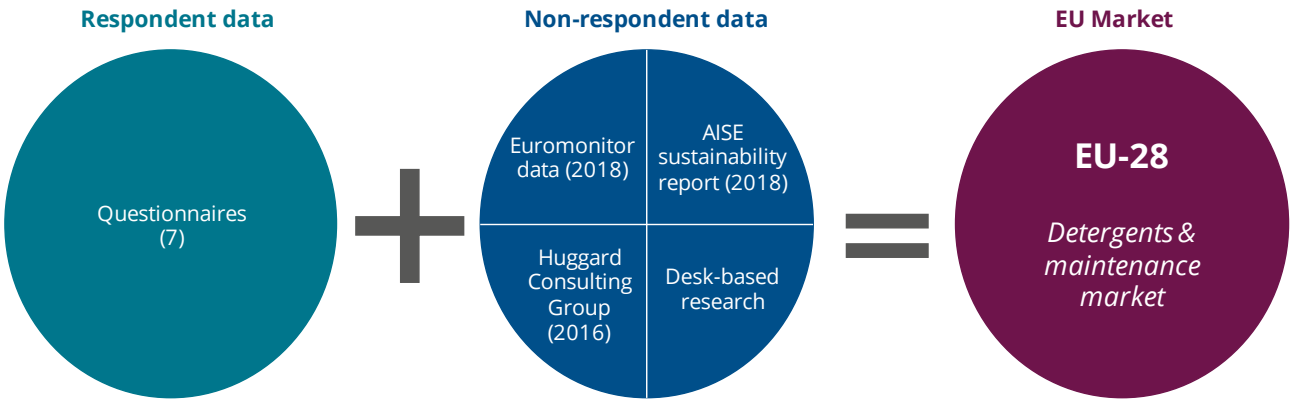


Figure 1.1: Method and data used to derive total impacts at EU-28 level

Using Euromonitor data provided by the A.I.S.E. Secretariat, the latest questionnaire respondents account for around 50% of the overall household care sector (the exact percentage varies by product category). The data collected is therefore considered to be sufficiently representative (especially for large companies) when seeking to extrapolate using the data previously collected and other sources of information for the household care sector.

1.6 Report structure

The remainder of this report is structured as follows:

- **Section 2** sets out the baseline scenario, i.e. the situation in which no additional regulatory action is taken, by providing information on the variety of products produced and the size and composition of the detergents and maintenance products market. It also sets out the function, number and volumes of polymers used by the sector that are potentially classified as microplastics under the current definition. In addition, the section also estimates releases of microplastics to the environment.
- **Section 3** assesses the availability and technical feasibility of known alternatives. It summarises the key findings of the SEA study from 2018 and 2019 and relevant 'new' information from the survey carried out in July 2020 related to the steps and time required for reformulation.
- **Section 4** provides information on the impacts, i.e. costs and benefits. It also summarises what the most likely response of the affected companies is according to the stakeholder consultation.
- **Section 5** summarises the key findings of the study and makes recommendations for amendments of the proposed restriction.

2. Baseline scenario

2.1 Introduction

As set out in ECHA's official guidance document on the preparation of a socio-economic analysis, a baseline scenario describes the "*situation in the absence of the proposed restriction (or any further Risk Management Options (RMOs))*" (ECHA, 2008, p.50). The baseline scenario does not necessarily reflect the current situation as the expected implementation of new legislation of relevance or the modification of existing legislation over the timescale of the SEA should be taken into account according to ECHA (2008). Any other relevant expected developments, such as a voluntary phase-out of microbeads, should also be taken in account in the baseline scenario. The status of current EU and national regulations are already clearly set out in the Annex XV dossier,

Sections 2.2 and 2.3 provide information on the variety of products produced and the size and composition of the detergents and maintenance products market. Sections 2.4 and 2.5 detail the function, number and volumes of polymers used by the sector that are potentially classified as microplastics under the current definition, while Section 2.6 assesses ECHA's estimate of releases of microplastics to the environment.

2.2 Detergents and maintenance products

To understand the potential impacts that a regulation on intentionally added microplastics could have on the sector for detergents and maintenance products and especially the wider society it is essential to understand the variety of products supplied by the sector and the value they provide to society. Companies active in the market for detergents and maintenance products manufacture products for (i) the **household care sector** and/or the (ii) **professional cleaning and hygiene sector**.

According to A.I.S.E. (2016a), the household care sector provides households with products falling into the following product categories:

- **Laundry care** – Laundry care products include laundry detergents in powder, tab and liquid form as well as fabric conditioners, carpet cleaners and laundry aids.
- **Surface care** – The surface care product category covers a wide variety of products including, all-purpose hard surface cleaners, multi-purpose, bathroom, toilet, oven, kitchen, window/glass and floor cleaners, as well as descalers, drain openers, scouring agents and household antiseptics. Further products in this category are surface wipes and toilet cleaning products.
- **Dishwashing** – The dishwashing product category includes hand and machine dishwashing products as well as dishwashing additives.
- **Maintenance products** – The maintenance product category is made up of air care products, i.e. aerosol, electric, gel and liquid air fresheners, scented candles and car air fresheners; polishes, i.e. shoe, floor, furniture and metal polishes; as well as home insecticides.

- **Bleaches** – Bleaches are chlorine-based products that are designed for general domestic cleaning purposes. Only products clearly labelled as bleach are included in this category. Chlorine-based laundry bleach therefore also falls in this category. Colour-safe laundry bleach, meanwhile, is included in the laundry aids product category. Similarly, bleach-based cleaners – primarily marketed as surface or toilet cleaning products – are not included in the bleach category but the surface care and toilet care product categories.

Companies active in the sector for professional cleaning and hygiene (PC&H) manufacture products for professional users in various sectors such as the healthcare sector and the food and beverage industry. According to A.I.S.E. (2016a), the products produced are divided in six broad categories:

- **Healthcare** – Products provided to the healthcare sector include products for cleaning and disinfection of healthcare facilities such as hospitals and elderly care homes as well as products for the disinfection of hands, skin, healthcare equipment and surgical instruments.
- **Food & beverage** – The food & beverage product category comprises specified products for professional users in the food, beverage and agricultural industry. It includes products for employee hygiene and bottle cleaning as well as chain lubricants, disinfectants and surface cleaners.
- **Kitchen & catering** – The kitchen & catering product category includes products such as dishwashing detergents, additives such as water hardness regulators, glassware cleaners, rinse aids, surface cleaners and disinfectants.
- **Building care –** The building care category includes a variety of cleaning products such as general-purpose cleaners, facade cleaning products, sanitary cleaners and a variety of floor care products.
- **Laundry** – The laundry product category consists of laundry products specifically designed to meet the needs of industrial users. Examples include on-premise and industrial laundry detergents, pre-wash-additives, boosters, products for pH-adjustment, water hardness regulators, bleach additives, disinfectant detergents, fabric softeners and ironing aids.
- **Technical cleaning** – The technical cleaning product category comprises products for transportation/car/aircraft/railroad care as well as workshop and metal products cleaning. Products for degreasing, delaquering, and metal surface conversion are further examples of products falling in this product category.

In addition, products for **water treatment** applications are provided by companies active in the sector for professional cleaning and hygiene (PC&H). Water treatment products, especially flocculants and coagulants, are an integral part of public health sanitary strategies and water management due to their importance in the function of municipal, institutional and industrial wastewater treatment. Water treatment is an integral part of healthcare, food & beverage and institutional professional hygiene.

Three examples of the societal benefits provided by products manufactured for the professional cleaning & hygiene sector are provided in Box 2.1 to Box 2.3 below.

Box 2.1: Societal benefits of cleaning products for the healthcare sector

The cleaning products for the healthcare sector provide important benefits to society. They contribute towards the avoidance of healthcare-associated infections (HAIs), which are infections people get while they are receiving healthcare for another condition. These infections can be caused by bacteria, fungi, viruses, or other less common pathogens. MedTech (2017) indicates that HAIs prolong the suffering of patients and increase healthcare costs. The report indicates that 4.1 million people are affected by HAIs in the EU every year. This results in at least 37,000 deaths and an annual economic impact of €6 billion according to the European Centre for Disease Prevention and Control (ECDC). The ECDC estimates that implementing hygiene and infection control programmes could prevent 20-30% of HAIs. These programmes are vital for the healthcare sector and society and this is even more evident now with the imminent threat of COVID-19. Many of these programmes are reliant on the availability of suitable cleaning and disinfection products made by the professional cleaning and hygiene sector.

Box 2.2: Societal benefits of cleaning products in the food and beverage product category

Cleaning and disinfectant products are essential to achieving high standards of hygiene along the entire food and service industry supply chain to mitigate the risks and likelihood of getting food-borne diseases, thereby also contributing to the avoidance of healthcare costs. In fact, there are over 200 diseases caused by microorganisms, i.e. bacteria, viruses, fungi, prions, and parasites, or chemicals, radioactivity or even physical agents that can be spread through food. They can cause various illnesses, ranging from diarrhoea to very severe ones, e.g. kidney and liver failure, brain and neural disorders, reactive arthritis, cancer and septicaemia, i.e. blood poisoning, some of which can be long-term. In the EU more than 23 million people fall ill per year as a result of unsafe food, 3 million of which are less than 5 years old, according to World Health Organization (2015). Annually, these food-borne diseases ultimately result in 5,000 deaths in Europe (World Health Organization, 2015).

Box 2.3: Societal benefits of flocculants and coagulants used in water treatment applications

Water-soluble polymers, like polyacrylamides (PAMs) are an integral part of the food industry, institutional and public health sanitary strategies and water management. In industrialized countries, PAM-based flocculants and coagulants are key for the operation of municipal and industrial wastewater treatment plants. All municipal wastewater treatment plants in the EU use PAM-based flocculant technology for sludge preparation, with an estimated 15 million tons of municipal wastewater sludge treated with PAMs per year. Without this technology, the total capacity of all existing wastewater treatment facilities in the EU would not be enough to treat the entire amount of wastewater. The PAM technology is considered indispensable for achieving the limits prescribed by the EU Water Framework Directive (Directive 2000/60/EC). By improving the dewatering process, PAM technology also reduces the energy required for transport, disposal and the incineration of arising waste.

2.3 EU detergents and maintenance product market

An important part of defining the baseline scenario is understanding the market size of the sector. This provides important context on the scale of impacts caused by a possible restriction and the importance of the sector to the EU in terms of the generation of jobs and value added.

2.3.1 Number of EU companies

According to A.I.S.E. (2018), 85% of 700 existing manufacturing sites in Europe are operated by SMEs. While six companies accounted for 65% of sales in the EU household care sector as of 2016, hundreds of additional companies – mainly SMEs primarily active at the national level - generated 20% of EU sales (A.I.S.E., 2016a). The remaining 15% of EU sales were generated by own label brands (A.I.S.E., 2016a). Meanwhile, the professional cleaning and hygiene sector consisted of more than 500 SMEs active in niche markets at national level, as well as three multi-national companies active at a European level as of 2016 (A.I.S.E., 2016a).

2.3.2 EU market value

As of 2016, most products made in the EU, i.e. approximately 90%, were used within the EU, with only 10% of sales going to countries outside of the EU (A.I.S.E., 2016a). In 2017, the European market for detergents and maintenance products –including Switzerland and Norway in addition to the EU countries – was estimated to have a total market value of €35.9 billion (A.I.S.E., 2018). A break-down of the market value of different sub-sectors as well as employment generated in the sector and the wider value chain is shown in **Figure 2.1**.

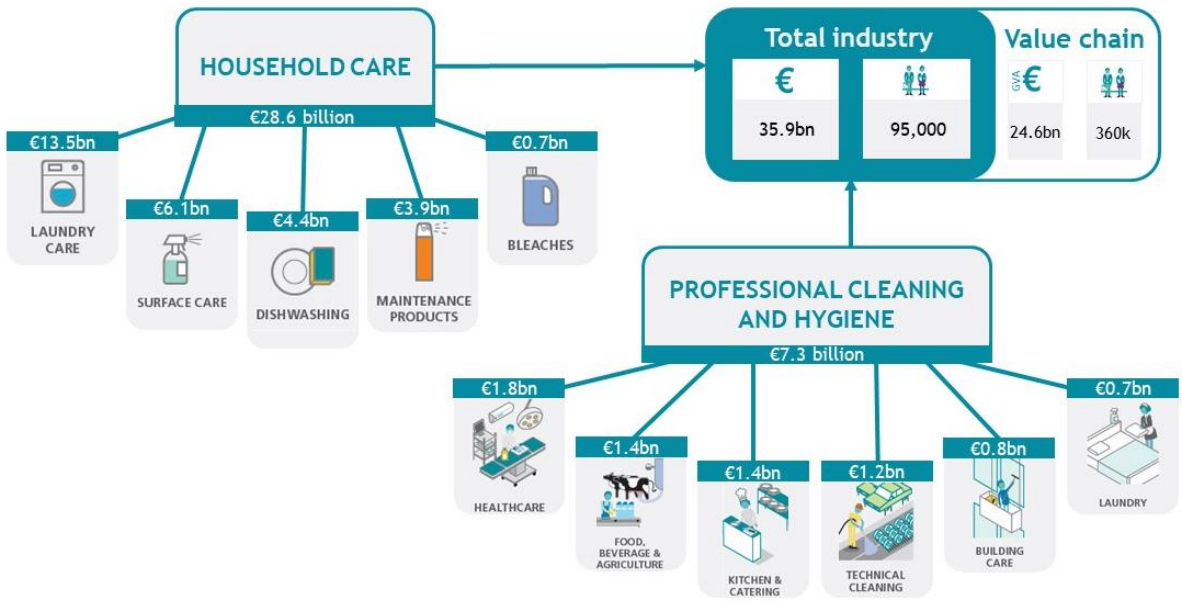


Figure 2.1: EU detergents and maintenance market
Source: Adapted from data in A.I.S.E. (2018)

In terms of market value, the household care sector is the bigger sector of the two accounting for €28.6 billion, while the professional cleaning and hygiene sector accounts for €7.3 billion as of 2017

(A.I.S.E. 2018). Compared to 2016, the overall sector experienced growth of 1.2% in 2017, while it had grown by 0.7% the previous year, i.e. from 2015 to 2016 (A.I.S.E., 2017; A.I.S.E., 2018). As shown in **Figure 2.1**, the laundry care sector is the biggest sector in the household care sector accounting for 47.3% of the total market value of the whole sector, i.e. €13.5 billion. The surface care, dishwashing and maintenance products sector have a market value of €6.1 billion, €4.4 billion and €3.9 billion respectively. With a market value of €0.7 billion the market for bleaches is the smallest of all sectors. It is also the only market sector experiencing negative growth from 2016 to 2017 according to A.I.S.E. (2018). While the market value of bleaches declined from 2016 to 2017, the other sectors grew at a rate between 0.9% and 1.9% (A.I.S.E., 2018).

The four biggest sectors in the household care sector, i.e. laundry care, surface care, dishwashing and maintenance products can be split into further sub-categories. The market values of these subs-categories are illustrated in **Figure 2.2**. In the laundry care sector, liquid detergents account for the biggest share of the overall laundry care market value with a value of €4.3 billion. Powder detergents, laundry aids and fabric conditioners have a market value of €2.6 billion, €2.8 billion and €2.5 billion respectively, while the market value of detergent tablets is €1.3 billion. In the surface care sector, surface care products account for 72% of the total market value, i.e. €4.4 billion, while toilet care products have a market value of €1.7 billion. In the dishwashing sector, products for automatic dishwashing have a higher market value (€2.6 billion) than hand dishwashing products (€1.8 billion). Air fresheners having a market value of €2.4 billion account for approximately 62% of the overall market value of the maintenance product sector, which also includes home insecticides and polishes (A.I.S.E., 2018).

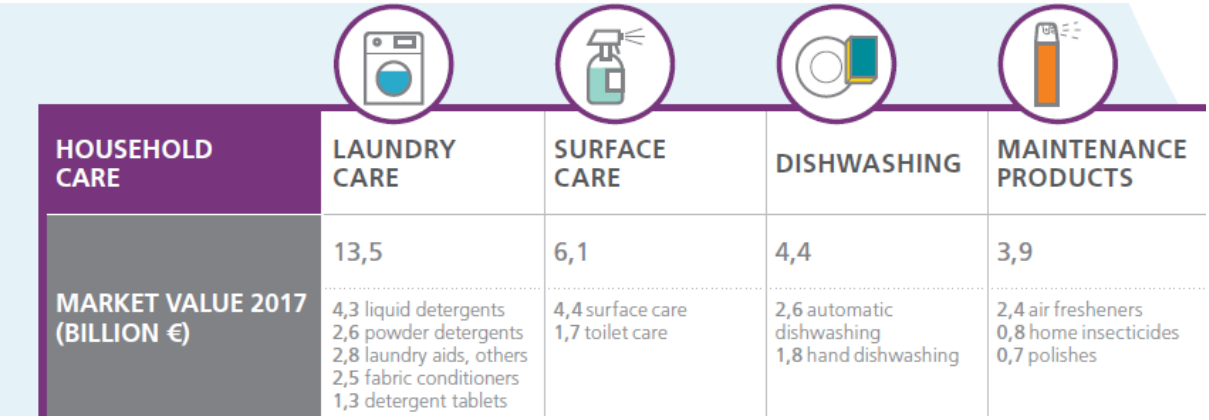


Figure 2.2: Market value of product sub-categories in the household care sector (2017)
Source: A.I.S.E. (2018)

The professional cleaning and hygiene sector has seen higher growth than the household care market. It grew by 3% from 2014 to 2015, by 3.5% from 2015 to 2016 and again by 1.7% from 2016 to 2017 (A.I.S.E., 2016b; A.I.S.E., 2017; A.I.S.E., 2018). In 2017, it had a market value of €7.3 billion as illustrated in **Figure 2.1**, which is based on A.I.S.E. (2018), thereby accounting for around 20% of the market value of the total industry. The market for healthcare cleaning products is the biggest professional sector accounting for €1.8, while the food, beverage & agriculture market and the kitchen & catering market both have a market value of €1.4 billion. The sectors for technical cleaning, building care and laundry have a market value of €1.2 billion, €0.8 billion and €0.7 respectively.

2.3.3 Employment

According to a socio-economic analysis conducted by the Huggard Consulting Group on behalf of A.I.S.E., the household care and professional cleaning and hygiene sectors together support around 95,000 direct jobs in the EU, Switzerland and Norway. In addition, the activities of their value chain support more than 360,000 jobs in the EU (Huggard Consulting Group, 2016).

2.3.4 Gross Value Added (GVA)

In addition to providing significant benefits in terms of employment, the industry also generates a Gross Value Added (GVA) of €24.6 billion throughout the value chain (Huggard Consulting Group, 2016). GVA refers to the difference between the output value of a company (accounting for products made for the EU market and those exported outside of the EU) and the value of products and services purchased to produce this output (OECD, 2018).

The detergent and maintenance product sector also enhances the productivity of many business actors especially in the food and beverage industry, the pharmaceutical and hospitality sectors as well as the contract cleaning sectors (Huggard Consulting Group, 2016). Other positively affected sectors include the medical technology and food retailing sectors. Overall, the detergent and maintenance product sector contributes to the productivity of various business sectors which together are estimated to generate a GVA of more than €600 billion and support more than 19 million direct jobs.

2.4 Function of polymers used

Polymers used in the detergent and maintenance products provide numerous desirable technical functions, such as anti-redeposition agent, dye transfer inhibitor, surface protecting polishing and viscosity controller. The technical function delivered depends on the polymer used and on the product category in which this is used; it should be noted that the same polymer can also provide multiple functions (e.g. an opacifier influences also the viscosity). In the following sections the function of numerous polymers is described, more specifically, for polymers that fall under the ECHA definition of microplastic particles.

Based on data gathered from respondents to a survey carried out for A.I.S.E. in April 2019, the sector was estimated to use approximately 120 polymers that fell under the proposed restriction and were not within the scope of any of the derogations at that stage.[3] From the responses received during a more recent survey for A.I.S.E. (July 2020) this number is thought to have significantly decreased due to changes made in the revised restriction proposal, in particular the derogation introduced for soluble polymers. Data was not collected at polymer level (this time round in July 2020 due to the limited time period available for collecting data for the 2nd public consultation) so a precise number cannot be given, but in order to give some sort of orders of magnitude estimate, the total number of polymers affected could be closer to around 10-20 polymers.

[3] *It should be noted that there are uncertainties associated with the 120 polymers estimate, as some respondents indicated a generic chemical group of the polymer and due to the intrinsic nature of polymers, the same polymer can exist in different forms, e.g. polyethylene can be either solid plastic or semi-solid wax.*

From the responses to the A.I.S.E survey in April 2019, the key function of microplastics in the sector include: encapsulated ingredients, opacifiers / viscosity modifiers, abrasives and waxes / polishes main ingredients. Other functions identified include: dye transfer inhibitor, dispersing agent, soil repellent, stabilizer, thickener, disintegrant, anti-redeposition agent, dispersant, surface modification, antifoam/ foam inhibitor and lubricant.

Based on a previous A.I.S.E. consultation in 2018 the polymers most commonly used in detergent and maintenance product formulations can be grouped in the following seven polymer categories:

- Polyethers (e.g. Polyethylene glycol and Ethoxylated lauryl alcohol)
- Polyacrylates (e.g. Acrylic styrene copolymer and sodium polyacrylate)
- Siloxanes and Silicones (e.g. Polydimethylsiloxane)
- Polysaccharides (e.g. Cellulose gum, Xanthan gum and starch)
- Polyvinyl (e.g. Polyvinylpyrrolidone)
- Polyesters (e.g. Polyethylene terephthalate)
- Other (e.g. melamine formaldehyde)

It should be noted that the properties of these polymers, such as particle size distribution, physicochemical properties (e.g. water solubility), biotic and abiotic degradability in relevant environmental compartments, significantly vary depending on the type and size of the polymer/copolymer used.

Table 2.1 below, includes some examples of the technical functions provided by these seven broad polymer categories, given by respondents to the 2018 A.I.S.E. consultation.

Table 2.1: Function provided by different types of polymers

Polymer group	Key technical functions provided by polymer (non-exhaustive list)
Polyethers	• Viscosity modifier • Anti-foaming agent (e.g. stops excess foaming in bottles during filling) • Emulsifier • Dye • Builder/co-builder
Polyacrylates	• Opacifier (e.g. optical differentiation of products that affects consumer choice) • Rheology modifier • Binder • Builder/co-builder (e.g. provides functions essential for controlling water hardness) • Complexing/sequestering agent • Cleaning agent/booster • Film former/softening agent (e.g. leaves a protective layer on surfaces upon drying, offering high gloss, durability, and detergent resistance with excellent removability) • Soil release agent • Surface modifying agent (helps control surface tension properties) • Thickener

Polymer group	Key technical functions provided by polymer (non-exhaustive list)
	• Improves cleaning (i.e. makes cleaning faster and easier as treated surfaces resist dirt, soap scum and grease)
Siloxanes and Silicones	• Foam control/anti-foaming agent (e.g. reducing/eliminating the risk of foam generation during the washing process) • Softening agent • Surface protectant and polishing agent - Nourishes and covers surfaces with a thin layer of oil that creates a subtle gloss whilst also providing a lot of free space within its structure for individual water vapour molecules to pass through that allows air to pass through the substrate and therefore the coverage that it creates allows the article/substrate to breath.
Polysaccharides	• Viscosity/rheology modifier, thickener • Opacifier • Anti-redeposition agent • Film former • Water retention • Suspension agent
Polyvinyl	• Anti-foaming agent required to avoid excess foaming in bottles during filling • Thin soluble films • Dye transfer inhibitor reducing/eliminating the risk of colour transfer between fabrics during the washing process.
Polyesters	• Surfactant • Soil release agent (helps remove soil and prevents it's build-up) • Detergent booster (increasing the efficacy of the product).
Other	• Opacifier / viscosity modifier • Encapsulating fragrance

A brief description of the technical function provided by some functional ingredients is presented below. Depending on the final restriction adopted some of these functions may not be affected.

Box 2.4: Technical function of a rheology modifier

A typical rheology modifier offers high low-shear viscosity and pseudoplasticity (shear-thinning rheology) required by detergent products. High low-shear viscosity is important because it helps maintain the stability of the dispersion. Without this stability, the detergent formulation is vulnerable to the separation of phases, a drawback from the standpoint of aesthetics, shelf life and performance. Pseudoplasticity is equally critical; a lower viscosity at higher shear rates is important for pourability. It is not pituitous, that is, it produces a formulation that flows readily and does not leave long, stringy tendrils hanging from the mouth of the dispenser after the user has finished pouring.

Box 2.5: Technical function of encapsulated fragrances

Fragrance is an important attribute for consumers because it communicates product efficacy (cleanliness, hygiene, "freshness") and mitigates formulation base odour. The encapsulation of fragrances in fabric enhancers, detergents and in wash scent beads helps achieve a long-lasting scent (e.g. the fragrance is still perceivable days or weeks after washing fabrics such as clothes, bedding, and towels) whilst reducing significantly the quantity of fragrance used. Encapsulation

technology is the most sustainable and resource-efficient way to dose fragrances in consumer products. In addition it delivers higher satisfaction and financial benefits to consumers (through lower product prices).

Trying to replicate the scent intensity and longevity using traditional fragrance molecules without encapsulation is difficult because the molecules are inherently volatile and therefore quickly evaporate from the surface they have been deposited onto. As most laundry care products contain high levels of surfactants for cleaning, these can prevent fragrance deposition onto the targeted substrate, treating the fragrance oil as a stain to be washed away. Only ~1% and ~10% of the fragrance oil added to detergents and fabric enhancers respectively survive the washing, rinsing and drying process. In contrast, when added as encapsulated fragrance about 20% (detergents) and 50% (fabric enhancers) is retained on fabrics. This represents a 5-20 fold improvement of retention efficiency to deliver the same function. It has been estimated that the use of encapsulated fragrances saves at least 30% of fragrance oil.

Encapsulation offers increased control of deposition (more active delivery to the surface) and the release profile (released at the most appropriate time). The loss of encapsulates as a fragrance delivery technology would further limit progress in laundry product compaction because both the reduction in product dose and the higher cleaning agent concentrations place technical limits on the amount of free fragrance oil required. Encapsulates provide a major innovative and resource efficient solution to this problem.

Box 2.6: Technical function of flocculants and coagulants

Polyacrylamide (PAMs) technology is essential for the functioning of all equipment used in the wastewater treatment process. The use of PAMs is essential for sludge dewatering, as it allows the formation of larger and stronger flocs, which facilitate dewatering.

Box 2.7: Technical function of a complexing/sequestrating agent

A complexing/sequestrating agent is used in laundry detergents to help prevent soil from resettling on fabrics after it has been removed during washing. These compounds are adsorbed on both soil and fabrics, where they keep soil particles from resettling on fabrics being washed and act as a dispersing agent.

Box 2.8: Technical function of an opacifier

An opacifier imparts a milky, lotionized appearance to a wide variety of household liquid products. The addition of these polymers gives products a unique pleasant, milky opaque appearance that radiates efficacy, mildness and care to the consumer. Product appearance is a key driver for consumer choice as next to the visual aspects it is an important cue for essential product attributes (often this is used for mild products, sensitive skin etc.).

Box 2.9: Technical function of an abrasive

Abrasives are materials that are used to polish, buff, or scour away soils such as dirt and dust. They are added to some detergents to increase mechanical force/motion and as a result less aggressive chemicals are necessary or less time is needed to obtain the same cleaning result. Abrasives can be found in cleaning products such as pot and pan cleaners, hand wash dish detergents, and machine dish detergents.

RIVM. (2016). Emission of microplastics and potential mitigation measures: Abrasive cleaning agents, paints and tyre wear, RIVM Report 2016-0026, National Institute for Public Health and the Environment. Retrieved from: https://www.rivm.nl/dsresource?objectid=dad60794-a4a2-44f9-8416-624cfbc4861e&type=org&disposition=inline

Box 2.10: Technical function of polymers used in waxes

Waxes include products with a natural and synthetic origin. They have numerous functions and are used by several industry sectors. For detergents and maintenance products, waxes provide highly desirable functions by rendering fibres and chipboards moisture-proof and imparting gloss and protection in polishes for example. The applications of waxes are generally classified into two different categories, i.e. their use as processing aids and their use as base material or additive for the creation of certain product properties. In the case of candles - a product falling in the maintenance product category – waxes serve as an important processing aid allowing for moldability and extrudability, while also providing an important function for the finished product through serving as fuel for a controlled burn. Waxes also serve as the major ingredient for all polishes and deliver important surface protection for various materials including leather, floors and cars. More specifically, waxes in polishes applied in the automotive industry provide surface protection for metal and painted surfaces as well as corrosion protection. Furthermore, waxes are used as viscosity regulators in the production process of coatings, while also delivering surface protection and serving as a matting and slip agent in the final product.

European Wax Federation. (2018). Function & Effect/Methods. Retrieved from: https://www.wax.org/
European Wax Federation. (2018b). Applications. Retrieved from: https://www.wax.org

Box 2.11: Technical function of foam control and anti-foaming agents

Silicones play an important role in the manufacturing process but also in the use of final detergent products by serving as foam control or anti-foaming agents. As processing aids, these polymers have a positive effect on process efficiency by preventing the creation of foam during the manufacturing process. The bottle-filling process is an example of a key process that is facilitated by the use of these polymers. Silicones also provide important benefits in the use of various end-products, including laundry detergents, fabric softeners and hard surface cleaners, by serving as foam control agents. By ensuring the build-up of the correct foam level, silicones help to prevent a loss in cleaning efficiency. While other types of foam control agents exist, silicones, which deliver the desired functions over a broad range of temperatures, are the most cost-effective solution due to their long-lasting performance and low use levels that is usually between 0.1 to 0.4%.

Dow Corning. (2012). Silicone Foam Control Agents for Household Cleaning Applications. Retrieved from: https://www.xiameter.com/EN/Pages/RetrieveDocument.aspx?type=Lit&DocumentId=090276fe801903dd&s=172061

2.5 Volumes of polymers used

As part of A.I.S.E.'s survey in July 2020 data on polymers affected by the proposed restriction (i.e. polymers not benefitting from one of the proposed derogations) were collected. Respondents who provided quantitative volume data account for a market share of between 15-65% (rounded) depending on the product category. **Table 2.2** below presents the estimated amounts of polymers used in the EU in 2018 (i.e. respondents + non-respondents) that are considered to be within the revised scope of the restriction broken down by product category, as well as a comparison of these estimates to the estimates provided during the previous survey (April 2019).

Table 2.2: Breakdown of the total volume of polymers used by product category

Product category	Reduction in volumes of polymers affected (compared to previous 2019 report) due to change in the restriction scope	Total volume (tonnes) of polymer used by entire sector in 2018
Solid laundry detergent	6%	6400
Liquid laundry detergent	1%	5300
Fabric conditioner	24%	500
Glass/window, bathroom, kitchen cleaners	84%	100
All-purpose hard surface cleaners	22%	200
Toilet cleaners	<1%	<10
Automatic dishwasher detergent	100%	<10
Manual dishwasher detergent	57%	200
Waxes and polishes	28%	900
Air care products	100%	<10
Professional building care	100%	<10
Bleaches	<1%	<10
Other	95%	100
TOTAL	20%	**Approx. 13,700**

Notes:

- Respondent data based on 7/14 companies (one company was excluded as raw material volumes were reported instead of polymer volumes).
- Volume data are reported to the nearest 100 tonnages to avoid the impression of false accuracy.
- Volume data do not include, to the extent possible, volumes of polymers that fall under one of the derogations.

The product category "other" includes flocculant and coagulant products for water treatment, pest control products, teat disinfection products and water softeners. These typically relate to the professional cleaning and hygiene sector for which there is no readily available market share information that can be used for extrapolating respondent data. Therefore, the tonnage reported for this category is likely to be underestimated.

A total of 13,700 tonnes of microplastics are estimated to have been used in the EU in 2018, based on the most recent July 2020 A.I.S.E. survey. This is lower than the volume previously estimated to have been used in the EU in 2018, based on the A.I.S.E. survey in April 2019 (16,900 tonnes) mainly due to the revised scope of the restriction. Most respondents have indicated that the reduction in volumes can be primarily attributed to the derogation added relating to polymers with a solubility > 2 g/L (paragraph 3c). A few respondents have also noted that volumes have been affected by

changes in the definition of 'particles containing solid polymer' (paragraph 2d), as well as more clarity on the derogation that relates to substances or mixtures containing microplastics with physical properties permanently modified during end use, such that the polymers no longer fulfil the meaning of a microplastic (paragraph 5b). However, it should be noted that there is still a degree of ambiguity in the current ECHA definition, which may affect the estimated volume of polymers used.

The recent A.I.S.E survey estimates are still significantly higher than previous estimates from the sector where microplastic particles were defined as "*water-insoluble solid plastic particles with a size less than 5mm that can be found as aquatic litter*". In the preliminary SEA report (eftec, 2018) based on the survey undertaken in 2018, the volume used by respondents was estimated to be approximately 1,000 tonnes in 2017 using this definition. There are also other reasons for this more than tenfold increase. Firstly, the most recent survey had a higher response rate and, secondly, key stakeholders now have a better understanding of the problem, better knowledge of the polymers they use and whether these are considered within the scope of the definition used in each survey.

The concentration of polymers in the formulation varies depending on the product category and on the specific substance used to deliver a specific function. This variability can be seen in **Table 2.3** which summarises estimates for the minimum, maximum and average concentrations of polymers per product category (according to the responses received to A.I.S.E.'s consultation in April 2019) required to fulfil their intended technical function. The median concentration of affected polymers used across all detergent and maintenance products is 0.73%.

Table 2.3: Concentration of polymer used per product category

Product category	Concentration of polymers used				
	10th Percentile	90th Percentile	Median	Standard Deviation	Sample Size
Solid laundry detergent	0.03%	29.64%	0.75%	4.78%	25
Liquid laundry detergent	0.01%	3.10%	0.20%	2.80%	31
Fabric conditioner	<0.01%	3.45%	0.04%	4.41%	11
Glass/window, bathroom, kitchen cleaners	0.01%	5.00%	0.99%	1.78%	11
All-purpose hard surface cleaners	0.02%	3.08%	0.98%	1.37%	18
Toilet cleaners	-	-	-	-	1
Automatic dishwasher detergent	0.23%	14.01%	1.93%	6.01%	13
Manual dishwasher detergent	0.01%	3.54%	0.94%	0.88%	9
Waxes and polishes	0.03%	14.85%	1.14%	6.74%	40
Air care products	0.56%	32.00%	1.60%	14.08%	5
Professional building care	-	-	-	-	2
Bleaches	0.16%	0.50%	0.25%	0.14%	5
Water treatment	0.08%	2.90%	1.20%	26.90%	39
Other					
TOTAL	**0.01%**	**14.49%**	**0.73%**	**12.75%**	**210**

Note:

- Percentiles and median values are presented instead of minimum / maximum and mean values in order to exclude outliers.

- For confidentiality reasons water treatment volumes have to be reported along with the "other" product category.

The variability of the data is illustrated in **Figure 2.3**. As can be seen, average concentrations of microplastics in products are below 30%, whilst in most cases falling between 0.01% and 10%.

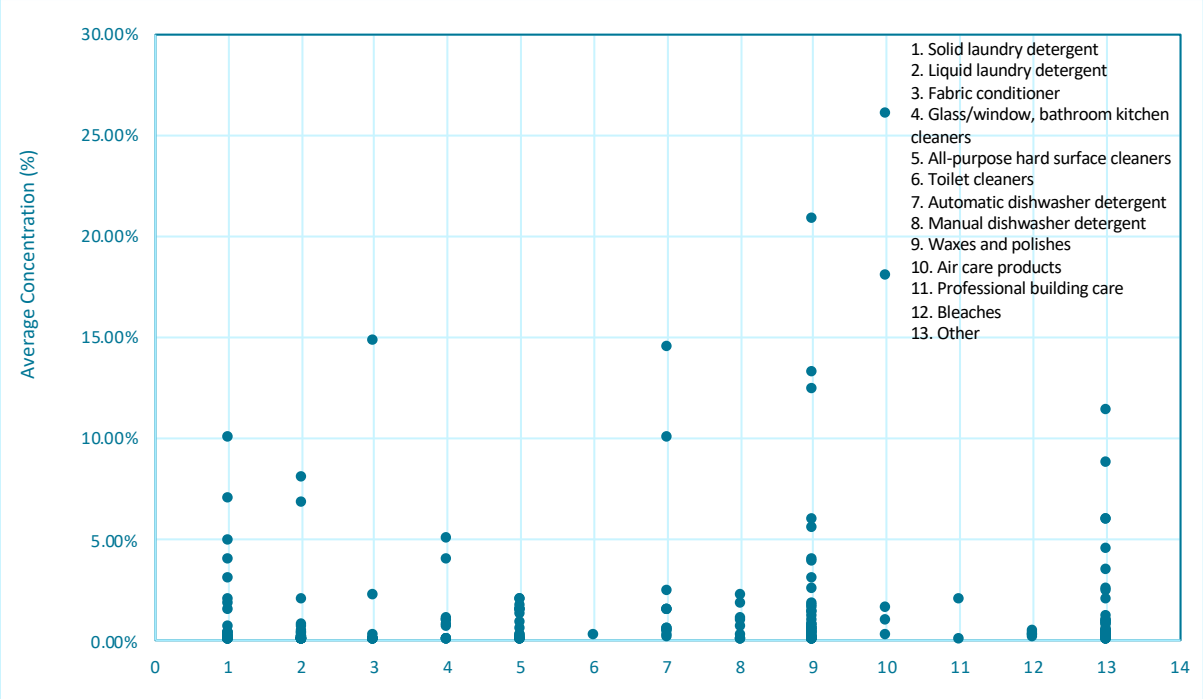


Figure 2.3: Average concentration data by product category

In response to the specific data request by ECHA as part of the 2019 consultation on the proposed restriction, **Table 2.4** presents the proportion of products that contain microplastics to achieve their intended function in different concentration ranges.

Table 2.4: Breakdown (%) of products affected by proposed restriction – by concentration limit bands

Product category	Concentration				
	Greater than 1.0% w/w	Between 0.1% w/w and 1% w/w	Between 0.01% w/w and 0.1% w/w	Between 0.001% w/w and 0.01% w/w	Less than 0.001% w/w
Solid laundry detergent	61%	31%	7%	0%	0%
Liquid laundry detergent	10%	65%	15%	10%	1%
Fabric conditioner	23%	51%	25%	0%	0%
Glass/window, bathroom, kitchen cleaners	64%	31%	4%	1%	0%
All-purpose hard surface cleaners	50%	30%	19%	0%	0%
Toilet cleaners	34%	64%	1%	1%	0%
Automatic dishwasher detergent	75%	25%	0%	0%	0%
Manual dishwasher detergent	25%	52%	15%	6%	2%
Waxes and polishes	72%	22%	2%	3%	0%

Product category	Concentration				
	Greater than 1.0% w/w	Between 0.1% w/w and 1% w/w	Between 0.01% w/w and 0.1% w/w	Between 0.001% w/w and 0.01% w/w	Less than 0.001% w/w
Air care products	22%	78%	0%	0%	0%
Professional building care	41%	54%	3%	3%	0%
Bleaches	28%	70%	2%	0%	0%
Water treatment	52%	30%	10%	6%	2%
Other					
Total	**46%**	**39%**	**10%**	**4%**	**1%**

- For confidentiality reasons water treatment volumes have to be reported along with the "other" product category.

From the interview and questionnaire responses, it is evident that the majority of products, i.e. 85%, contains microplastics in a concentration above 0.1% w/w to achieve the intended function. Ninety-five percent of products affected are considered to contain microplastics above the 0.01% w/w concentration limit being proposed by ECHA. The concentration varies depending on the product type as shown in **Table 2.4**.

A few respondents consider that microplastics may be present in a substance or a mixture as an impurity. For example, if the concentration is below 0.1% in a product, the polymer is not expected to have a functional use within the product but may have in one of the raw materials (for example for the viscosity of the raw material). Thus, microplastics might be contained in the final product without carrying out a function.

From a sample size of 210 data points, only five data points report the concentration of microplastics to be lower than 0.01% and less than 5% of products are considered by respondents to contain microplastics in concentrations lower than 0.01%. This implies that if the concentration of a microplastic is below 0.01% in a product, the polymer does not have a functional use within the product but it is present as an impurity.

2.6 Releases of microplastics

The Scientific Opinion of the Group of Chief Scientific Advisors published in June 2019 finds that "*relatively few studies record microplastics in nature at or below the 10-50 micron size range*" (European Commission, 2019, p.6). According to the Scientific Opinion, this is due to the detection limit of commonly used analytic equipment and not the absence of such particles. Experimental studies in fact find increasing microplastic concentrations consisting of microplastics of decreasing size implying that the amount of microplastics present in the environment could be much higher than currently recorded.

Apart from a lack of reliable studies on the concentration of microplastics in the environment, the Scientific Opinion also points to deficiencies in scientific knowledge on "*the effects of different concentrations, compositions, sizes, and shapes of microplastic on ecosystems and humans*" (European Commission, 2019, p.6). It therefore concludes that despite current evidence suggesting that

microplastics do not pose a widespread risk to humans and the environment, the knowledge gaps imply that there "*are significant grounds for concern*" (European Commission, 2019, p.7). It stresses that precautionary measures need to be taken to minimise releases to the environment and to minimise the presence of microplastics in marine and freshwater water environments but also air and soils.

In relation to the detergents and maintenance products sector, ECHA (2019a) in their Annex XV dossier assumes that microplastics used in these products are released to the environment via two pathways, i.e. down-the-drain and through direct releases to the environment. Releases caused by the use of detergents, including those containing fragrance encapsulates, are assumed to go down-the-drain at a level of 100%. Waxes and polishes are, meanwhile, assumed to be released to the environment via two pathways, i.e. down-the-drain and through direct releases to the environment. In accordance with Environmental Release Category (ERC) 8C, it is assumed that 30% of all polymers used in waxes and polishes are released to water, while 15% are directly released to air. Direct releases to the environment thus account for 33% of all releases caused by the use of waxes and polishes, while releases to water account for 67%. In the case of direct releases to the environment via air, the release factor is assumed to be 100%. The same assumptions are made in the Annex to the Background Document to the Opinion on the Annex XV dossier, i.e. ECHA (2020a).

After an extensive evidence review, ECHA (2019a, p.43) concludes in their Annex XV dossier that "*the down-the-drain pathway has a release factor of approximately 50%, with the release to agricultural soil via biosolids contributing 43 of the 50% (i.e. 86% of the releases to the environment from the down-the-drain pathway)".* Fourteen percent of the releases from this pathway are assumed to go to surface waters due to be contained in treated wastewater effluents. The information on the release factor of the down-the-drain pathway presented in ECHA (2020a) is in line with this information. Based on these assumptions, ECHA (2020a) estimates annual releases of microplastics to the environment from detergents containing microbeads, fragrance encapsulates, other detergents and waxes and polishes. ECHA's results are shown in **Table 2.5**.

Table 2.5: Releases to the environment from detergents and maintenance products (ECHA), 2022-2041 average

Product group	Volume of affected polymers used, 2022-2041 average (tonnes/year)		
	Low	Central	High
Microbeads contained in detergents	0	0	0
Polymeric fragrance encapsulates	260	400	540
Other microplastics contained in detergents	9,440	15,200	20,960
Waxes, polishes and air care products	1,300	1,300	1,300
Total use	**11,000**[4]	**16,900**	**22,800**
Total releases	**5,516**	**8,513**	**11,512**

Source: ECHA (2020a) – Table 65

[4] *In Table 65 of the Annex to the Background document, ECHA (2020) reports a total use volume of 11,200 tonnes. The sum of the sub-categories presented in the table however equals 11,000.*

ECHA (2020a) states that in their impact assessment "*the central tonnage scenario will assume that a total of 16 900 tonnes of microplastics is used per year, based on the respondent data from A.I.S.E.'s latest survey extrapolated to the whole sector (#2382)*". This use volume, which is presented in Table 62 in the Annex to the Background Document, refers to 2018. In the low and high scenario, ECHA (2020a) assumes declining use volumes over time. The use volumes estimated under the high scenario, for example, decline from 23,000 tonnes in 2018 to 22,800 from 2020 onwards. Such a decline is not accounted for in the central scenario. In line with the approach applied for the low and high use scenarios, the annual use volume from 2021 onwards should therefore be below 16,900 tonnes per year.

ECHA's approach for estimating releases to the environment has been replicated with volume estimates for the period between 2022 and 2042, which were derived using the annual volumes of polymers (considered to be microplastics under the revised definition) used by product category shown in **Table 2.2** as a starting point. **Table 2.2** relates to 2018 and is based on data provided by A.I.S.E. members. **Table 2.6**, meanwhile, presents the estimated releases of polymers considered to be microplastics in 2018 resulting from the annual use volume shown in **Table 2.2**. The total release volume resulting from uses in the detergents and maintenance products sector in 2018, i.e. 6,670 tonnes, lies between the low and central annual release estimates reported by ECHA in the Annex to the Background Document to the Opinion on the Annex XV dossier (shown in **Table 2.5**).

Table 2.6: Releases of polymers considered microplastics to the environment as a result of the use in the detergents and maintenance products sector in 2018

Product group	Annual emissions released to environment in 2018 (tonnes)		
	Soil (via spreading of sewage sludge)	Water (post wastewater treatment)	Air
Solid laundry detergent	2,752	448	0
Liquid laundry detergent	2,279	371	0
Fabric conditioner	215	35	0
Glass/window, bathroom, kitchen cleaners	43	7	0
All-purpose hard surface cleaners	86	14	0
Toilet cleaners	<5 *		0
Automatic dishwasher detergent	<5 *		0
Manual dishwasher detergent	86	14	0
Waxes and polishes	156	25	89
Air care products	0		<5 *
Professional building care	<5 *		0
Bleaches	<5 *		0
Water treatment	43	7	0
Industrial cleaning & disinfectants			
Other			
Total	**5,660**	**921**	**89**
Total	**6,670**		

* For confidentiality reasons, an exact release volume cannot be provided for this category. The reported volume is presented to provide some order of magnitude. These volume estimates are however not incorporated in the total use volume.

When estimating total release volumes over a 20-year period in the absence of a restriction, i.e. between 2022 and 2041, changes in the market were factored in as the market will increasingly move towards 'green products', i.e. products based on increasingly sustainable formulations, due to consumer demands and general political and societal developments. Some results of these developments are already observable in the market. Voluntary reformulation towards greener products is expected to occur as a result, which will amongst other things lead to a reduction of the use of polymers considered to be microplastics. Based on an assumed reduction rate of 3% per year, it is estimated that the volume of polymers considered to be microplastics used annually by the entire sector would decline from 13,700 tonnes in 2018 to 12,129 tonnes in 2022 and to 6,799 tonnes in 2041. The volumes of polymers estimated to be used each year between 2022 and 2041 are illustrated in **Figure 2.4** in conjunction with the resulting releases to the environment.

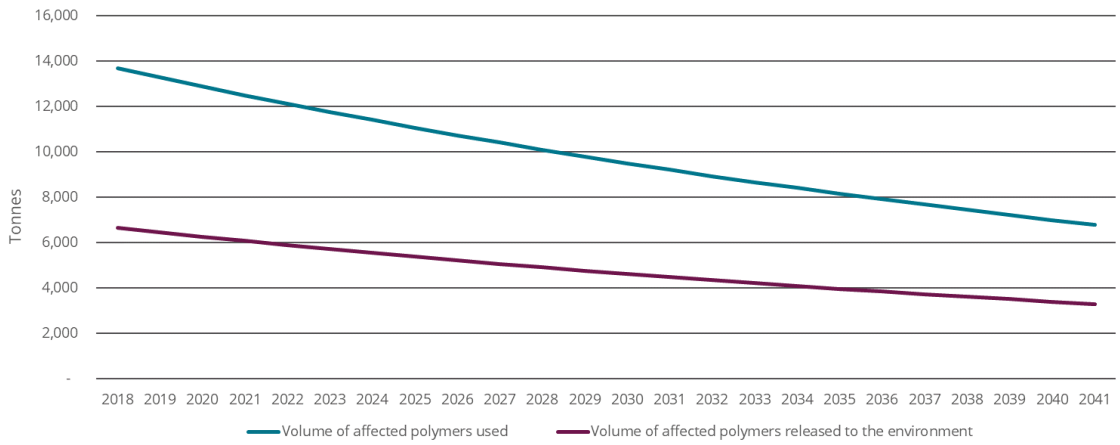


Figure 2.4: Volume of affected polymers used and resulting releases, 2018 - 2039

When estimating the release volume of polymers considered microplastics over 20 years without a restriction, i.e. the baseline scenario, the time period between 2022 and 2041 has been analysed. The year 2022 has been used as the starting point due to it being the entry-into-force date used by ECHA in the Annex to the Background Document to the Opinion on the Annex XV dossier. **Table 2.7** presents the total volume of polymers considered to be microplastics released to soil, water and air between 2022 and 2041 in a scenario without a restriction.

Table 2.7: Baseline scenario - Releases of polymers considered microplastics to the environment from detergents and maintenance products, over a 20-year period (2022-2041)

Product group	Emissions released to environment over 20 years, i.e. 2022 - 2041(tonnes)		
	Soil (via spreading of sewage sludge)	Water (post wastewater treatment)	Air
Solid laundry detergent	37,049	6,031	0
Liquid laundry detergent	30,681	4,995	0
Fabric conditioner	2,894	471	0
Glass/window, bathroom, kitchen cleaners	579	94	0
All-purpose hard surface cleaners	1,158	188	0
Toilet cleaners	<50 *		0

Product group	Emissions released to environment over 20 years, i.e. 2022 - 2041(tonnes)		
	Soil (via spreading of sewage sludge)	Water (post wastewater treatment)	Air
Automatic dishwasher detergent	<50 *		0
Manual dishwasher detergent	1,158	188	0
Waxes and polishes	2,094	341	1,200
Air care products	0		<50 *
Professional building care	<50 *		0
Bleaches	<50 *		0
Water treatment	579	94	0
Industrial cleaning & disinfectants			
Other			
Total	**76,192**	**12,403**	**1,200**
Total	**89,795**		

* For confidentiality reasons, an exact release volume cannot be provided for this category. The reported volume is presented to provide some order of magnitude. These volume estimates are however not incorporated in the total use volume.

Under the baseline scenario for the detergents and maintenance products sector, i.e. a situation without a restriction, 89,795 tonnes of microplastics are estimated to be released to the environment over 20 years, i.e. between 2022 and 2041, as shown in **Table 2.7** and illustrated in **Figure 2.5**. Eighty-five per cent of all releases to the environment are estimated to end up in soil through the application of sewage sludge, while approximately 14% end up in the water environment. Therefore, it is possible that the majority of microplastics being released into the environment could be avoided through better risk management of sewage sludge.

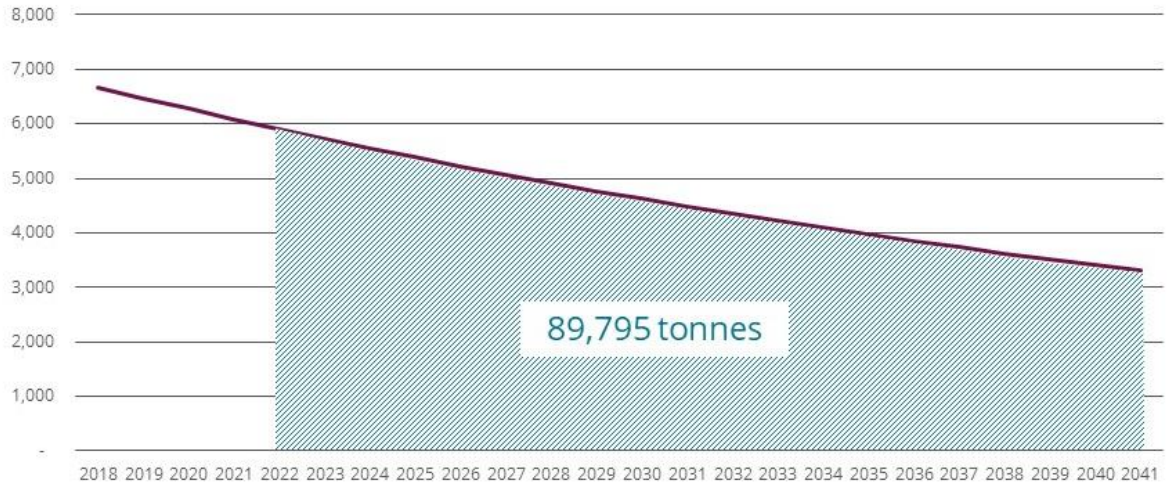


Figure 2.5: Baseline scenario - Releases of polymers considered microplastics to the environment from detergents and maintenance products, over 20-year period (2022 – 2041)

2.7 Summary of the baseline scenario

The baseline scenario can be summarised as follows:

- There are over 900 companies active in the European soaps, detergents and/or maintenance

market. Most of these companies are SMEs although 10 multinationals are particularly active with respect to specific product categories (e.g. laundry/dishwashing detergents).

- These 900+ companies directly employ ~95,000 people in the EU, Switzerland and Norway and indirectly support more than 360,000 jobs within Europe. The European market in 2017 (including Switzerland and Norway) for detergents and maintenance products was estimated to have a value of €35.9 billion, with a GVA of ~€24.6 billon.
- These products provide both desirable cleaning functions to end-users (e.g. film former and as complexing agents), the effectiveness of cleaning (for example with the use of soil release agents and dye transfer inhibitors), the overall end-user experience (e.g. aesthetic, touch/feel and smell), as well as freshness (by using opacifiers, softening agents and encapsulated fragrances).
- Indispensable products in the industrial sector include flocculants and coagulants used in water treatment applications. These are currently used in all municipal wastewater treatment plants in the EU for sludge preparation.
- Despite some uncertainties in the interpretation of responses, the April 2019 survey identified approximately 120 polymers used by the industry that fell within the scope of the proposed restriction. From the responses received during a more recent survey for A.I.S.E. (July 2020) the number of polymer affected is thought to have significantly decreased due to changes made in the revised restriction proposal. Restriction of these polymers would impact both household products and those used by the professional cleaning & hygiene sector.
- The affected polymers are used in small proportions within products made by the detergent and maintenance sector. The median concentration in products is estimated to be 0.73%. There is some variation depending on the type of product with the concentration ranging between 0.01% and 10% of the total product.
- Interview and survey responses indicate that most of the products affected, i.e. 95%, are considered to contain microplastics above the proposed 0.01% w/w concentration limit. A considerable share of the products considered to be affected, i.e. 85%, is considered to contain affected polymers in a concentration above 0.1% w/w.
- The total release of polymers meeting the ECHA definition of microplastics into the environment in 2018 from the detergents and maintenance products sector is estimated at 6,670 tonnes (using the same approach as used by ECHA in the Annex XV dossier).
- Under the baseline scenario (i.e. a situation without a restriction), over 20 years the detergents and maintenance products sector are estimated to release a total of 89,795 tonnes of microplastics. This estimate is factors in market developments triggering an increase move towards more sustainable /green products. Eighty-five per cent of all releases to the environment are estimated to end up in soil through the application of sewage sludge, while approximately 14% end up in the water environment (post wastewater treatment).

3. Assessment of alternatives

3.1 Introduction

The analysis of alternatives is an important part of the socio-economic analysis of any proposed restriction. According to the ECHA guidance (ECHA, 2008) on compiling Annex XV dossiers for restrictions, the objective of the analysis of alternatives is:

"*To provide information for the analysis of whether the equivalent function provided by the substance can be obtained by other substances or techniques and for assessing the net impact of the proposed restriction to the human health and the environment. This will facilitate in defining a proportionate restriction which is targeted to the identified risk.*"

The guidance states that relevant information on alternatives might include:

- "*Information on the risks to human health and the environment related to the manufacture or use of the alternatives; and*
- *Technical and economical feasibility, availability, including the time scale.*"

The term 'alternative' is used in the ECHA guidance to mean alternative chemical substances or alternative techniques (processes and technologies) or combinations thereof that can be used to replace (partially or totally) the substance of concern in a given use or a number of uses by providing the *equivalent function* that the substance delivers in those uses or by making the function redundant.

The ECHA guidance also states that the information collected via the analysis of alternatives can be included in a socio-economic analysis of the proposed restriction. In particular, the analysis can be used in the definition of the 'proposed restriction' scenario, and specifically the behavioural response to the restriction by actors in the supply chain(s) affected by it. The ECHA guidance gives the following examples of what sorts of behavioural responses might be expected:

- Use an alternative – This could involve using a different substance or process with no, or some, loss in functionality and/or durability etc.;
- Continue using substance by relocating production outside of the EU – This will depend on whether relocation outside of the EU to continue manufacture using the substance is the best investment decision;
- Discontinue production – whether this would lead to a (long-run) loss to society is said to depend on whether (e.g.) a similar final product could be imported instead.

In this respect, an 'alternative' to continuing to use a restricted substance can be any course of action which implies compliance with the restriction. The guidance recognises that individual companies within an industry might respond in different ways, although one response might be more likely than any other. If there are alternatives available, the use of an alternative substance would often be the

least expensive option for the users and therefore the most likely response. If there are no suitable alternatives (either substance or process) available, it is more difficult to predict what the likely response will be.

3.2 Literature review on suitable alternatives

This section provides an overview of existing information on possible alternatives to microplastics used in the detergent sector identified through a review of publicly available studies as well as information resulting from previous consultation conducted by A.I.S.E. with its members. Overall there was not an extensive set of literature on alternatives for the detergents sector, whereby only three studies provided information on alternatives specifically for the detergent sector. Several important studies in the area such as seven studies published by the Canadian Government, the European Commission, the German Federal Environment Agency and the Swedish Environmental Protection Agency did not cover the topic of alternatives relevant to the detergents sector at all.

The EC (2017a) study by Amec Foster Wheeler presents results from a literature review and an industry consultation designed to identify possible alternatives to microplastics used as abrasive cleaning agents. It notes that, while household cleaners using inorganic abrasives such as silica (i.e. silicon dioxide), alumina, clay or calcium carbonate exist, these and especially silica – which is considered to be a widely applicable alternative – cannot be considered to be a suitable alternative to microplastics in all detergent products. Thermoplastic microbeads are seldom used as abrasives in some cleaning products designed for delicate surfaces due to their mild abrasive action. Silica is considered to be an inappropriate alternative for such applications due to its relative hardness. Similarly, silicon carbide is reported as another abrasive that constitutes a technical feasible alternative in certain applications but is not appropriate for applications requiring a soft abrasive function.

A report (RIVM, 2016) published by the Dutch National Institute for Public Health and the Environment supports this view by reporting use of the same inorganic abrasives, i.e. silica, alumina and calcium carbonate, in household cleaning products while stating that these abrasive agents may not be feasible for "certain niche products, such as cleaning agents for lenses and precision instruments". While it confirms that calcium carbonate, silica and aluminium are abrasives already used in the detergent sector, a report (OSPAR Commission, 2017) published by the OSPAR Commission does not define them as possible alternatives as microplastics are specifically used when the aforementioned substances are not suitable due to their hardness causing scratches on delicate surfaces.

An industry consultation conducted by A.I.S.E (AISE 2018b) revealed activities at company level on the suitability of glass, sugar and minerals for use in toilet cleaners. While these alternatives are not fully validated yet, companies expressed concern about difficulties of using these alternatives in the extrusion process, the resulting differences in aesthetic appearance and the higher price of the alternatives. The consultation did not identify any known alternative for use in bathroom acid cleaners. In the case of hard surface cleaners, a biodegradable and bioactive polymer derived from renewable surfaces was reported as a potential alternative; though, they had no indications whether

ECHA's definition would apply to the alternative as well. It was however noted that for some product sub-categories switching to this alternative would result in a loss of performance and higher costs for raw materials. Naturally derived substances were reported as an alternative to microplastics used in stainless steel cleaners but it was mentioned that this would lead to a loss in performance.

3.3 Findings from surveys of A.I.S.E members on alternatives

During the previous survey of A.I.S.E. members in 2018, respondents were asked via a questionnaire to provide the following information related to the analysis of alternatives:

- The functional category of the microplastics they use;
- The specific technical function provided by each microplastic – why is it important and what advantages does it give compared with products which do not use it?
- All possible alternatives (drop-in alternatives, alternative processes, and alternative products) not covered by the ECHA and/or A.I.S.E. microplastics definition which could be used instead of each microplastic for each product/function, and whether or not these alternatives are already on the market;
- A description of any barriers preventing the respondent from using these alternatives – technical, economic, availability, health, environmental or safety or any other reasons why they would not use any of these alternatives;
- A description of R&D activities the respondent has undertaken and/or plans to undertake to phase out the use of intentionally added microplastics, and which microplastics are expected to be more or less difficult to substitute
- How likely they were to adopt any of a range of possible responses if a restriction was implemented, and what would be their most likely response.

In this way, these questions were designed to collect information on the suitability of alternatives to microplastics, their availability and the effort required to develop and implement them. It also elicited whether any 'non-technical' alternatives might be adopted in the event that real substitutes for the use of microplastics are unavailable. This in turn can be used to inform questions about the effectiveness and proportionality of a proposed restriction, the response and impacts of a restriction (see Section 4.3), and the need for derogations, transition periods and so on.

Regarding the ease of replacing microplastics in different products, two companies reported that replacing microplastics in automatic dishwasher detergents and floor polishes is expected to be difficult or impossible (although specific reasons were not given). Another company reported that the removal of opacifiers from kitchen and all-purpose cleaners is expected to be simpler than for other products, since microplastics in these cases are simply used to deliver a visual cue to consumers. They expect it to be more difficult for use in liquid laundry detergents as here the opacifiers cue effectiveness and mildness and are considered to be much more part of the consumer experience of the product. The same company reported that, for all products containing encapsulate

fragrances, it is currently not expected to be possible to achieve the consumer and environmental benefits of microplastics through other means. Alternatives that are stable enough to bring these benefits in these types of applications (water-based emulsion) are said to be unavailable or also synthetic polymeric materials.

Regarding specific alternatives, respondents to the questionnaire provided the information reported in **Table 3.1**. As such, the information presented may not be considered relevant/representative by all stakeholders. This information relates to candidate alternatives which respondents have identified but which have not yet been adopted or which have not yet been shown to be suitable. In general, respondents reported that there were few candidate alternatives to the polymers they currently use. All of these candidates would be expected to be of lesser performance and of higher cost. In some cases, it was suggested that the alternative might have environmental or human health drawbacks (e.g. higher volumes of non-recyclable waste, potential cancer risks such as TiO_2, greater use of potential allergens). Respondents also suggested all candidate alternatives would need to be subject to performance and product testing, and activities such as a safety assessment, patent investigation, reformulation, consumer testing, corrosion testing, and so on.

If a candidate alternative can pass the various tests, the reformulation step alone has been reported to take around two years. The time taken for the finished end-product to gain market share after reformation however can be relatively short so long as there is only a marginal change in the final price and overall performance of the product (e.g. a product with a higher price and reduced performance may never gain the same market share to cheaper and superior performing products with polymers meeting the definition of microplastics).

Respondents also took the opportunity to identify some polymers for which they consider there are currently no suitable alternatives. These are summarised in **Table 3.2**. Polymers were not always given a unique identifier or name so some duplication might be present. It is notable that this list is much longer than the list of candidate alternatives.

Table 3.1: Candidate alternatives identified by questionnaire respondents (in 2018)

Polymer	Product type	Function	Candidate alternatives	Comments
Polyethylene granules Polyurethane granules	All-purpose hard surface cleaners Professional building care	Abrasive	Natural ingredients (e.g. silica)	Performance will be lower, there may be instability issues, more expensive
Polyvinyl chloride	Glass/window, bathroom, kitchen cleaners	Abrasive	Ground walnut shell	More expensive and requires the reformulation of products due to a higher density. Availability of sufficient supplies unclear
Glycol distearate, laureth-4 Cocamidopropyl betaine	Toilet cleaners	Opacifier / viscosity modifier	Mackadet OPR-1	Negative effect on shine. Shelf-life possibly affected due to stability issues. Additional cost of handling and making it compatible with existing automated systems.
Styrene-acrylate copolymer	Liquid laundry detergent Glass/window, bathroom, kitchen cleaners All-purpose hard surface cleaners Manual dishwasher detergent	Opacifier / viscosity modifier	Mackadet OPR-1	
			Titanium dioxide TiO_2 (or similar inorganic whitener)	Appearance quite likely to be affected, which could impact customer perception. Cost could be an issue. Stability, inclusion levels would need to be tested. Performance testing (cleaning properties for all products types, whiteness for laundry, softness for fabric conditioners and fragrance delivery) as well as product testing (such as stability, colour, fragrance, rheology, microbiology) would be required. TiO_2 has recently been classified as suspected of causing cancer by inhalation, possibly triggering changes to SDS and pack labels depending on inclusion level.
			Remove the opacifier completely.	Consumers perception of the product may be affected and in some cases stability issues may be visible. Formulations will mostly be cheaper, although re-formulation to improve stability may be required that could result in overall more expensive formulations. Alternatively, packaging may need to be altered to mask the appearance change (e.g. opaque or fully shrink-wrapped). The cost implications are not yet clear.
			Create formulations as stable, opaque emulsions.	This will most likely affect performance and cost and is not recommended.

Polymer	Product type	Function	Candidate alternatives	Comments
			Replace with alternative organic opacifier e.g. Euperlan Green (vegetable-derived) natural pearliser.	Typically these materials are recommended for Personal Care applications. Additional costs and formulation incompatibilities are expected and it is not clear whether the availability of these materials can be ensured. Whether the desired appearance will be achieved is also unclear.
Melamine formaldehyde	Solid laundry detergent Liquid laundry detergent Fabric conditioner	Encapsulated ingredients	Alternative polymer shell chemistries, e.g. Polymethyl methacrylate, Polyurethane crosspolymer–1, Polyurethane crosspolymer-2	All have broadly similar properties to melamine so might not be suitable alternatives.
			Complete removal with higher levels of fragrance oil	IFRA standards would limit the level of fragrance oil that could be used, which may result in a loss of long-lasting freshness in laundry care products and as a result reduced consumer satisfaction, an increase in washing frequency and higher household costs. Loss of encapsulates as a fragrance delivery technology would further limit progress in laundry product compaction because reduction in product dose and higher cleaning agent concentrations both place technical limits on how much free fragrance oil is required.

Table 3.2: Polymers identified by questionnaire respondents as having no known alternatives

Polymer	Product type	Function
2-Propenoic acid, 2-methyl-, 2-[(1,1-dimethylethyl) amino]ethyl ester, polymers with acrylic acid, acrylic acid-pentaerythritol-TDI reaction products, 2-carboxyethyl acrylate and pentaerythritol tetraacrylate, 2,2'-(1,2-diazenediyl)bis[4-cyanopentanoic acid]- and 2,2'-(1,2-diazenediyl) bis[2-methylbutanenitrile]-initiated	Fabric conditioner Liquid laundry detergent Other	Encapsulated ingredients
Acrylic acid thickeners	All-purpose hard surface cleaners Professional building care	Opacifiers / viscosity modifier
Acrylic Copolymer	Automatic dishwasher detergent Solid laundry detergent	Co-Builder agent
	Waxes and polishes	Main ingredients
	Toilet cleaners	Corrosion inhibitor
	All-purpose hard surface cleaners Waxes and polishes	Opacifiers / viscosity modifier Soil release agent
	Fabric conditioner	Others
Acrylic Homololymer	Automatic dishwasher detergent Solid laundry detergent Fabric conditioner Liquid laundry detergent	Co-Builder agent Opacifiers / viscosity modifier
Styrene/acrylate copolymer	All-purpose hard surface cleaners Liquid laundry detergent	Opacifiers / viscosity modifier
Alcohol Ethoxylate	Automatic dishwasher detergent Liquid laundry detergent Solid laundry detergent	Main ingredients Surfactant
Beeswax	Waxes and polishes	Main ingredients
Carnauba wax emulsion 24%	All-purpose hard surface cleaners Waxes and polishes	Main ingredients
Sodium Laureth Sulfate, Glycol Cetearate and Cocamidopropyl Betaine.	Liquid laundry detergent	Opacifiers / viscosity modifier
Floor polish emulsions	Professional building care Waxes and polishes	Main ingredients
Fatty alcohol ethoxylate and pearlescent agent	Toilet cleaners	Opacifiers / viscosity modifier
Polyethylene wax	Waxes and polishes	Main ingredients
Polydimethyl siloxane polymer	All-purpose hard surface cleaners Automatic dishwasher detergent Fabric conditioner Liquid laundry detergent Manual dishwasher detergent Solid laundry detergent	Antifoaming agent
Polyethylene Glycol	Automatic dishwasher detergent	Compacting agent
Methacrylamidopropyltrimethylammoniuchloride , ethylacrylate and acrylic acid, polymer		Surface modifying agent
Methacrylamidopropyltrimethylammonium chloride, polymer with N-Isopropylpropenamide, acrylic acid and Acrylamide tert-butylsulfonic acid, sodium salts		Surface modifying agent
Polypropylene wax	Waxes and polishes	Main ingredients
Styrene Copolymer	Liquid laundry detergent	Opacifiers / viscosity modifier
Acrylic carboxylated copolymer		Cleaning Booster
Polypropylene Terephthalate	Liquid laundry detergent	Soil release agent
Vinyl Pyrrolidone Polymer	Liquid laundry detergent Solid laundry detergent	Dye Transfer Inhibitor
Water soluble Polyester Polymer	Liquid laundry detergent Solid laundry detergent	Detergency Booster
Xanthan Gum	Liquid laundry detergent	Opacifiers / viscosity modifier

As shown in **Table 3.3**, 43 separately identified polymers are indicated at present 68 times in 10 different product types, with 14 different functions (including 'other') mentioned 63 times. Liquid laundry detergent and waxes and polishes were both mentioned 14 times, with significant mentions for fabric conditioners, all-purpose hard surface cleaners and solid laundry detergents. Encapsulated ingredients, opacifiers/viscosity modifiers and waxes/polishes main ingredients were the most frequently mentioned functions for which there are no alternatives to the current microplastics.

Table 3.3: Product types and functions of microplastics with no reported alternatives

Product type	Mentions	Function	Mentions
		Encapsulated ingredients	10
		Opacifiers / viscosity modifier	15
Fabric conditioner	7	Waxes / polishes main ingredients	17
Liquid laundry detergent	14	Co-Builder agent	3
Other	6	Corrosion inhibitor	1
All-purpose hard surface cleaners	8	Surfactant	2
Professional building care	3	Antifoam agent	4
Automatic dishwasher detergent	5	Compacting agent	1
Solid laundry detergent	8	Surface modifying agent	2
Waxes and polishes	14	Others	1
Toilet cleaners	2	Soil release agent	2
Manual dishwasher detergent	1	Cleaning Booster	1
		Dye Transfer Inhibitor	2
TOTAL	68	Detergency Booster	2
		TOTAL	63

During the interviews held with A.I.S.E members in April 2019, several companies indicated that they have phased out microbeads in consumer products, a few have voluntarily committed to stop using microplastics in opacifiers, whilst one company has set an internal target to omit microplastics in a fragrance delivery system in the next few years. Overall, several companies seem to have started working on finding alternatives, with the proposed derogations for naturally occurring polymers and biodegradable polymers being viewed as giving more options when looking for alternatives. The main driver is that companies are anticipating consumer pressure to reformulate, whilst most companies recognise that the use of microplastics is a concern for the environment and there is a need to act proactively despite marine litter being a more pressing issue that regulators should be seeking to regulate.

More recently, in July 2020, A.I.S.E members were asked via a questionnaire to provide the following information related to the analysis of alternatives:

- What alternatives to the polymers affected have been tested since 2018?
- Any suitable alternative polymers found?
- Were any of the alternative polymers promising enough to warrant further research and development / pilot testing?
- Further details on these promising alternative(s) and the status of the reformulation effort.
- If none of the alternatives tested are suitable what were the reasons for their non-suitability?

Most respondents indicated that suitable alternatives of microplastics have not been identified yet for a number of product types, such as solid laundry detergents, liquid laundry detergent, fabric conditioners and others. Respondents did however note on-going efforts to identify suitable alternatives. In particular, a few respondents affirmed that they have tested a number of alternatives since 2018, but these have not been considered promising enough to warrant further research and testing. Only one respondent indicated that a potential alternative has been identified (for a particular product), with feasibility testing on-going. Therefore its' suitability at this stage is uncertain. It should also be noted that finding a suitable alternative for one application/product does not mean read-across for the whole industry and for different products offered. Finally, a few respondents mentioned on-going efforts from polymer suppliers to find suitable alternatives.

Fragrance encapsulation

With regard to fragrance encapsulate technologies, most respondents noted that at the moment there is no suitable alternative available in the market that works efficiently in laundry applications in order to ensure the use of less fragrances, whilst at the same time bring equivalent benefits. The possible "substitutes" for encapsulations of fragrances for detergent products, if these are banned before finding a suitable alternative compliant with the proposed restriction, included:

- Using more fragrance. This would mean that industry would go back to using high levels of fragrances to compensate for retention inefficiency. It was estimated that If industry added 33% more fragrance to products this would result in an estimated additional 19,000 MT of fragrance used. Besides the increase in the volume of fragrance used and its associated costs, adding more fragrance oil does not deliver equivalent long-lasting benefits as fragrance encapsulates, for numerous reasons:
  - Inefficient Delivery: Most fragrance components have physical-chemical properties that resemble oily soils and as such, are prone to removal during the washing and rinsing process. As a result, they have poor deposition / retention on fabric. Only 1%-5% of neat fragrance oil is retained through the washing, rinsing and drying process.
  - Stability: Some fragrance components are prone to hydrolysis, oxidation, or Schiff base formation when not protected from product mixtures by encapsulation, resulting in perceptible shifts of character (the way a fragrance smells) during the shelf life of a product affecting product acceptance.
  - Evaporation: All fragrance components are inherently volatile and are thus prone to evaporation from treated surfaces resulting in a drop in detection – below the perceptibility limit - within minutes to hours of application.
- Using pro-fragrances: Pro-fragrances predominantly work by depositing on clothing and slowly delivering fragrance components through chemical mechanisms such as hydrolysis. These are considered poor substitutes as they are narrow in character and express one fragrance note (substance) at a time, while fragrance microcapsules can deliver up to 50 and can pull from a palette of over 400 fragrance raw materials. Pro-fragrances predominantly work by depositing on clothing and slowly delivering fragrance components through chemical hydrolysis. Besides the increase in the use of fragrances, these inefficient molecular delivery systems further increase the

environmental footprint due to the delivery chemistry. For example, polymer assisted pro-fragrance delivery systems (i.e. polyethylene diamine polymers that form Schiff's bases with aldehyde and ketone fragrance raw materials) have poor loading, requiring very high levels of polymer and are therefore very mass inefficient and expensive.

- Using inorganic carriers: (i.e. zeolite loaded particles) These are considered leaky and incompatible with liquid applications. Consumers have moved to liquid and unit dose laundry and fabric enhancer products. As such inorganic carriers are not suitable for the dominant and growing consumer application forms in the market.
- Using organic carriers: (i.e. starch loaded particles and "gel caps") These are unstable as they dissolve in laundry liquids and in the wash, so resemble adding neat fragrance oil. In addition, the enzymes (proteases and amylases) used in detergent products (as a biological way to enhance cleaning) destroy gelatin and starches rendering them unsuitable for these applications.

In an effort to enable long lasting freshness benefits before suitable alternatives to encapsulate technologies can be brought to market, industry may move to pro-fragrance chemistries. The carbon footprint of these can be expected to dwarf the additional fragrance volumes.

For more information on the lack of alternatives for encapsulated fragrances, please see information submitted by the International Fragrance Association (IFRA) into the 2nd public consultation.

3.4 Reformulation efforts

This subsection sets out information related to efforts to reformulate products that contain polymers that would meet the proposed definition of microplastics.

In relation to timings, based on the interview responses (in April 2019), some companies are not able to devote large resources to start reformulation efforts before a final EC decision on the restriction. There were several reasons given for this:

- No firm regulatory outcome has been determined at this stage. The restriction has not been finalised and there is a possibility that the Annex XV dossier or proposed restriction will change prior to a final decision being made by the EC.
- There is lack of clarity on some aspects of the current proposed restriction scope (e.g. definition of microplastics and the proposed derogations). As a result, it is difficult to get management sign off for large scale investment decisions for reformulations when there is still uncertainty on if/how a product will be affected.
- Companies have to prioritise other more time sensitive regulatory constraints and pressures / other reformulation priorities, such as CLP reclassifications for some preservatives and fragrance ingredients, and preservatives that need to comply with the Biocidal Products Regulation. This is particularly true for SMEs that face both financial and personnel constraints.
- Innovating with regulatory uncertainty is more onerous as multiple potential solutions need to be vetted against the restriction. It is therefore more optimal to wait whist regulatory uncertainty (e.g. scope of the restriction and derogations) is resolved.

- An earlier transition may be more expensive and if the product price is increased it may lead to loss of sales relative to those products on the market that have not yet transitioned.

On the other hand, polymer suppliers seem driven to start preparing before the restriction is finalised, in order to be able to meet customer demand and to be able to offer different types of solutions/brands. Polymer suppliers support customers in their reformulation efforts and help them find new materials to use. They are actively involved in research and development efforts to be able to provide customers with solutions that work in specific formulations. This means that polymer suppliers invest time in the reformulation process, and incur costs associated to lab space, safety testing and regulatory compliance, for instance for registering a new material under REACH.

Overall, companies are aware that reformulation pressures are expected to increase over time. Once the restriction enters into force, ECHA will introduce other reclassifications and restrictions during the five years considered as the transition period. However, it should be noted that companies are typically staffed to reformulate only a small fraction of their product portfolio each year. This means that there are significant resource limitations for reformulations.

Reformulation efforts vary depending on the desired function of a polymer and the regulatory status of the polymer and product. If there are alternatives available, then it is a standard reformulation. On the other hand, innovation efforts are required if there are currently no alternatives available (the predominant situation) or if the formula needs to significantly change in order to have the same effectiveness/desired function.

The reformulation process for a product is summarised below, based on input provided by various stakeholders during the interviews held. What should be stressed however, is that companies will need to reformulate many products at the same time and therefore this increases the complexity, time and costs.

Box 3.1: The reformulation process for a product

Reformulation steps vary from company to company and may include the following:

- Developing the research and development idea and defining the approach, with the aim to develop a solution that achieves performance targets and is suitable for the intended product.
- Testing feasibility at the lab scale.
- Confirming feasibility by testing the solution in an application.
- Assessing performance by testing the solution in different applications to ensure the reformulated product is as good as the product it aims to replace.
- Conducting stability testing (for example to test how the reformulated product reacts to the other components in the formulation and packaging).
- Assessing the risks and hazards of the solution and ensuring compliance with regulation and different local certifications or eco-labels that the product should have to be able to market it in the same way.
- Ensuring Intellectual Property Rights/Freedom to Practice.
- Analysing investment, by considering the efficiency and affordability of the solution, the feasibility of the process, procurement and the finished product stability,

- Testing to assess consumer acceptance
- Introducing the solution to the market for some applications/products
- Scaling-up the solution in the pilot plant to make it suitable/affordable for use across many products and markets.
- Launching the products

Polymer suppliers will also need to follow key reformulation steps, which may include:

- Developing a business case
- Scouting the technology
- Refining the technology
- Scaling-up

Figure 3.1 summaries the main steps to undertake to reformulation a product.

Figure 3.1: Reformulation steps

Innovation is particularly important for fragrance encapsulations, where alternatives need to be found in order to maintain the same function and level of fragrance. Encapsulates are among the most complex technologies to invent and use, as they need to diffuse the right amount to achieve the intended effect, whilst also containing fragrances for the shelf life of a product, so that the product is stable.

The complexity of fragrance encapsulate technologies was further highlighted during the latest A.I.S.E. survey (July 2020). More specifically, one respondent noted that addressing the grand challenge of "Functional Viability" and "Biodegradability", requires significant innovation and development. Encapsulating a fragrance in a bio-degradable shell necessitates resolving the technical paradox of maintaining intact capsules in products (for up 2 years of the shelf life of products), whilst at the same time making those capsules readily degradable when entering the environment. It was further noted that most off the shelf solutions can satisfy one condition but not the other. To address this challenge, multiple approaches would need to be explored simultaneously to determine the most promising leads to pursue. The respondent further explained that this could entail up to 16 different approaches being investigated in the early stages, in which progress is relatively slow. Furthermore, it was emphasised that taking an innovation to market is not a simple task, it is a concerted effort across multiple fronts and partners.

Figure 3.2 depicts the multiple aspects and interdependent nature of the various operations.

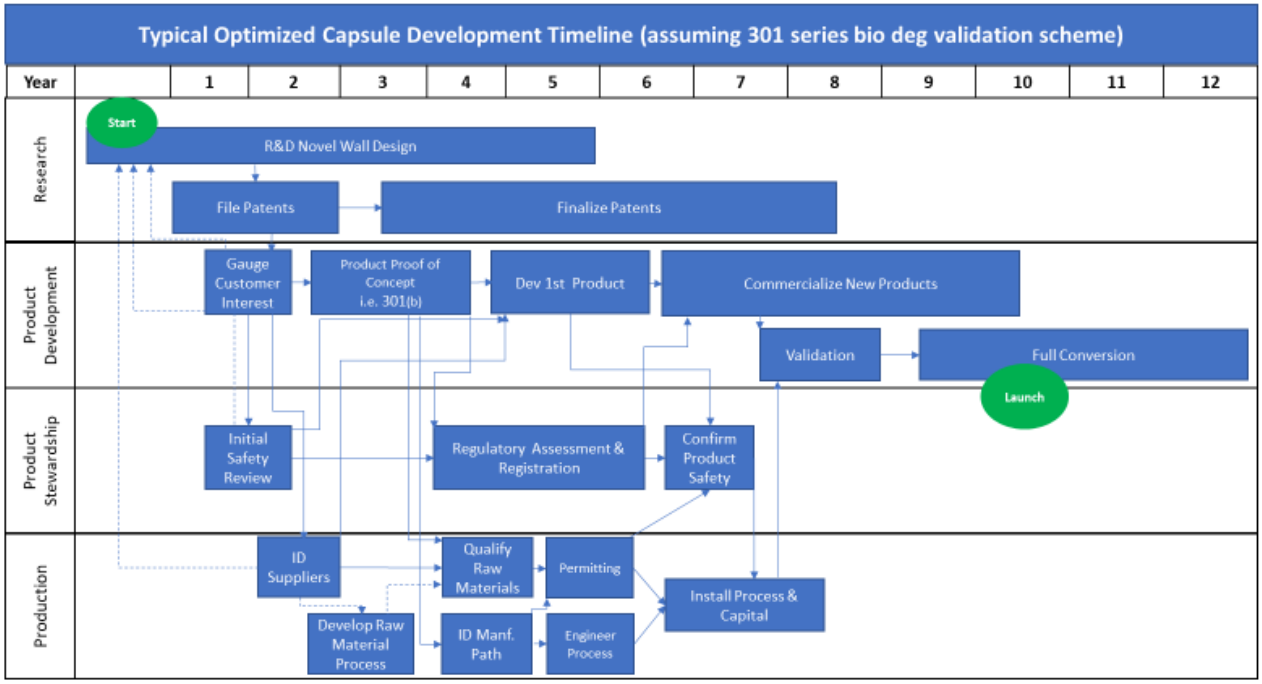


Figure 3.2: Typical optimised capsule development timeline

The same respondent indicated that fully commercializing a fragrance encapsulate entails systematically working through the many deliverables outlined in **Figure 3.3** below, in route to industrialization. It was also noted that the first generation of a new technology tends to be focused and limited in scope, and thus not an appropriate full replacement of an existing material.

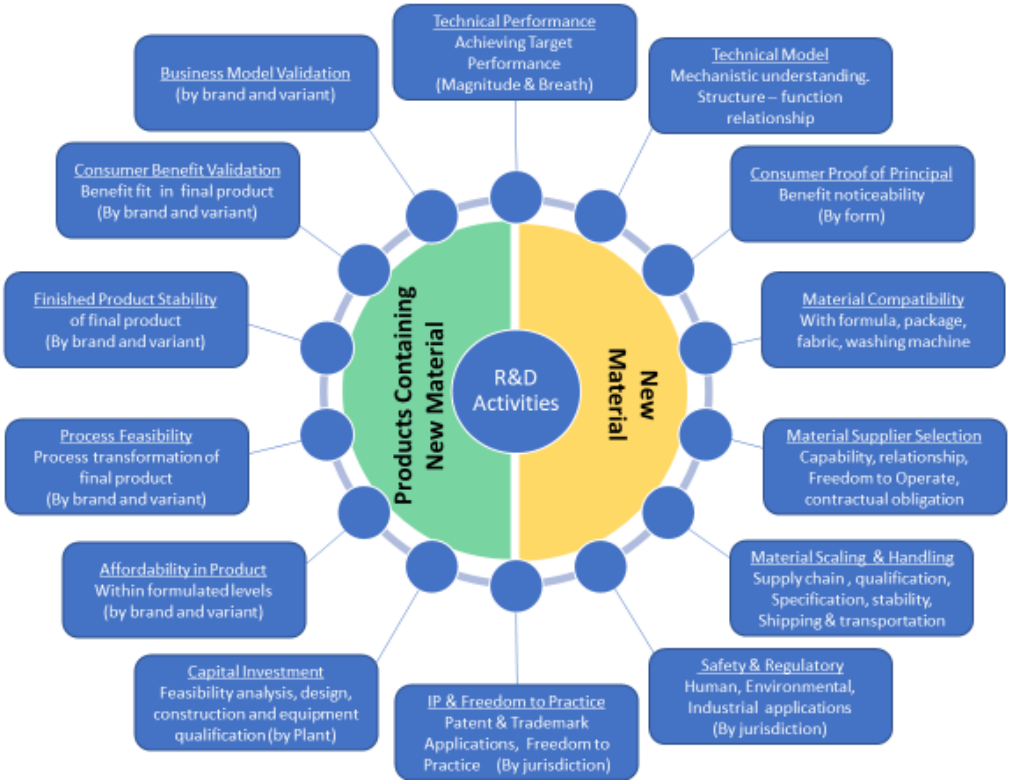


Figure 3.3: Research and Development deliverables

3.5 Transition period

ECHA is currently proposing a 5 year transition period from Entry into Force (EiF) for detergents, waxes, polishes and air care products, as well as a 5/8 year transition period from EiF for the encapsulation of fragrances in detergents and other mixtures. For the purposes of the SEA analysis, it is assumed in the restriction scenario that an 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products.

Based on the interview responses in April 2019, most companies consider it possible to reformulate their affected products in five years *only* if reformulation is simple and there are suitable alternatives (which for the most part is not currently the case). Several companies stated that it is not possible to transition in less than five years, as this is the minimum time required (from scoping to the launch of the product) to develop alternatives and reformulate products.

According to the responses, the time required to reformulate depends on the availability of alternatives. If the reformulation is more complex and there are no suitable alternatives, it will take longer (up to ten years) as the new material must first be invented, sourced and safety tested, and only then it can be re-formulated into a product. For example, it is considered very hard to find suitable alternative for water treatment products and some of the corrosion inhibitors that are tailored made. In addition to this, time is needed for research and experimentation, in order to determine whether the product function is maintained and generate stability / shelf life data to ensure that the new product will be as suitable to the consumer as the current product throughout the product life. Specific products are expected to be more challenging/problematic and may require a longer transition period, such as disinfectant products and pest control products or anything subject to additional registration, such as products that falls under the Biocidal Products Regulation (BPR), as these will have an additional regulatory burden.

Companies with a diverse portfolio of products affected will need additional time for the broader commercialization across the business, in addition to developing the solution. This can take five years, depending on the iterations needed to fit different applications and the size of the business, and could lead to higher costs and adversely affect sales if forced, for example if a suboptimal solution is chosen to comply with the regulation.

Interviewees highlighted that there are different reformulation pressures from ECHA, such as the REACH restriction for siloxanes, and the new classifications for ingredients such as those in fragrances. Therefore, any reformulation program would have to look at it holistically and assess numerous restrictions, so that a product is reformulated once. It was also noted that the time needed to reformulate one product is not proportionate to the time needed to reformulate all products, as this will depend on the number of products that need to be reformulated at a given time.

Respondents to the most recent A.I.S.E survey (July 2020) were asked to identify what percentage of their portfolio affected can be reformulated within 5, 6, 7, 8 and 10 years. As shown in **Table 3.4**, a longer transition period of 10 years should allow for a full reformulation of all affected products.

Table 3.4: Percentage of all reformulations possible within different time periods

Product category	Percentage of ALL reformulations possible				
	Within 5 years	within 6 years	within 7 years	within 8 years	within 10 years
Solid laundry detergent	60%	70%	83%	95%	100%
Liquid laundry detergent	60%	70%	83%	95%	100%
Fabric conditioner	50%	50%	70%	90%	100%
Glass/window, bathroom, kitchen cleaners	50%	50%	75%	83%	100%
All- purpose hard surface cleaners	50%	50%	75%	83%	100%
Toilet cleaners	50%	50%	75%	83%	100%
Automatic dishwasher detergent	75%	75%	75%	75%	100%
Manual dishwasher detergent	75%	75%	75%	75%	100%
Waxes and polishes	50%	50%	75%	83%	100%
Air care products	50%	50%	75%	83%	100%
Professional building care	50%	50%	75%	83%	100%
Bleaches	60%	70%	73%	75%	100%
Other	60%	75%	88%	100%	100%

Notes: results based on survey responses received from 7 companies. It is important to bear in mind that not all respondents are affected by the proposed restriction for each product category and/or may not make any products for certain categories.

Whilst the number of reformulations would be the same, the resources required at the same time would be less. A longer transition period would benefit research and development and anything that requires registration. It would also enable efforts to focus on **innovation**, which is a key driver for businesses, and would ensure that regrettable substitutions are avoided, for example a new substance with as-yet-unknown hazards. Therefore, a longer timeline is expected to help make a better choice of alternatives, develop better products and avoid regrettable substitutions. Ultimately a longer transition period would also benefit consumers as a more efficient, better quality, cheaper and mature products in the market will be available.

With regard to **fragrance encapsulates, the innovation timeline for encapsulate development is considered by most respondents to be roughly 10 years**, whilst the development of a biodegradable alternative is expected to take as long or longer. During the most recent A.I.S.E. survey (July 2020), one respondent emphasised that a 5 year transition period would mean significant investment in unproven technologies in order to comply, which presents a risk, for example the technologies may not be suitable across the whole gamut of product types and formats, or may deliver sub-par results from an environmental perspective (e.g. not passing screening degradability standards). As a result, additional development would be required, but also potentially longer biodegradability testing timelines. A longer timeline for implementation (8/10 years) would allow for a wider range of possible technologies to be tested in parallel, and thus a higher likelihood of better alternatives being identified and regrettable substitutions avoided.

Furthermore, another respondent provided detailed information on the timeline for developing alternatives and reformulating products. More specifically, the company noted that fragrance encapsulates are complex technologies and a review of the historic development timeline for commercialization is warranted. The company's innovation history indicates it takes 10 years to fully commercialize a fragrance

encapsulate, i.e. 5 years to come up with a viable fragrance encapsulate chemistry on small scale, and an additional 5 years for the subsequent generations of a new technology to be refined to enable mass adoption across the entire business line up. This entails addressing formulation incompatibilities across several forms, and hundreds of variants, scaling the new materials to make the investments affordable on a mass scale. **Figure 3.4** illustrates the company's innovation history through two generations of non-biodegradable fragrance encapsulate technologies.

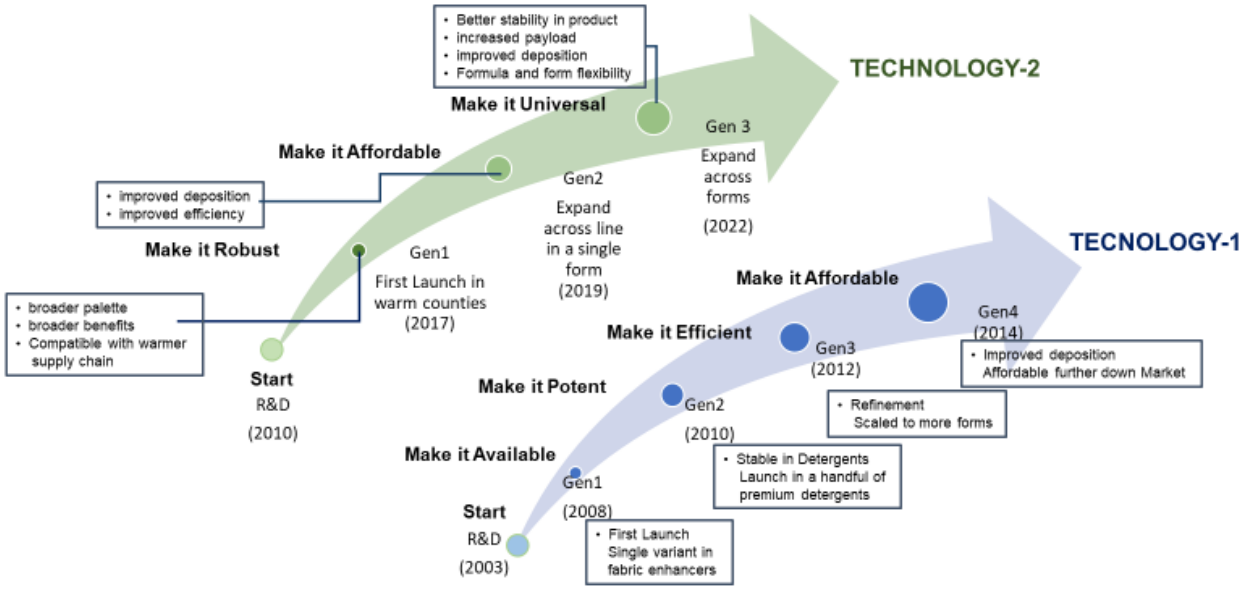


Figure 3.4: Examples of the innovation cycle of two generations of fragrance encapsulate technologies

The company concludes that, even if finding and implementing on a laboratory / pilot plant scale a suitable alternative for the encapsulation of fragrances is feasible during a transition period of 5 years, it is not expected to be sufficient time to expand the solution across the entire business (to enable compliance) given the company's historical experience with these complex technologies.

In summary, during the latest A.I.S.E survey (July 2020), **industry emphasised the need for a minimum transition period of at least 8 years, specifically for the encapsulation of fragrances**, given their low contribution in microplastic volumes and their environmental benefits, and also considering that there are no available technologies that could replace encapsulated fragrances, and that sufficient time is needed for research and testing.

3.6 Summary

To summarise the available information on alternatives:

- There is a lack of existing studies that have identified and assessed (in any detail) the suitability of possible alternatives to the use of polymers (in general) potentially qualifying as microplastics in detergent and maintenance products (e.g. most attention has been spent on the cosmetics sector). To date, those alternatives identified within existing literature have been ruled out as not being

suitable by the same authors.

- From the responses received from the 2018 survey, there is more evidence of where there are no technically feasible alternatives to the use of specific polymers rather than the cases where reformulation would be feasible. Waxes and polishes and liquid laundry detergents were the two products most referred to by respondents as there being no alternatives.
- In the instances where information has been provided on the assessment of candidate (possible) alternatives, no obvious alternatives were identified as being potentially suitable for that specific product. It is also clear that even if some were deemed suitable in the future for a specific product, this alternative may not be suitable for other detergent and maintenance products.
- In some cases, candidate alternatives did not meet certain technical functions (e.g. stability issues), whilst in other cases, it was a combination of higher costs of alternatives , supply issues, and inferior product characteristics.
- Stakeholder interviews conducted in April 2019 found that, although some larger multinational companies have begun preparing for the restriction through researching the possible impacts and identifying the polymers potentially affected, many companies (especially SMEs) are unable to begin this process due to both financial pressures and uncertainty surrounding the scope of the proposed restriction. However, drivers such as consumer preferences encourage early R&D and reformulation, for example the phasing out of microbeads.
- The overall findings from the interviews and questionnaires suggest that a longer transition of 10-years, compared to the proposed 5-years, should allow for a full reformulation of all affected products. Furthermore, a longer timeline is expected to foster greater innovation, a key driver for business, and allow for a better choice of alternatives to avoid regrettable substitutions.
- Finally, from the latest A.I.S.E survey (July 2020), it is evident that **there is a need for a minimum transition period for encapsulated fragrances of at least 8 years**, given their low contribution to microplastic volumes and their environmental benefits (e.g. avoidance of the us of significant volumes of fragrances) and considering that there are no available technologies that could replace encapsulated fragrances, and that sufficient time is needed for research and testing. In addition to this, a longer transition period would help avoid regrettable substitutions. Additional evidence has been provided to support a higher transition period, including examples of two encapsulate innovations that have taken roughly 10 years to commercialise widely.

4. Assessment of impacts

4.1 Introduction

This section sets out the estimated impacts of the proposed restriction set out in the Annex XV dossier (June 2020 version) relative to the baseline scenario set out in Section 2. Section 4.2 sets out the types of actors affected along the supply chain, and section 4.3 sets out what their most likely response to the proposed restriction would be. Section 4.4 sets out the estimated number of reformulations required, with Section 4.5 setting out the time required. Section 4.6 estimates the costs of the proposed restriction and Section 4.7 sets out the estimated benefits. A sensitivity analysis is carried out in Section 4.8 looking at for example if different transition periods were used, and Section 4.9 summarises the key results.

4.2 Actors affected by the proposed restriction

Numerous types of actors will be affected by the proposed restriction along the supply chain. This includes (i) polymer providers, (ii) companies who provide fragrances and encapsulated fragrances, (iii) companies who make detergent and maintenance products for the household care sector and (iv) companies who provide detergent and maintenance products for the professional cleaning and hygiene sector.

The proposed restriction will equally apply to multi-national corporations and Small and Medium sized Enterprises (SMEs). Some companies are mainly active in the detergents and maintenance products market, whilst others have a more diverse portfolio (e.g. personal care products, professional products and medicines) meaning the proposed restriction will affect more divisions within the company. Some companies have products affected across all different detergents and maintenance product categories, including 'other' products such as water treatment products, disinfectants, pest control products and water softeners, whilst some companies only have affected products that fall under a few product categories.

Different types of companies along the supply chain are affected to a different degree. This variability was evident from the interview and questionnaire responses (April 2019), where respondents indicated that <5%-70% of the company's total portfolio (based on sales revenue) of detergent and maintenance products is affected by the proposed restriction. As shown **Table 4.1** on average 40% (n=7) of respondent's total product portfolio would be affected by the proposed restriction. Nevertheless, it should be noted that due to the revised scope of the restriction, the percentage of total product portfolio affected by the proposed restriction is expected to be lower. It is assumed that the new restriction proposal (June 2020 version) that around 5-30% of a company's total product portfolio might now be affected, with the range depending on the size and variety of products made by the company.

Table 4.1: Percentage of total product portfolio affected

	Average	Range (low-high)
Percentage of total product portfolio affected (based on sales revenue)	40%	<5-70%

Notes:

- Based on 7 respondents who account for a market share of around 40% but varies by product category – Other 7 questionnaire respondents did not provide sales revenue data
- The lower range may change in the future, as there may be additional products entering in the market or currently on the market affected by the restriction that have not been identified. A few respondents also noted that the percentage provided is low mainly because of their interpretation of the proposed derogations that some of their products would not be affected.

From the interview responses, most companies will benefit from the proposed derogations to an extent. More specifically, companies that use natural polymers would be exempted under paragraph 3a, biodegradable polymers, such as surfactants would also be exempted under paragraph 3b, soluble polymers would be exempted under paragraph 3c, as well as polymers that are permanently modified, such as film-forming products, would be exempted under paragraph 5b and polymers that are permanently incorporated into a solid matrix when used would be exempted under paragraph 5c.

4.3 Most likely responses along the supply chain

During the 2018 A.I.S.E consultation, questionnaire respondents were asked to assess the likelihood that they would adopt each of a range of suggested possible responses to a restriction based on the proposed ECHA definition of microplastics. They were then asked to identify the most likely response, and the possible impacts associated with it. Respondents were asked for their responses as manufacturers, exporters and importers. Restriction responses could vary across product types and microplastic function. These responses have been updated with relevant information gathered in April 2019 through interviews with seven affected companies.

4.3.1 Manufacturers of detergent and maintenance products

The likely responses to a restriction varied across manufacturers and product types but the likelihood of their response was more certain. Most respondents reported that it was certain/highly likely that they would attempt to reformulate all their products to work without those polymers that when used would meet the proposed definition of microplastics.

Manufacturers reported that they would market non-microplastics products if they already had them in their portfolio, and would attempt to reformulate away from those polymers that when used would meet the proposed definition of microplastics. A few manufacturers indicated that production of certain products would be stopped in the EU (but would continue outside of the EU for non-EU markets if possible). This primarily relates to waxes and polishes, since substituting away from those polymers that when used would meet the proposed definition of microplastics in these types of products is generally expected to be very difficult.

From the responses it can be concluded that if those polymers that when used would meet the proposed definition of microplastics are intrinsic to the performance of a product and a manufacturer has been unable to identify an adequately performing substitute, it is likely that these products would disappear from the market and the company would close that part of its business. Where those polymers that when used would meet the proposed definition of microplastics provide product characteristics rather than functions, alternative products are more likely to be (and might already be) available. In this case, the market is likely to move over towards these alternatives, potentially with some loss in consumer value, depending on how important the microplastic-derived characteristic is.

During the A.I.S.E consultation in July 2020, interviewees indicated again that they plan to reformulate products that contain polymers that when used would meet the proposed definition of microplastics. It is estimated that each company in the sector would need to reformulate between <10 products to 240 products by the end of the proposed transition. As shown **Table 4.2** it is estimated that on average 100

(n=10) reformulations would be required per company. Importantly this excludes any reformulation that companies may additionally carry out to avoid the instructions for use and/or reporting requirement set out as part of the proposed restriction.

Table 4.2: Number of reformulations required per company

	Average (mean)	Range (low-high)
Number of reformulations required	100	<10-240

Notes:

- Based on 7 respondents (other respondents were not able to estimate the number of reformulations required within the timescales available). These respondents account for around 50% of the market (but varies by product category)
- Numbers rounded to nearest 10 to avoid the impression of false accuracy
- This excludes any reformulation that companies may additionally carry out to avoid the instructions for use and/or reporting requirement set out as part of the proposed restriction

As explained in Section 4.2, there is considerable variation between companies in the sector depending on how many products they have on the market across the various detergent and maintenance product categories. **Table 4.3** seeks to illustrate the variability based on the available data. Whilst the dataset may appear small (A.I.S.E July 2020 survey), these respondents account for around 50% of the household care sector and the respondents who manufacturer products for the professional cleaning and hygiene sector are thought to be representative for the part of the sector. There is some variation, with these respondents accounting for a market share of more than 50% for some product categories and less than 50% for other categories. Again, it is important to note that this excludes any reformulation that companies may additionally carry out to avoid the instructions for use (IFU) and/or reporting requirement set out as part of the proposed restriction.

Table 4.3: Number of reformulations required per company – Grouped in bands

	Number of reformulations per company			
	<10	10-100	101-200	200+
Number of companies (%)	33%	17%	33%	17%

Notes:

- Based on 7 respondents (other respondents were not able to estimate the number of reformulations required within the timescales available)
- This excludes any reformulation that companies may additionally carry out to avoid the instructions for use and/or reporting requirement set out as part of the proposed restriction

Most interviewees emphasised the difficulties and problems associated to the proposed restriction, in particular the effort and cost associated to the reformulation process. Furthermore, if there are no (equally good/cost effective) alternatives, there may not be an option to reformulate, which may eliminate certain products from being available in the market. A few respondents also mentioned that it is not easy to reformulate specific products. For example, candles, air care products, shoe polishers and floor waxes. Another example are thickeners, as there may not be an alternative material to use.

This SEA report focuses solely on the costs associated with reformulation of detergent and maintenance products and the number of (and costs associated with) reformulation do not include products outside of this sector. That said it is worth mentioning that companies (typically large companies) with a diverse portfolio beyond detergent and maintenance products (e.g. they also make cosmetic and/or medical products), will also be faced with different derogations and transition periods, which increases the complexity. Furthermore, interdependencies in raw materials and reformulations that will have to be done

across different product categories, in response to different regulatory pressures, further increase the complexity. Thus, large companies will need to navigate through the whole complexity of the restriction. These companies believe that the proposed 5-year transition period is therefore not long enough.

With regards to the instructions for use (IFU) requirement, further action is not expected for products already covered by the Detergents regulation. It has also been assumed that IFU will be required only where user behaviour can influence releases of microplastics to the environment. For products that would be subject to updating IFU, most respondents noted that the decision to reformulate to avoid the IFU requirements will depend on customers (e.g. if they subsequently demand 'microplastic free' products), whilst products that have an Ecolabel certification will have to be reformulated if the same standard and Ecolabel are to be retained.

The proposed restriction is expected to increase awareness and societal pressure towards microplastic free products. Customer acceptance and customer satisfaction are important considerations. It is expected that customers and retailers will request microplastic free products, in particular when the restriction comes into force, so certain derogations may not completely negate the need to reformulate, and companies may need to reformulate independently of the transition period given. A few respondents noted that if microplastic free products cannot be produced fast enough, this may result in a loss of sales, and potentially even a loss of products.

Related to IFU requirements , labels are already overloaded with text, so it is difficult to add text in labels in order to keep the product in the market. Furthermore, some products have the same label that incorporates different languages. Thus, adding text to the label may make multiple languages not possible, which will limit sales across borders and increase the cost for the business (i.e. the company will have to use a different label depending on the native EU language where the product is being sold).

To comply with the reporting requirement, some respondents indicated that the company will first have to develop an internal IT tool or a new functionality in existing IT tools, to be able to collect the information that needs to be reported to ECHA. The development of such an IT tool can take 3-6 months. Respondent estimates on required resources for reporting volumes of microplastics to ECHA ranged from 10 man-days to 5 full time equivalent employees. Most respondents welcomed that the transition period for reporting and IFU requirements were increased, as this would for example give them sufficient time to put IT tools in place for reporting requirements.

4.3.1 Importers and Exporters

During the 2018 A.I.S.E consultation, only one company declared itself an importer. Attempted reformulation of products to work without microplastics was stated as 'highly likely'. The same company considered reformulation across its entire portfolio 'highly likely' in its role as an exporter, too. Three other companies each reported exporting a single category of products, stated it was 'certain' that reformulation would be attempted. Another stated that reformulation as well as marketing existing non-microplastics products was certain. Finally, another one stated that it was 'highly likely' that export of the product would cease, but production outside of the EU would continue (although both reformulation and total shut-down of production were not ruled out).

4.3.2 Consumers

Consumers are expected to be impacted depending on the responses to the restriction taken upstream in the supply chain. These responses will, of course, depend on what those upstream actions are. Impacts are driven by the extent to which suppliers are successful in maintaining the functionality, quality and price of their products as they switch from formulations based on microplastics to formulations which do not use microplastics. Reductions in quality will tend to be associated with a loss in consumer value ('consumer surplus'), and could be accompanied by an increase in costs elsewhere to compensate (e.g. use of greater volumes of product to make up for lower effectiveness). An increase in price will tend to generate consumer surplus losses and greater consumer expenditure. Even if price and quality are maintained, consumers might incur costs temporarily (e.g. in switching to alternative products) if there is a delay in getting substitute formulations onto the market. Where products disappear from the market permanently, consumers will tend to switch to existing alternatives (without microplastics) or adopt alternative technologies, as well as reduce their expenditure on cleaning products in total. It is possible that attempted reformulation by manufacturers will be met with varying degrees of success, and hence some rationalisation of the market (reduction in product choice) is likely.

4.4 Number of reformulations

As discussed above, reformulation is expected to be at least the *initial* response of the majority of the detergents industry to a possible restriction on microplastics based on the ECHA definition. This is an initial response because whether reformulation will be successful or not is uncertain, and this will determine whether further action (and hence costs) is required to comply with the restriction.

In the framework of the Evaluation of the Detergents Regulation, the European Commission published in January 2018 a report prepared by RPA "Support to the Evaluation of Regulation (EC) No 648/2004 (Detergents Regulation). As part of the consultation for this report, A.I.S.E. estimated the following numbers of firms and formulations in the consumer and industrial detergents sector:

- 50 large firms- each with 300-500 formulations
- 600-650 SMEs- each with 80-120 formulations each
- This results in 63,000-103,000 total detergent products, split equally between consumer and industrial.

This figure excludes products in scope of the proposed restriction on microplastics which do not contain detergents (e.g. waxes and polishes). ECHA in their Annex XV dossier central estimate an additional 5,528-9,037 waxes and polishes products would need to be reformulated, which could be used in the absence of better data. This means a total number of detergent products of 70,000 – 110,000 (rounded to avoid the impression of false accuracy).

Using the number of firms in the sector and the average number of reformulations reported in the RPA (2018) study (noted above) and the average number of reformulations required per company (100) as a result of the proposed restriction (see **Table 4.2**), it is possible to estimate the total number of reformulations required within the EU. Since the survey data reported in **Table 4.2** is more representative for large companies, as set out in **Table 4.4** below the 100 reformulations per company is used under this approach (Approach 1) for large companies only. SMEs have on average fewer formulations compared to

large companies. For SMEs this was previously estimated (in April 2019) that on average 25 reformulations will be required per SMEs. Based on the revised restriction scope, it is now assumed that around 20 reformulations will be required by SMEs but large companies (based on latest survey) will still need to reformulate around 100 products. This results a total estimate of 17,500 reformulations required (down from a previous estimate of 20,625).

Table 4.4: Estimating the number of reformulations - Approach 1

	SMEs	Large companies
Number of sites in EU	625	50
Average number of reformulations per company	20	100
Total number of reformulations	12,500	5,000
Total number of reformulations	**17,500**	

Note: This approach would exclude the number of reformulations that may be undertaken to avoid the instructions for use and/or reporting requirement.

Alternatively, using the number of formulations in the EU and the average percentage a company's portfolio is affected (see **Table 4.1**), the total number of reformulations required as a result of the proposed restriction is estimated at 18,250 (see **Table 4.5**). Whilst Approach 2 results in a higher number of reformulations required, this could still be considered conservative as the average portfolio is based on the low and average band and many companies may have a higher proportion of their portfolio affected.

Table 4.5: Estimating the number of reformulations - Approach 2

	Low estimate	High estimate
Total number of formulations in EU	70,000	110,000
Average portfolio affected by restriction	5%	30%
Total number of reformulations required	3,500	33,000
Total (rounded mean average)	**18,250**	

Note: the high estimate has been reduced from 40% (estimated in April 2019) to 30% to reflect new revised scope of the proposed restriction

Approaches 1 and 2 above are both 'top-down' methods to estimating the total number of reformulations. As part of the questionnaire conducted for this study (July 2020), companies were asked to provide data on the number of reformulations that they would have to undertake due to the proposed scope of the restriction as well as any additional reformulations they would undertake in order to avoid the instructions for use and/or reporting requirements proposed. **Table 4.6** sets out the aggregated number of reformulations required from 7 questionnaire respondents. This can be used to develop a 'bottom-up-approach' to estimating the total number of reformulations required.

Table 4.6: Number of reformulations required - Respondent data only (July 2020)

Product category	Number of reformulations required by transition period	Number of additional reformulations undertaken to avoid microplastic instructions for use and reporting requirement	Total number of reformulations
Solid laundry detergent	150	70	220
Liquid laundry detergent	290	90	380

Product category	Number of reformulations required by transition period	Number of additional reformulations undertaken to avoid microplastic instructions for use and reporting requirement	Total number of reformulations
Fabric conditioner	160	10	170
Glass/window, bathroom, kitchen cleaners	10	10	20
All- purpose hard surface cleaners	20	10	30
Toilet cleaners	0	0	0
Automatic dishwasher detergent	0	0	0
Manual dishwasher detergent	10	10	20
Waxes and polishes	0	130	130
Air care products	0	10	10
Professional building care	0	0	0
Bleaches	10	0	10
Other	20	110	130
Total	640	390	1030

Notes:

- The results are based on 7 survey responses
- The number of reformulations has been rounded (to the nearest 10) to avoid the impression of false accuracy
- The respondent data cannot be directly compared to the previous survey respondent data as the new respondent data is based on a smaller sample size.

Based on the results shown in **Table 4.6**, it was possible to extrapolate the results (Approach 3) to estimate the total number of reformulations required at 15,990. Whilst the respondents accounts for a large market share (i.e. around 50% but varies between product categories) they can only be considered representative for large companies. However, most of the sector is made of SMES that whilst they have a very small market share, they collectively have more formulations than large companies. As there was no formulation data provided by SMEs, it was necessary to use the total number of reformulations required by SMES from Approach 1 (See **Table 4.4**) which was apportioned by product category using the breakdown of the respondent data (**Table 4.6**).

Table 4.7: Estimating the number of reformulations - Approach 3

Product category	Total number of reformulations (respondent data)	Non-respondents - Large companies	Non-respondents - SMEs	Total sector
Solid laundry detergent	220	100	2670	2990
Liquid laundry detergent	380	180	4610	5170
Fabric conditioner	170	90	2060	2320
Glass/window, bathroom, kitchen cleaners	20	30	240	290
All- purpose hard surface cleaners	30	30	360	420
Toilet cleaners	0	0	0	0
Automatic dishwasher detergent	0	0	0	0
Manual dishwasher detergent	20	20	240	280
Waxes and polishes	130	670	1580	2380
Air care products	10	20	120	150
Professional building care	0	0	0	0
Bleaches	10	20	120	150
Other	130	130	1580	1840

Product category	Total number of reformulations (respondent data)	Non-respondents - Large companies	Non-respondents - SMEs	Total sector
Total	1030	1290	13580	15990

Notes:

- The number of reformulations has been rounded (to the nearest 10) to avoid the impression of false accuracy.
- The respondent data column is based on 7 survey responses
- The non-respondent – large companies' column has been determined using respondent market share data
- The non-respondent – SMEs column has been determined using the number of reformulations required by SMEs from Approach 1. This was then broken down by product category using the respondent data breakdown. The effect of rounding at product category level means, the final estimate is slightly higher.

Each of the three approaches have their merits and drawbacks, so it is difficult to say which approach is more certain than others. However, as shown in **Table 4.8**, since the approaches all produce reformulation estimates that are fairly similar, it was deemed that an average of these numbers would be appropriate (and that it would not be necessary to use a low and high estimate). This results in a best estimate of **17,000 reformulations required** (rounded to avoid the impression of false accuracy). The change in the scope of the restriction therefore has a significant reduction as the 2019 report estimated total reformulations at 21,880.

Table 4.8: Total number of reformulations required - Used in analysis

	Low scenario	Central scenario	High scenario
Total number of reformulations – revised Annex XV dossier	6,800	10,500	14,200
Total number of reformulations – This study	**15,990**	**17,500**	**18,250**
Total number of reformulations – Used in the analysis		**17,000**	

Notes: The number of reformulations used in the analysis has been rounded (to the nearest 1000) to avoid the impression of false accuracy.

In comparison to the Annex XV dossier, the estimated number of reformulations required may be considered high at first glance, since these numbers are above ECHA's high scenario estimate for the total number of reformulations required. However, the Annex XV dossier estimates do not consider any additional reformulations driven by companies wanting to avoid the 'instructions for use' and reporting requirements laid out in paragraphs 7 and 8 of the proposed restriction. The reason given for this by ECHA is that companies would not be obliged to undertake these additional reformulations, and even if companies reformulated to avoid these requirements, they would be affected by them until the reformulations were completed.

Due to the revised restriction scope, respondents to the most recent A.I.S.E survey (July 2020) have re-assessed the number of reformulations that can be attributed to the IFU and reporting requirements. Even though this is lower than that from the April 2019 A.I.S.E survey, it is significantly more than zero, and therefore the basis for ECHA to assume no additional reformulations in their central scenario does not appear justified. It would also not be logical to assume that having an IFU and annual reporting requirement has no correlation with the number of reformulations undertaken, since IFU and reporting requirements are not costless (both administrative costs but also implications for how that information is then viewed

upon by the general public). If were really true that no additional reformulations are required, then ECHA would place less emphasis on the need for annual reporting over say reporting every 5 years.

4.5 Time required to reformulate

As was set out in **Table 3.4** within Section 3.5, it would not be possible for all companies to reformulate their total portfolio within 5 years. **Figure 4.1** illustrates the time required based on **Table 3.4** for all products that need to be reformulated. It shows that after a 5-year transition period, 57% of all products affected would be reformulated. Around 77% of reformulations would be possible within a 7-year transition period and that reformulation of all affected products should be feasible within a 10 year transition period.

Figure 4.1: Estimated time required to complete all reformulations

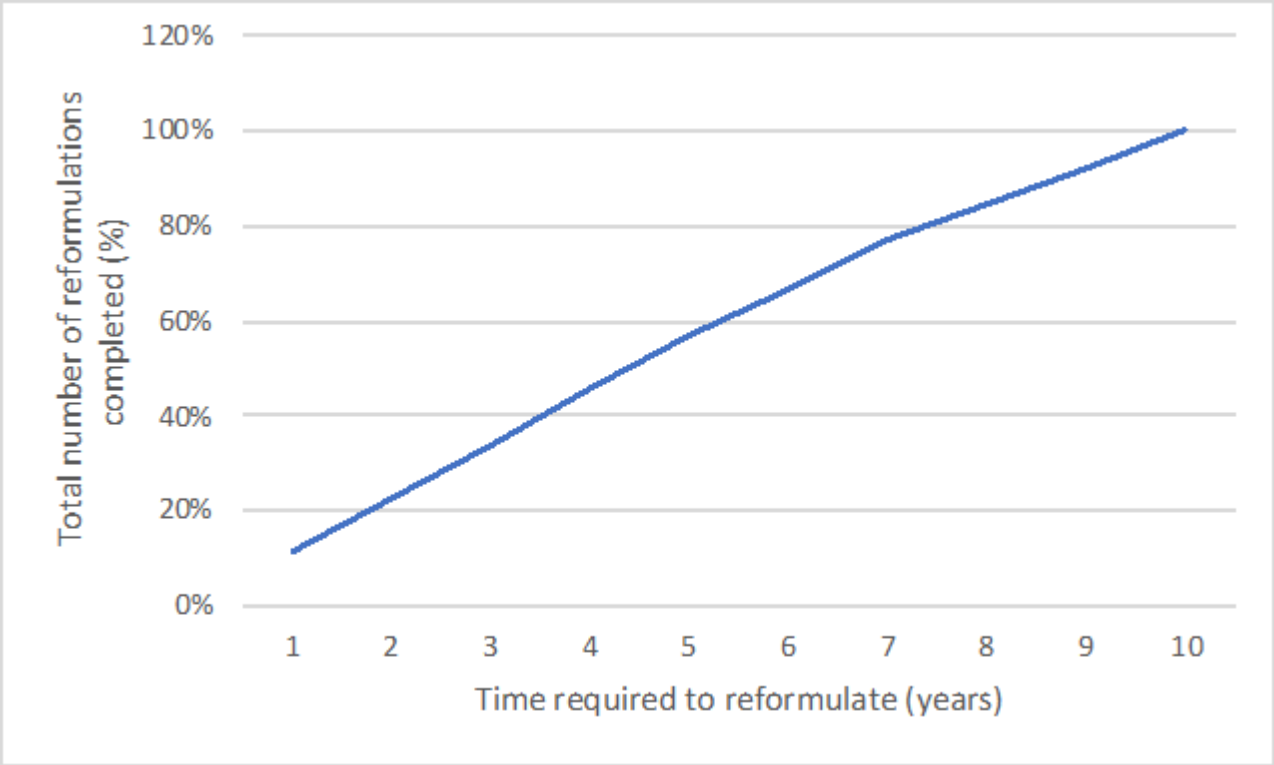


Figure 4.1 reflects the overall industry position (i.e. total reformulation), but it is possible that some companies may be able to reformulate faster than others. With more time, more companies will be able to innovative with reformulations.

Companies will need to hire more staff to seek to continue innovation as part of reformulations, as it will be a challenge to reformulate so many formulations, due to numerous reasons such as compliance with ISO methods (which take up to 2 years to run) which will limit the number of iterations of new material testing. Having 10 years for reformulation should result in fewer regrettable substitutes, minimised cost and performance issues for consumers, and still working towards achieving other targets such as greater use of sustainable materials and an overall reduction in raw material consumption (encapsulated fragrances are a good example).

4.6 Costs

This section provides an estimate of the costs of the proposed restriction, broken down by:

- The costs of reformulation;
- The costs of instructions for use and reporting;
- Increased costs of raw materials; and
- Lost profits.

For the purposes of the SEA analysis, it is assumed in the restriction scenario that an 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products.

4.6.1 Reformulation costs

An indication of the likely scale of the costs of reformulation can be gained from a recent European Commission report on the costs of restrictions on the use of phosphates as part of the detergents regulation (RPA 2018). This RPA (2018) report provides an estimate of the costs incurred from reducing their use of phosphates in detergents (specifically, consumer laundry detergents and automatic dishwasher detergents). The types of costs likely to be incurred by industry in complying with a proposed restriction on microplastics can be summarised as follows:

- One-off R&D costs for reformulation
- One-off costs of changing production processes
- On-going costs of raw material increases
- One-off costs of relabelling and changing other literature
- One-off costs of marketing campaigns to advertise changes
- On-going costs of reduced product performance and consumer choice

On the basis of various sources of information, RPA (2018) estimated the R&D costs of **simple ('routine')** reformulation to be in the range of €10,000-€20,000 per product on average. This was lower than the indicative figures provided by respondents to A.I.S.E.'s microplastics survey in 2018 (although this survey produced too few responses to provide an estimate itself). Due to uncertainty in their data, RPA (2018) were unable to estimate the one-off costs of changes to production processes. They estimated that the costs of raw materials would increase by around 10% per year, and this is considered further in Section 4.6.3. Relabelling was estimated at around €0.2k-€3k per product, although whether relabelling would actually result in actual costs would depend on the timing of the introduction of the restriction and whether relabelling requirements could be incorporated into the usual 'refresh' which happens to all products periodically. RPA (2018) did not estimate costs of advertising and other marketing which would be needed to advertise product changes.

The second questionnaire distributed in the 2018 study (after the CfE deadline) attempted to elicit information from companies which would directly inform the possible costs of reformulation in response to a restriction on microplastics. Unfortunately, only seven responses were obtained, and these were

completed somewhat inconsistently. Respondents to the second questionnaire were also asked for information on the activity and costs of reformulation. This was from two perspectives:

- 'Routine' reformulation
- Reformulation expected to be undertaken if a restriction on microplastics was to be implemented

The distinction is relevant, since most if not all detergents products are reformulated periodically as part of standard competitive market behaviours. However, reformulation to find alternatives to microplastics in detergents products would require a fundamental assessment of product ingredients and characteristics, and hence is likely to be far more involved – and hence more costly and longer-lasting. On the other hand, there might be potential economies from undertaking a large number of reformulations at the same time. This means that 'routine' reformulation might not necessarily be an accurate indicator of the reformulation implications of a microplastics restriction.

There were insufficient responses to the second survey on the costs of forced formulation if a REACH restriction were implemented. The annual costs of reformulation for those who quoted a short period of time required (e.g. 1-3 years) were aligned with the unit costs reported by RPA for routine reformulation. However, they all stressed this was on the assumption of no difficulties in finding alternative formulations. They pointed to the example of replacing phosphates in dishwashing detergents. In this case, an ingredient was restricted, but no alternative was available. The company reported that the various projects for the reformulation of this product category took 10 years, around 50k person days in R&D and manufacturing, with increased costs of formulations amounting to approximately €10m per year - not accounting for the costs of reformulation itself. Companies also stressed that it was not certain that alternative formulations could be found in all cases, or that they would be acceptable to consumers.

In the questionnaire and interviews conducted in April 2019, respondents were asked to indicate the average cost of reformulation by product category. Unfortunately, companies were not able to differentiate a unit cost by product category but compared to the 2018 survey, had a better understanding of the average costs of reformulation resulting from the proposed restriction.

The costs of reformulation will typically include development costs, staff time and resources, equipment and costs linked to testing the solutions and products. Based on the interview and questionnaire responses in April 2019, the average cost per reformulation was estimated at €240,000 with a range of between €4,000 and €650,000. Based on the questionnaire responses in July 2020, the average cost per reformulation was essentially reconfirmed whereby the average costs was estimated at €270,000 with a range of between €5,000 and over €1 million. The low estimate of the range reflects the limited budgets available for SMEs rather than the optimal effort required to find the best solution in terms of product performance and ultimately consumer benefits. For many SMEs, they would be heavily reliant on their upstream suppliers for finding suitable alternatives. That said this is not to say they would not contribute to innovation but may perhaps be limited to fewer formulations and product categories.

Most respondents (in April 2019) noted simple reformulations costs to be within the range reported in the ECHA dossier (i.e. between €15,000-40,000) but more complex reformulations will cost significantly more. For example, in order to change a surfactant, research is needed to find a suitable alternative. Nevertheless, it is not easy to exchange one raw material with another, as some polymers are tailored made for a specific

application. In some cases, there are no suitable alternatives, which means a full innovation program is required. Another example given was pest control products that require a lot of experiments to be conducted and also need to be registered under the Biocidal Products Directive. Higher costs will also be incurred if reformulations need to be done in a shorter timeframe, as several options will have to be considered in parallel.

Furthermore, the production process will have to accommodate the reformulation process (i.e. investment in new production equipment), whilst higher costs of raw materials and/or more energy intensive processes may be required. There are additionally capital write offs that should be considered, i.e. production lines no longer possible to use (but these sunk costs are not being included in this SEA).

In most cases, respondents considered the average costs used by ECHA as too low. In addition to research and development costs, there are also administrative and other costs, such as regulatory costs that may be particularly high, for instance if registration is needed under the Biocidal Products Regulation. Some products require more consumer work and engagement, such as products containing encapsulated fragrances. On the other hand, it was noted that total reformulation costs highly depend on the number of projects that need to be undertaken at a given period and the number of products that are impacted (some products may be grouped together in one project, whilst others need to be looked at individually).

Polymer suppliers also incur a cost as a result of the proposed restriction, related to research and development, testing (such as toxicology and safety assessments), lab space, registration for new products, depreciation of existing assets/products. This upstream cost should be factored in in the reformulation costs of a product, in order to account for costs across the supply chain.

In addition, there is an opportunity cost that stakeholders raised. Instead of formulating new products, companies will have to look at existing products to reformulate to remove potential microplastics in order to comply with the restriction.

Regulatory changes may add a cost to the final product in the market, and it is difficult to show that this has an added value for consumers. Furthermore, there are companies that may not comply with regulations, and as a result may have a completive advantage as their product may be less expensive.

It is recognised that there is a huge difference between the RPA estimate of €10,200-€23,000 (including instructions for use) and the average cost of €240,000 and €270,000 from the A.I.S.E surveys. This is tested further as part of the sensitivity analysis carried out in Section 4.8.

In order to resolve this difference, the following approach is used. Firstly, the RPA estimate of routine reformulation was converted to an annual cost, whereby it is conservatively assumed all routine reformulation would be completed within 3 years resulting in an annual unit cost of reformulation of €3,400-€7,700. This means the unit costs of reformulation of €34,000-€77,000 for a product that takes 10 years.

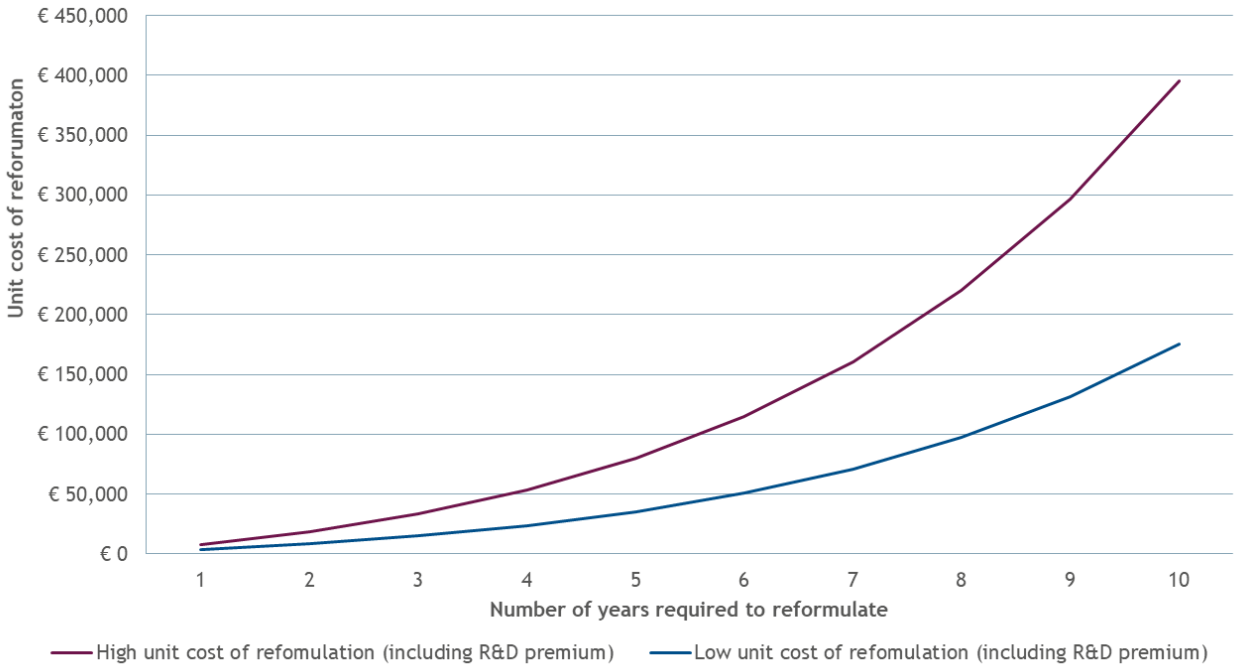
In the absence of restriction, companies would consider abandoning R&D activity (e.g. after a few years or a feasibility study) if there were no clear alternatives identified. However, faced with the need (forced) to reformulate, they would then need to weigh up spending an 'R&D premium' to reformulate or if it is better

to withdraw from the market for these products that are difficult to reformulate. This would result in other impacts like decommissioning production lines/plants, some involuntary redundancy and lost profit.

However, by assuming it is possible to successfully reformulate within 10 years, these types of costs are avoided, but at a higher R&D cost as depicted through what is referred to as an 'R&D premium' factor. The 'R&D premium' factor is set at 20%. Initially in the first 3 years the 'R&D premium' factor has limited impact whereby companies will focus R&D on what is perceived to be the 'best candidate' alternative polymers to switch to. However, if these candidate alternatives are all unsuccessful, the costs of reformulation will substantially increase over time as more innovative solutions are required / more intensive R&D is required and compromises made with product performance (as options available diminish).

Figure 4.2 illustrates the effects of the R&D premium, whereby any reformulations possible within 3 years will incur costs as estimated by RPA, but the longer the reformulation takes, the higher the total cost of that reformulation. Under the low scenario, the total cost of a reformulation taking 10 years is still lower than the average cost of reformulation (€240,000) estimated in the latest 2019 questionnaire and interview results, whilst the high cost scenario, estimates a maximum cost of just under €400,000 which is still under the upper range of €650,000 noted from the latest 2019 questionnaire and interview results and below the €1million upper range in the 2020 survey results.

Figure 4.2: Unit cost of reformulation factoring in an R&D premium



To put the unit costs of reformulation illustrated in **Figure 4.2** into context, the average reformulation cost for the REACH restriction on D4/D5 for wash-off personal care products (made by the cosmetics sector) was €350,000 per product. This is significantly higher than the weighted average cost estimated at €52,695-€118,823 (factoring in the R&D premium) as shown in **Table 4.9**.

Using the unit costs illustrated in **Figure 4.2** and the time required to successfully reformulate all products shown in **Figure 4.1**, **Table 4.9**. shows the estimated total cost of reformulation at around €491 million to €1.1 billion (in present value).

Table 4.9: Estimated total cost of reformulation

	Unit	Low	High
Total number of formulations to be reformulated	Number	17,000	17,000
unit cost (€) of reformulation	€ per formulation	€ 39,952	€ 90,088
Total costs of reformulation	€ million (undiscounted)	€ 679	€ 1,531
Total costs of routine reformulation	**€ million (discounted)**	€ 491	€ 1,108

Notes:

1. The total costs do not factor any one-off costs of changes to production processes
2. The total costs do not factor any changes in the costs of raw materials
3. The total costs have been presented in 2020 present value using a 4% discount rate as per the REACH SEA guidance
4. The number of reformulations does not include waxes and polishes and therefore is a significant underestimate.

The total costs estimate does not include ongoing higher production costs or any new capital investment required. They also do not include any allowance for reductions in performance and consumer value if, as expected, reformulation does not (generally) result in products of equivalent or comparable performance to those using microplastics currently on the market. If some reformulations were successful and others not, the result would be likely to be a rationalisation of the market, with consumers moving towards 'successful' products and 'unsuccessful' products being dropped. This could lead to further rounds of R&D and reformulation, and impacts associated with rationalisation in the industry (such as redundancies). There could also be an overall reduction in expenditure on detergents products, with associated reductions in consumer surplus.

4.6.2 Costs of instructions for use and reporting

Previously ECHA had an instructions for use requirement set out in Paragraph 7. Companies that took part in the interviews (n=7) in April 2019 estimated a one-off average cost of re-labelling of approximately €8,000/formulation with the cost ranging from €1,000 to €25,000 per formulation affected.

This one-off cost includes costs associated with regulatory checks, updating the design (which may be available in different forms due to multiple product sizes) and adding the new text. A few interviewees emphasised that costs will be in the high-end range if labels / artwork need to be re-designed. A labelling change means that there will also be a cost associated with not using pre-printed labels. Removing the requirement for instructions for use until after the transition period would allow for more time to manage changes and distribute the work and costs over more years, so that the overall cost could be much lower and, in some cases, completely avoided. An interesting point raised was that in addition to the instructions for use requirement, loss of product performance claims because of an ingredient being substituted, such as freshness that lasts for a certain number of weeks, may also require re-labelling of a product.

Figure 4.3 illustrates how the number of formulations requiring updated labels were estimated. It factors that some products would have to be re-labelled even if the plan was to reformulate them to avoid the stigma associated with the instructions for use and costs (and stigma) of reporting tonnage data to ECHA. However as shown, most companies would not necessarily reformulate due to the instructions for use and reporting requirements but were aware that these activities could lead to consumer demand for 'microplastic-free' products and therefore force companies to reformulate despite the proposed derogations.

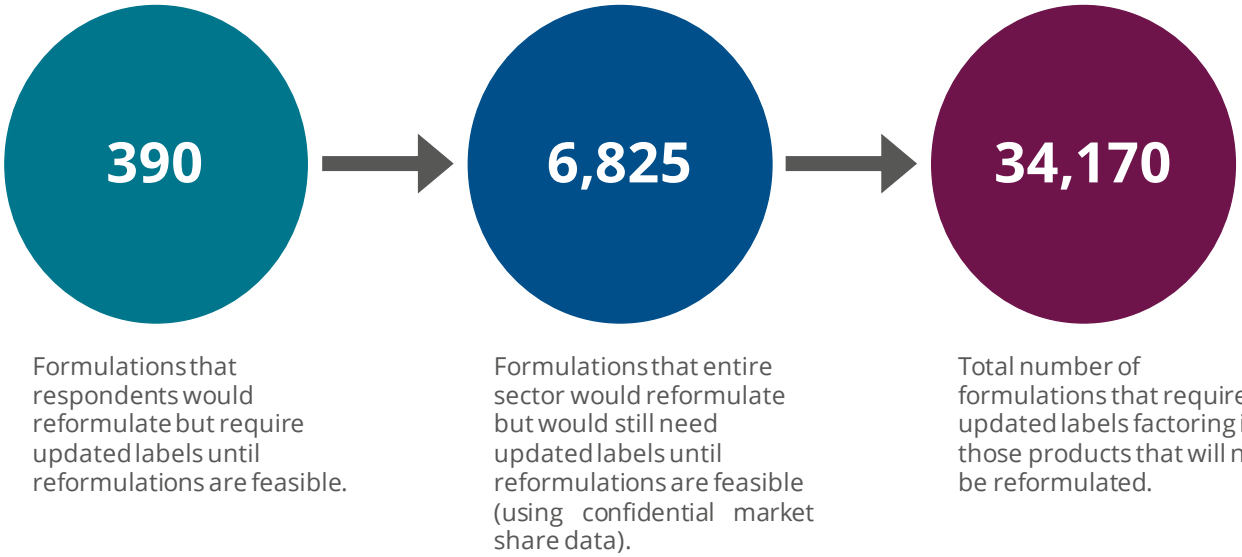


Figure 4.3: Number of formulations requiring updated labels

The total one-off cost of updating labels is estimated at €205 million, based on a unit cost of €8,000 per formulation. The sensitivity analysis in Section 4.8 explores further the impacts of using different unit cost values.

Table 4.10: Cost of updating labels

	Values
Total number of formulations requiring updated labels after two years of EIF	34,170
Average one-off cost of updating instructions for use per formulation	€8,000
Total one-off cost of updating instructions for use	**€205,020,000**

Instructions for use (IFU) requirement

Respondents to the latest A.I.S.E. survey (in July 2020) we asked about how the costs of labelling would change in light of changing the labelling requirement to an instructions for use (IFU) requirement. No respondents provided any quantitative data on this. Qualitatively respondents noted that the costs may be cheaper now if it was not necessary to label the product but could be done in a different way (e.g. updating information available if someone scans the QR code) but noted that this was still incur costs to the company to do.

Regarding the reporting requirement, it was previously difficult for respondents to provide cost estimates as they would need more clarity on what they need to report to ECHA and in what format. A few respondents mentioned that an internal IT tool may be required, so the cost for developing/updating existing systems should be factored in. The best-case scenario would be that such a tool would minimise the number of man-months needed to report information to ECHA, as reporting would be embedded into the system. The administrative cost estimated by a few respondents were €10,000 per year but some large multinational companies noted that the administrative costs would be significantly higher as it would require hiring additional staff. Therefore, an annual cost of €10,000 per company is deemed to be conservative. Respondents to the latest A.I.S.E. survey (in July 2020) were asked about how the costs of reporting might change in light of changes on what needs to be reported (e.g. reporting emissions rather than tonnes of polymers used). However no new quantitative data was provided so it was deemed

reasonable to assume the costs have not changed significantly.

Table 4.11 sets out the total estimated annual cost of reporting to ECHA on the basis that all firms in the sector will be required to report data to ECHA at least for 5 years. The total annual cost is estimated at €6.75 million per year. This cost should fall over time due to firms becoming more familiar with the reporting requirements as well as successfully reformulating the entire affected portfolio, thereby avoiding the reporting requirement.

Table 4.11: Cost of annual reporting to ECHA

Number of companies reporting to ECHA (See **Table 4.4**)	675
Annual cost of reporting	10,000
Total annual cost of reporting	**€ 6,750,000**

Notes:
The estimated number of companies required to report data to ECHA only includes manufacturers of detergents and maintenance products and does not incorporate industrial end-users of the products as well as importers. The estimated annual cost of reporting therefore does not account for the costs that these actors could incur in relation to the reporting requirement.

4.6.3 Increased costs of raw materials

All interview respondents agreed with the Annex XV dossier in that there will clearly be an increase in raw material costs, as alternative polymers/raw materials are expected to be more expensive. However, respondents were not able to say with confidence what the % change in raw material costs would be, stating that the ECHA assumption of 50% seemed reasonable in the absence of anything better.

Respondents did infer that with a longer transition period (or in general over time) the increased cost of raw material would fall over time (e.g. to 20-30%). A longer transition period would allow for more innovation and improved performance which would translate to mitigating some of the increased raw material costs. For example, fragrance encapsulates enable the use of significantly less fragrance which is among the most expensive material in the business. Time is required to increase the chance of successful innovation programs, and thereby companies avoiding to having to revert to the pre-encapsulates formulations which use more fragrance and therefore higher raw material costs. A reduced increase in raw material costs with a longer transition period is assessed further as part of the sensitivity analysis conducted in Section 4.8.

Table 4.12 sets out the estimated increase in raw material prices on an annual basis as well as the 20-year assessment period used in the Annex XV dossier. This results in a cost of €88.2 million (NPV) over a 20-year period.

Table 4.12: Increase in raw material costs

Annual tonnes of polymers affected used by sector (see Table 2.2)	13,700
Annual increased cost in raw materials	€ 5,274,500
Total cost over 20 years (NPV)	**€ 88,206,000**

Notes:
1. The annual increase in costs of raw materials is based on the same assumption of a 50% increase in price (i.e. €550/tonne) as per the Annex XV dossier
2. The total costs have been presented in 2020 present value using a 4% discount rate as per the REACH SEA guidance

To put this estimate into context, ECHA in the Annex XV dossier estimate the costs to be in the region of:

- €0 - €183 million (central estimate = €86million) for polymeric fragrance encapsulates
- €0 - €173 million (central estimate = €63million) for other microplastics contained in detergents
- €0 – €11 million (central estimate = €5million) for waxes polishes and air care products respectively.

4.6.4 *Lost profit*

In the Annex XV dossier, ECHA used Eurostat profit data (€3.823 billion in 2016) and the number of formulations in the RPA (2018) report of 103,000 to estimate the average profit per formulation of €37,000. These estimates are also used for this analysis.

As illustrated earlier in **Figure 4.1**, it would not be possible for all formulations affected to be reformulated within the 5-year transition period being proposed. Therefore, until these products have been reformulated, companies will lose profit. It is recognised that some redistribution of sales within the EU could be possible (i.e. to those that have reformulated within the 5-year period), but it is also possible that products that are more difficult to reformulate in time would be universal across the sector and therefore there could be sector wide loss of profits for specific product categories. For this reason, ECHA have only included lost profit as a sensitivity for their upper scenario only, but the justification to exclude lost profits from the central estimate do not seem justified sufficiently and therefore SEAC should reconsider their inclusion in both the central and upper scenario for those reformulations using polymers that must be reformulated before the end of the transition period but is not possible to fully do so by the end of the transition period.

As shown in **Table 4.8**, the total number of reformulations required is 17,000. As shown in **Table 4.13** below, following the end of the transition periods, not all reformulations will be completed (see **Figure 4.1**). This will result in loss in profits for these companies until after the 10-year period whereby it is estimated that all remaining reformulations required will be completed and there will be no further loss in profit. It is recognised that companies may never gain their existing market share, so some market redistribution will be inevitable.

Table 4.13: Lost profit

Lost profit	Year 6	Year 7	Year 8	Year 9	Year 10	TOTAL
Number of reformulations not possible	7,319	5,617	3,915	2,554	1,277	
Lost profit (€ million)	€ 271	€ 208	€ 145	€ 94	€ 47	€ 765
Lost profit (€ million) – NPV	€ 198	€ 146	€ 98	€ 61	€ 30	€ 533

Notes:
1. The total costs have been presented in 2020 present value using a 4% discount rate as per the REACH SEA guidance

The total loss of profit is estimated at €533million (NPV). It is possible that some of the profit loss could be smaller if it is possible for some companies to 'temporarily' substitute with an inferior polymer/product until a 'better' reformulation can be developed over time or to switch/stick to using a polymer derogated

(but still subject to the IFU and reporting requirements set out in Paragraph 7 and 8) until it is possible to fully reformulate (and thereby avoid any further costs associated with the requirements set out in the restriction proposal). However, if companies were to temporarily switch to an inferior formulation this would reduce the size of any consumer surplus, which is difficult to monetise.

To put these numbers into context, for the upper scenario only, ECHA estimated in the Annex XV dossier for polymeric fragrance encapsulates lost profit between €74.3 million and €50.5 million (5 and 8 year transition period respectively), for other microplastics contained in detergents lost profit of up to €97.9 million and for waxes, polishes and air care products lost profit of up to €0.7 million.

4.6.5 Breakdown of total costs by product category

For the purposes of the SEA analysis, it is assumed in the restriction scenario that an 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products. **Table 4.14** provides a breakdown of the estimated total costs of the proposed restriction by product category. As most of the cost components estimated earlier with Section 4.6 have not been estimated by product category, the breakdown by costs was calculated by prorating the total cost of that component with the number of reformulations required per product category. It shows that the laundry detergent (solid and liquid) are the most impacted for the household cleaning sector.

Table 4.14: Breakdown of total costs of proposed restriction by product category

Product category	Cost of reformulation (mean) (€million - NPV)	Cost of updating labels (€million - one off)	Cost of reporting (€million - NPV)	Increased cost of raw materials (€million - NPV)	Lost profit (€million - NPV)	TOTAL (€million - NPV)
Solid laundry detergent	149.4	26.5	16.5	12.9	99.5	304.7
Liquid laundry detergent	258.4	34.0	28.5	22.3	143.6	486.7
Fabric conditioner	116.0	3.8	12.8	10.0	38.9	181.5
Glass/window, bathroom, kitchen cleaners	14.6	4.0	1.6	1.3	9.7	31.1
All- purpose hard surface cleaners	21.1	4.0	2.3	1.8	14.1	43.3
Toilet cleaners	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Automatic dishwasher detergent	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manual dishwasher detergent	14.1	4.3	1.6	1.2	9.4	30.5
Waxes and polishes	118.8	72.8	13.1	10.2	79.2	294.2
Air care products	7.5	<0.1	0.8	0.6	5.0	13.6
Professional building care	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bleaches	7.5	<0.1	0.8	0.6	5.0	14.0
Other/ water treatment / Industrial cleaning & disinfectants	92.1	56.1	10.2	7.9	61.3	227.6
Total	799.5	205.0	88.2	68.9	465.6	1627.3

Notes:

1. The total costs have been presented in 2020 present value using a 4% discount rate as per the REACH SEA guidance

4.7 Benefits

In the Background Document to the Opinion on the Annex XV dossier, ECHA (2020b) calculates the emission reduction resulting from the proposed restriction over a 20-year period for the detergent and maintenance products sector as well as other affected sectors. In the case of the detergents and maintenance products sector, ECHA's estimates factor in the implementation of a 5-year transition period for 'other microplastics' contained in detergents and waxes, polishes and air care products. With respect to polymeric fragrance encapsulates, ECHA's summary table on the impacts of the proposed restriction presents estimated emission reductions resulting from a proposed restriction with a 5-year transition period. For comparison, emission reductions under an 8-year transition period for polymeric fragrance encapsulates are provided in a table note. The results for the detergents and maintenance products sector are shown in **Table 4.15** in conjunction with the percentage share of total avoided releases the sector accounts for. Assuming a 5-year transition period, ECHA estimates that the proposed restriction leads to an emission reduction of between 116,670 and 298,290 tonnes of polymers considered to be microplastics for all sectors over a 20-year period. ECHA's central estimate is 206,680 tonnes. These estimates include avoided releases from fertilisers, fertiliser additives, capsule suspension plant protection products, coated seeds, rinse-off and leave-on cosmetic products and detergents as well as waxes and polishes.

Table 4.15: Impact of the proposed restriction on releases to the environment, 20-year period (ECHA estimates)

Product group	Emission reduction (tonnes)		
	Low	Central	High
5-year transition period for all categories			
Microbeads contained in detergents	Likely fully phased out before entry-into-force		
Polymeric fragrance encapsulates	2,000	3,000	4,100
Other microplastics contained in detergents	72,000	115,900	159,800
Waxes, polishes and air care products	8,800		
Sub-total (Detergents and maintenance products sector only)	**82,800**	**127,700**	**172,700**
Total (all sectors)	**116,670**	**206,680**	**298,290**
Share of total emission reduction (based on relevant estimate)	**71.0%**	**61.8%**	**57.9%**
8-year transition period for polymeric fragrance encapsulates, 5-year transition for all other categories			
Microbeads contained in detergents	Likely fully phased out before entry-into-force		
Polymeric fragrance encapsulates	1,600	2,400	3,300
Other microplastics contained in detergents	72,000	115,900	159,800
Waxes, polishes and air care products	8,800		
Sub-total (Detergents and maintenance products sector only)	**82,400**	**127,100**	**171,900**
Total (all sectors)	**116,270**	**206,080**	**297,490**
Share of total emission reduction (based on relevant estimate)	**70.9%**	**61.7%**	**57.8%**

Source: ECHA (2020b) – Table 1 and Table 28

To compare the cost-benefit ratio of a restriction with an 8-year transition period for polymeric fragrance encapsulates to a restriction with a shorter transition period of 5 years for polymeric fragrance encapsulates, emission reductions over 20-years were calculated for three different restriction scenarios, i.e. :

- An 8-year transition period for polymeric fragrance encapsulates and a 5-year transition period for all other categories of microplastics;
- An 8-year transition period for polymeric fragrance encapsulates in combination with a 6-year transition period for all other categories; and

- A 5-year transition period for all categories of microplastics, including polymeric fragrance encapsulates.

Volume estimates for the period between 2018 and 2041 were derived based on the annual volume of polymers used by product category (shown in **Table 2.2**) and the percentages of reformulations possible within five, seven and ten years provided in **Table 3.4**. These estimates were then used to calculate release volumes for each year following the entry-into-force date. **Table 4.16** shows the volume of polymers considered to be microplastics (as per the ECHA definition) released to the environment during the 20-year period following entry into force under the different scenarios.

Table 4.16: Releases to environment over 20 years following entry-into-force date – Different transition periods

Product group	Emissions released to environment over 20 years, i.e. 2022-2041 (tonnes)								
	8-year transition period for fragrance encapsulates, 5-year transition period for all other polymers considered to be microplastics			8-year transition period for fragrance encapsulates, 6-year transition period for all other polymers considered to be microplastics			5-year transition period		
	Soil (via spreading of sewage sludge)	Water (post wastewater treatment)	Air	Soil (via spreading of sewage sludge)	Water (post wastewater treatment)	Air	Soil (via spreading of sewage sludge)	Water (post wastewater treatment)	Air
Solid laundry detergent	9,632	1,568	0	10,733	1,747	0	9,632	1,568	0
Liquid laundry detergent	8,370	1,362	0	9,099	1,481	0	7,977	1,299	0
Fabric conditioner	961	156	0	1,004	163	0	806	131	0
Glass/window, bathroom, kitchen cleaners	161	26	0	183	30	0	161	26	0
All-purpose hard surface cleaners	323	53	0	366	60	0	323	53	0
Toilet cleaners	<50 *		0	<50 *		0	<50 *		0
Automatic dishwasher detergent	<50 *		0	<50 *		0	<50 *		0
Manual dishwasher detergent	269	44	0	290	47	0	269	44	0
Waxes and polishes	583	95	334	661	108	379	583	95	334
Air care products	0		<50 *	0		<50 *	0		<50 *
Professional building care	<50 *		0	<50 *		0	<50 *		0
Bleaches	<50 *		0	<50 *		0	<50 *		0
Water treatment Industrial cleaning & disinfectants Other	151	25	0	168	27	0	151	25	0
Total	**20,449**	**3,329**	**334**	**22,503**	**3,663**	**379**	**19,901**	**3,240**	**334**
Total – Share (%)	**85%**	**14%**	**1%**	**85%**	**14%**	**1%**	**85%**	**14%**	**1%**
Total	**24,112**			**26,545**			**23,475**		

* For confidentiality reasons, an exact release volume cannot be provided for this category. It is estimated that the release volume is significantly lower than 50 tonnes. These volume estimates are however not incorporated in the total.

Based on the resulting release volumes per year, the avoided releases under the three restriction scenarios were assessed. The results for each product category are provided in **Table 4.17**. The results show that the release of 65,683 tonnes of microplastics is avoided under a restriction with an 8-year transition period for fragrance encapsulates and a 5-year transition period for all other categories. In comparison, the release of 63,250 tonnes of microplastics is avoided when implementing a restriction with a transition period of 8 years for polymeric fragrance encapsulates in combination with 6 years for all other categories. A transition period of 5 years for all polymers considered to be microplastics under the current definition is estimated to avoid the release of 66,320 tonnes of microplastics.

Table 4.17: Avoided releases from detergents and maintenance products under different transition periods

Product group	Avoided releases over 20 years (tonnes)					
	8-year transition period for fragrance encapsulates, 5-year transition period for all other polymers considered to be microplastics		8-year transition period for fragrance encapsulates, 6-year transition period for all other polymers considered to be microplastics		5-year transition period	
	Volume	%	Volume	%	Volume	%
Solid laundry detergent	31,880	49%	30,600	48%	31,880	48%
Liquid laundry detergent	25,944	39%	25,096	40%	26,401	40%
Out of which: Polymeric fragrance encapsulates	*4,823*	*7%*	*4,823*	*8%*	*5,280*	*8%*
Out of which: Other microplastics	*21,121*	*32%*	*20,273*	*32%*	*21,121*	*32%*
Fabric conditioner	2,248	3%	2,198	3%	2,428	4%
Out of which: Polymeric fragrance encapsulates	*1,277*	*2%*	*1,277*	*2%*	*1,457*	*2%*
Out of which: Other microplastics	*971*	*1%*	*921*	*1%*	*971*	*1%*
Glass/window, bathroom, kitchen cleaners	486	1%	461	1%	486	1%
All-purpose hard surface cleaners	971	1%	921	1%	971	1%
Toilet cleaners	<50 *	-	<50 *	-	<50 *	-
Automatic dishwasher detergent	<50 *	-	<50 *	-	<50 *	-
Manual dishwasher detergent	1,034	2%	1,009	2%	1,034	2%
Waxes and polishes	2,622	4%	2,487	4%	2,622	4%
Air care products	<50 *	-	<50 *	-	<50 *	-
Professional building care	<50 *	-	<50 *	-	<50 *	-
Bleaches	<50 *	-	<50 *	-	<50 *	-
Water treatment Industrial cleaning & disinfectants Other	498	1%	478	1%	498	1%
Total	**65,683**	**100%**	**63,250**	**100%**	**66,320**	**100%**

* For confidentiality reasons, an exact avoided release volume cannot be provided for this category. It is estimated that the release volume is significantly lower than 50 tonnes. These volume estimates are however not incorporated in the total.

This means that implementing a transition period of 5 years for polymeric fragrance encapsulates instead of 8 years allows for the avoidance of a slightly higher volume of releases, i.e. approximately 637 tonnes, This constitutes less than 1% of total releases under the restriction scenario with an 8-year transition

period. Increasing the transition period for all other types of microplastics from 5 to 6 years, while still implementing a transition period of 8 years for polymeric fragrance encapsulates leads to additional releases of 2,433 tonnes.

The avoided release volume under a restriction with a 5-year transition period for all types of microplastics estimated in **Table 4.17**, i.e. 66,320 tonnes lies below the emission reduction estimates derived by ECHA in relation to the detergents and maintenance products sector on the basis of a 5-year transition period. For comparison, ECHA's estimates are provided in **Table 4.15**.

As shown in **Table 4.16**, most releases into the environment, i.e. 85%, end up in soil, while 14% of all releases end up in the water environment. ECHA should therefore consider whether alternative risk management options limiting the release of microplastics to soil through the application of sewage sludge exist and whether these could be a more cost-effective option for limiting releases of microplastics to the environment.

4.8 Sensitivity analysis

Based on the cost assessment carried out, **Table 4.18** provides a breakdown of the total costs using the same 20 assessment period as per the Annex XV dossier. It shows that based on the best estimate of all cost components, the proposed restriction is estimated to cost around €1.6 billion (NPV) for the detergent and maintenance sector. For the purposes of the SEA analysis, it is assumed in the restriction scenario that an 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products.

Table 4.18: Summary breakdown of costs

COSTS (20 YEAR PERIOD)	BEST ESTIMATE
Cost of reformulation (€million - NPV)	€ 800
Cost of updating labels / instructions for use (€million - one off)	€ 205
Cost of reporting (€million - NPV)	€ 88
Increased cost of raw materials (€million - NPV)	€ 69
Lost profit (€million - NPV)	€ 466
TOTAL (€million - NPV)	€ 1,627

To put this estimate into context, ECHA estimated in the Annex XV dossier, a central estimate cost of €526.4 million (NPV) for polymeric fragrance encapsulates (5 year transition period), €129.8 million (NPV) for other microplastics contained in detergents, and €6.5 million (NPV) for waxes polishes and air care products. This estimate is therefore significantly higher but aligns with the high estimates reported in the Annex XV dossier of 811.9 million (NPV) for polymeric fragrance encapsulates (5 year transition period), €1,330.6 million (NPV) for other microplastics contained in detergents, and €19.8 million (NPV) for waxes polishes and air care products. However, the Annex XV dossier does not factor in the costs associated with instructions for use and reporting (it is assumed that these are negligible in comparison to other restriction costs, and unlikely to be solely associated with the proposed restriction) and only factors lost profit in the high scenario. Critically it also does not factor that instructions for use and reporting requirements would lead to companies requiring to undertake additional reformulations. Therefore, this study estimates provide a more accurate estimate of the total costs to the sector.

A sensitivity analysis as reported in **Table 4.19** and **Table 4.20** was undertaken on cost and benefit components in order to understand to what extent changes in certain components have an influence on the main findings.

Table 4.19: Sensitivity analysis of cost related components

Adjusted component	Variables adjust in the model	Total cost estimate (€million NPV)	% change relative to central estimate
Central estimate - 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products	**n/a**	€ 1,627	-
Transition period of 5 years for encapsulated fragrances and for all other detergent and maintenance products	• Unit cost of reformulation R&D premium changes from 15% to 20% reflecting less time available to innovate and spread resources • Lost profit for up to 5 years for all detergent and maintenance products • Reduced innovation time available increases raw material cost increase from 35% to 50%.	€ 1,970	21%
Transition period of 8 years for encapsulated fragrances and 6 years for all other detergent and maintenance products	• Unit cost of reformulation R&D premium changes from 15% to 10% reflecting more time available to innovate and spread resources • Lost profit for up to 4 years for all other detergent and maintenance products & up to 2 years for EF • Increased innovation time available reduces raw material cost increase from 35% to 25%.	€ 1,251	-23%
Using respondent average cost of reformulation rather than RPA (2018) estimate	• The average unit cost of reformulation increases from €10,000-€20,000 to €270,000	€ 6,628	307%
Lower R&D premium	• Unit cost of reformulation R&D premium changed from 15% to 12.5%	€ 1,527	-6%
Reduced raw material price increase	• Reducing the raw material cost increase from 35% to 25%.	€ 1,608	-1%

Table 4.20: Sensitivity analysis of benefit related components

Adjusted component	Total emission reduction over 20 years (tonnes)	% change relative to central estimate
Central estimate - 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products	**65,683**	**-**
Transition period of 8 years for encapsulated fragrances and 6 years for all other detergent and maintenance products	63,250	-4%
Transition period of 5 years for encapsulated fragrances and all other detergent and maintenance products)	**66,320**	1%

The main findings of the sensitivity analysis are that:

- Reducing the transition period from 8 years to 5 years encapsulated fragrances would only reduce emissions avoided by 1% but would increase the costs of the proposed restriction by around a quarter, assuming there were suitable alternatives to enable a full transition within 5 years.
- Maintaining a transition period of 8 years encapsulated fragrances and giving all other detergent and maintenance products a transition period of 6 years would reduce the costs by a quarter, whilst only reducing emissions avoided by 4%.
- Moving away from using a conservative unit cost for reformulation (i.e. simple reformulation) to what was reported by companies taking part in an interview and/or questionnaire would triple the expected costs of the proposed restriction (i.e. costs of €6.6 billion NPV).

4.9 Summary of main costs and benefits

To summarise the main costs:

- Reformulation is expected to be at least the *initial* response of the majority of the detergents industry to a possible restriction on microplastics based on the ECHA definition. This is an initial response because whether reformulation will be successful or not is uncertain, and this will determine whether further action (and hence costs) is required to comply with the restriction.
- The 2018 consultation found that if those polymers that, when used, would meet the proposed definition of microplastics are intrinsic to the performance of a product and a manufacturer has been unable to identify an adequately performing substitute, it is likely that these products would disappear from the market and the company would close that part of its business. Where those polymers that when used would meet the proposed definition of microplastics provide product characteristics rather than functions, alternative products are more likely to be (and might already be) available. In this case, the market is likely to move over towards these alternatives, potentially with some loss in consumer value, depending on how important the microplastic-derived characteristic is.
- Based on the July 2020 consultation, it is estimated that each large company within the sector will be required to reformulate an average of 100 products, with responses ranging from <10 to 240 products, specifically to meet the restriction requirements. This does not include additional reformulations a company may conduct to avoid the instructions for use/reporting requirements. Varying approaches can be adopted to extrapolate this across the entire sector, producing an average of 17,000 total reformulations required.
- Results suggest that after a 5-year transition period, around 57% of all products affected would be reformulated. Respondents indicated that total reformulation of all affected products should be feasible within a 10-year transition period.
- For the purposes of the SEA analysis, it is assumed in the restriction scenario that an 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products. The estimated costs of the restriction are summarised in the table below. Note these do not include ongoing higher production costs or investment in new production equipment, nor do they include any allowance for reductions in performance and consumer value. If some reformulations were successful and others not, the result would be likely to be a rationalisation of the market, with consumers moving towards 'successful' products and

'unsuccessful' products being dropped. This could lead to further rounds of R&D and reformulation, and impacts associated with rationalisation in the industry (such as redundancies). There could also be an overall reduction in expenditure on detergents products, with associated reductions in consumer surplus.

COSTS (20 YEAR PERIOD)	BEST ESTIMATE
Cost of reformulation (€million - NPV)	€ 800
Cost of updating labels (€million - one off)	€ 205
Cost of reporting (€million - NPV)	€ 88
Increased cost of raw materials (€million - NPV)	€ 69
Lost profit (€million - NPV)	€ 466
TOTAL (€million - NPV)	€ 1,627

To summarise the main benefits:

- The main benefit of the proposed restriction is the avoided releases of polymers meeting the criteria of microplastics. It is not possible to value (monetise) these reductions in emissions in part due a lack of scientific evidence on the impacts of these microplastics in the environment. However, from a precautionary principle perspective, reducing these emissions is highly desirable as once in the environment they are very hard to remove and may remain (i.e. persist) in the environment for a long time and can end up in the food chain (including those consumed by humans).
- The proposed restriction (which factors an 8 year transition period is being granted to encapsulated fragrances and a 5-year transition period for detergent and maintenance products excluding for use of microbeads) is estimated to avoid the releases of around 65,683 tonnes of polymers meeting the criteria of microplastics over a 20-year period (2022-2041).
- Most of these microplastics (85%) would be spread to land via the spreading of sewage sludge to land, with 14% released to the water environment post wastewater treatment. ECHA should therefore consider whether alternative risk management options limiting the release of microplastics to soil through the application of sewage sludge exist and whether these could be a more cost-effective option for limiting releases of microplastics to the environment.
- To put this into context, within the Annex XV dossier (see their Table 1), ECHA estimates that over a 20-year period, the proposed restriction would save around 116,670 tonnes (low scenario), 206,680 (central estimate) and 298,290 tonnes (high scenario) factoring in different transition periods for different sectors. These scenario's reflect different definitions of microplastics none of which is what ECHA have proposed as their restriction. ECHA indicate that their central estimate provides a good proxy for the benefits of the proposed restriction (i.e. 206,080 tonnes). Under the central estimate, ECHA estimated that a restriction on the detergent and maintenance products sector would account for around 32% of microplastics avoided (i.e. 65,683 / 206,680=32%).
- However, this is likely to be a worse-case scenario as some sectors using microplastics have not been included within the 206,680 tonnes estimate and it is not clear if other sectors will provide information to ECHA which suggests they are either more / less impacted (i.e. both costs and emissions) than estimated in the Annex XV dossier.

A sensitivity analysis was undertaken on the cost and benefit components to better understand to what extent changes in certain components have an influence on the findings. The main findings are that:

- Reducing the transition period from 8 years to 5 years encapsulated fragrances would only reduce emissions avoided by 1% but would increase the costs of the proposed restriction by around a quarter assuming there were suitable alternatives to enable a full transition within 5 years.
- Maintaining a transition period of 8 years encapsulated fragrances and giving all other detergent and maintenance products a transition period of 6 years would reduce the costs by a quarter, whilst only reducing emissions avoided by 4%.
- Moving away from using a conservative unit cost for reformulation (i.e. simple reformulation) to what was reported by companies taking part in an interview and/or questionnaire would triple the expected costs of the proposed restriction (i.e. costs of €6.6 billion NPV).

5. Summary and recommendations

This SEA report has been provided to ECHA in the 2nd public consultation process on the proposed REACH restriction on intentionally added microplastics to help SEAC finalise their opinion. For the purposes of the SEA analysis, it is assumed in the restriction scenario that an 8 year transition period is being granted to encapsulated fragrances and 5 years for all other detergent and maintenance products.

The data underlying the analysis presented in this SEA report has been gathered through consultation with A.I.S.E. members in July 2020 in the form of an excel-based questionnaire. Therefore the analysis presented reflects the expected costs and benefits of the latest restriction scope published in the 2nd public consultation (PC). This builds on from previous surveys and interviews carried out in April 2019 based on the scope of the proposed restriction published during the 1st public consultation. The main differences in the key results are presented in **Table 5.1**.

Table 5.1 - Comparison of impacts based on different restriction scopes (1st PC vs 2nd PC restriction scope)

	Unit	Old scope (1st PC)	Latest / revised scope (June 2020 for 2nd PC)
Volume of polymers affected	Tonnes per year	16,900	13,700
Number of reformulations required	Number	22,000	17,000
Total costs	€ million (NPV over 20 years)	€3,067	€1,627
Avoided emissions from restriction	Tonnes over 20 years	117,470	66,320
Cost per kg avoided	€/kg	26	25

Based on the revised restriction scope (as of June 2020) the detergents and maintenance sector uses around 13,700 tonnes of polymers per year that would be affected by the proposed restriction and are not exempt under any of the proposed derogations. No updated concentration data was gathered, but based on the 2019 work, the median concentration of microplastics in products is estimated to be 0.73%. Some variation depending on the type of product exists, with the concentration mostly ranging between 0.01% and 10%. Interview and survey responses indicate that most (~95%) of the products affected are considered to contain microplastics above the proposed 0.01% w/w concentration limit, while a considerable percentage (~85%) contains microplastics in a concentration above 0.1% w/w.

A few respondents consider that microplastics may be present in a substance or a mixture as an impurity. Thus, microplastics might be present in the finished product without carrying out a specific function due to, for example, providing a function to one of the raw materials used.

There is a lack of studies that have identified and assessed the suitability of possible alternatives to the use of polymers potentially qualifying as microplastics in detergent and maintenance products. To date, alternatives identified within existing literature have directly been ruled out as not being suitable by the same authors.

Reformulation is expected to be at least the *initial* response of the majority of companies in the detergents industry to a restriction on microplastics based on the ECHA definition. This is an initial response because whether reformulation will be successful or not is uncertain, and this will determine whether further action (and hence investment) is required to comply with the restriction.

The findings from the interviews and questionnaire suggest that a longer transition of 10 years, compared to the proposed 5-year period, should allow for a full reformulation of all affected products. Furthermore, a longer timeline is expected to foster greater innovation, a key driver for business, and allow for a better choice of alternatives thereby avoiding regrettable substitutions.

It is estimated that the entire sector would have to reformulate 17,000 formulations. Results suggest that after a 5-year transition period, around 57% of all products affected would have been reformulated. Around 85% of reformulations would be achieved within a 8-year transition period. Respondents indicated that the reformulation of all affected products should be feasible within a 10-year transition period. A breakdown of the estimated costs of the restriction are summarised in the table below.

COSTS (20-YEAR PERIOD)	BEST ESTIMATE
Cost of reformulation (€ million - NPV)	€ 800
Cost of updating labels (€ million – one-off)	€ 205
Cost of reporting (€ million - NPV)	€ 88
Increased cost of raw materials (€ million - NPV)	€ 69
Lost profit (€ million - NPV)	€ 466
TOTAL (€ million - NPV)	€ 1,627

A sensitivity analysis was undertaken on cost and benefit components to identify to what extent changes in certain components have an influence on the findings. The main findings are that:

- Reducing the transition period from 8 years to 5 years encapsulated fragrances would only reduce emissions avoided by 1% but would increase the costs of the proposed restriction by around a quarter, assuming there were suitable alternatives to enable a full transition within 5 years.
- Maintaining a transition period of 8 years encapsulated fragrances and giving all other detergent and maintenance products a transition period of 6 years would reduce the costs by a quarter, whilst only reducing emissions avoided by 4%.
- Moving away from using a conservative unit cost for reformulation (i.e. simple reformulation) to what was reported by companies taking part in an interview and/or questionnaire would triple the expected costs of the proposed restriction (i.e. costs of €6.6 billion NPV).

Based on the findings in this SEA report a key conclusion is that **maintaining a transition period of 8 years for encapsulated fragrances is justified.** The longer transition period is essential to enable sufficient time for research and testing of suitable alternatives in order to avoid negative impacts on the environment and on customer satisfaction. This is supported by information submitted by the International Fragrance Association (IFRA) into the 2nd public consultation. Reducing the transition period to 5 years would trigger changes in consumer fabric washing behaviour and increase unintentional releases of additional microfibres form the additional washing of synthetic clothing. A reduction in the transition period would only reduce emissions avoided by 1% but increase the costs of the proposed restriction (on the sector) by around a third.

It would also seem **justified to extend the transition period for all other detergent and maintenance products to 6 years**. It is important to remember that there is currently a lack of alternatives and time is

required to conduct major reformulations for 17,000 formulations. The costs of reformulation used by ECHA assumes that all reformulations are 'simple'. If this assumption is not true (which is not realistic), it is expected triple the costs of the proposed restriction. Therefore granting additional time at least allow for more innovative solutions to be found in a more cost-effective way that links to other targets (e.g. reduced packaging) rather than reverting to old technology or possible regrettable substitution in order meet the 5 year transition period.

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