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PART 2/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Combatting microplastic pollution in the European Union

Accompanying the document

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE

on preventing plastic pellet losses to reduce microplastic pollution

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Annex 1:
Procedural information

1 LEAD DG, DECIDE PLANNING/CWP REFERENCES

The preparation of this file was led by the Directorate–General: DG Environment (ENV). It was included as the following items in the DECIDE/Agenda Planning database: PLAN/2020/8355 - ENV - Measures to reduce microplastic pollution.

2 ORGANISATION AND TIMING

The initiative is a deliverable under the European Green Deal and was further set out in the **Circular Economy Action Plan**[1] (CEAP).

The **Inception Impact Assessment Roadmap** was published in 2020.

The Call for Evidence[2] was published on 30 November 2021 with a feedback period until 18 January 2022.

The Open Public Consultation[3] was published on 22 February 2022 with a feedback period until 18 May 2022.

The Inter Service Steering Group (ISSG) for the Impact Assessment was set up by the Secretariat-General (SG). It included the following DGs and services: AGRI (Agriculture), BUDG (Budget), CLIMA (Climate Action), CNECT (Communications Networks, Content and Technology), COMM (Communication), COMP (Competition), EMPL (Employment, Social Affairs and Inclusion), ENER (Energy), ESTAT (Eurostat), FISMA (Financial Stability, Financial Services and Capital Markets Union), FPI (Foreign Policy Instruments), GROW (Internal Market, Industry, Entrepreneurship and SMEs), I.D.E.A. (Inspire, Debate, Engage and Accelerate Action), INTPA (International Partnerships), JRC (Joint Research Centre), JUST (Justice and Consumers), MARE (Maritime Affairs and Fisheries), MOVE (Mobility and Transport), OLAF (European Anti-Fraud Office), REGIO (Regional and Urban policy), RTD (Research and Innovation), SANTE (Health and Food Safety), SJ (Legal Service), TAXUD (Taxation and Customs Union) TRADE (Trade), NEAR (Neighbourhood and enlargement) as well as EEAS (European External Action Service). Meetings were organised between autumn 2021 and spring 2023.

The ISSG discussed the Inception Impact Assessment and the main milestones in the process, in particular the consultation strategy and main stakeholder consultation activities, key deliverables from the support study, and the draft Impact Assessment report before the submission to the Regulatory Scrutiny Board.

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[1] European Commission, Commission communication - A new Circular Economy Action Plan For a cleaner and more competitive Europe; COM(2020)98 final, 2020.

[2] European Commission, Commission call for evidence - Microplastics pollution: measures to reduce its impact on the environment, 2022 (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12823-Microplastics-pollution-measures-to-reduce-its-impact-on-the-environment/feedback_en?p_id=27539989).

[3] European Commission, Commission public consultation - Microplastics pollution: measures to reduce its impact on the environment, 2022 (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12823-Microplastics-pollution-measures-to-reduce-its-impact-on-the-environment/public-consultation_en).

3 CONSULTATION OF THE REGULATORY SCRUTINY BOARD

In January 2022, the authors consulted the Regulatory Scrutiny Board (RSB) about the Impact Assessment (IA) during an upstream support meeting.

The RSB received the draft version of the IA report on 17 October 2022. Following the meeting with the RSB on 16 November 2022, the RSB gave a negative opinion on 18 November 2022. The opinion included recommendations that were addressed in the revised IA report as outlined in the table below. The major recommendation of the RSB was to restructure the scope of the IA around pellets, where it had previously equally considered the other identified sources of unintentional microplastic releases (paints, tyres, textiles, geotextiles and detergent capsules). Contextual information and preliminary analyses of these sources can now be found in Annex 15 of this IA.

The revisions to this IA were also the subject of an additional Inter Service Steering Group meeting on 05.05.2023.

Table 1: RSB recommendations and how they were addressed

RSB Comment	***How the comment has been addressed***
Main Points in the RSB's first opinion	
The report does not set out the **exact scope of the initiative**. It is not clear upfront on the issues that will be dealt with in parallel and future initiatives. It does not sufficiently explain the coherence with other legislation.	The report's structure has been completely revised to streamline the scope of the analysis and make clear from the beginning that pellets are the focus of the impact assessment. The introductory text makes this clear, and also indicates the reasons for targeting pellets: sufficient information and best handling practices are available and existing EU legislation does not specifically address pellets as a form of pollution along the entire supply chain. It mentions the other sources that had also been initially investigated, and explains why those sources are no longer dealt with in the main body of this IA. The other pieces of legislation and related initiatives are covered in section 2.3.2, as well as Annex 6, 8 and 9.
The **objectives** of the initiative are not specific enough and do not clearly relate to the **problems**. The report is not clear on how much this initiative is expected to contribute to the 30% reduction target.	Due to the change in scope, the problems have been revised and made specific focussing on pellets. The objectives have also been further specified. The intervention logic graph in section 4.3 provides a clear overview of this initiative's objectives and the problem it aims to tackle i.e. poor handling of pellets. Pellet losses account for 7-10% of total microplastic releases to the EU environment (intentional and unintentional), being the third largest source of releases as calculated by this IA. The preferred option (i.e. Option 2.b) would lead to an estimated reduction potential of 25 142 – 140 621 tonnes of pellet losses.

	Therefore, it would lead to an estimated 60-83% reduction in total pellet microplastic releases, which averages at around 7% in total microplastic releases. This option is therefore expected to contribute roughly to 1/4th of the 30% overall reduction target set out in the Zero Pollution Action Plan.
The presentation of **measures and options** is not sufficiently clear or focused on the precise problems to be tackled by this initiative. The impact analysis is not sufficiently clear and the level of uncertainty is not defined.	Due to the revised structure, the measures analysed have been reduced and are now specific to the problem of poor handling of pellets and subsequent harmful losses. Section 5.2. describes the identified four policy options and then sections 6 & 7 assess their impacts including on the different stakeholder groups, and how they compare. The levels of uncertainty (mainly related to measuring pellet losses and to the reduction potential of ongoing pellet initiatives) are clearly expressed and taken into account in section 5.1 where the baseline is explained.
The presentation of **stakeholder views** is too general and does not allow to understand their different views.	Annex 2 on the consultation of stakeholders has been completed to better present stakeholder views and provide more insight into how this initiative is perceived. To further deepen our understanding of SMEs' opinions, an additional survey targeting only SMEs was carried out between January and March 2023. The results of this survey are captured in Annex 12 and where relevant throughout the report, notably under each option assessed.
Points on what to improve from the first opinion	
The report should clearly frame **the scope of the initiative in its wider context**, better describing its boundaries and limits. It should clearly describe why it focuses on unintended emissions at source level and discuss why, for example, the degradation of macroplastics is not considered as in scope. It should clearly describe and analyse the **problems** posed by microplastics released in the environment. It should present the risks to human health and the environment, including climate impact. This analysis should be supported by solid evidence. Where such evidence is lacking or is uncertain, the report should indicate this clearly and discuss the robustness of the available evidence.	Section 1 has been revised to clearly explain the political and legal context where unintentional microplastic releases at source had been identified as a priority. Once in the environment, such releases are almost impossible to capture and their mobility across all environments is an aggravating factor. Therefore end-of-pipe measures are all but effective. The IA explains that a legislative framework is already in place to reduce the presence of macroplastics in the environment, which is the most effective way of tackling the degradation of macroplastics as a source of microplastics. It also covers the upcoming REACH restriction proposal targeting intentionally added microplastics. This first section also clearly states that the scope of this initiative is now reduced to pellet losses at source level. Section 2.2.1 outlines the adverse impacts of pellet losses on the environment, the climate, human health and the economy. Further information on these

	impacts are provided in Annex 7. Specifically, the report, clearly states that there is no scientific consensus with regards to the health impacts of pellets (and microplastics more generally), while explaining why the application of the precautionary principle is warranted (due to the observation of microplastics throughout the human body and food chain).
The report should better describe the **existing and on-going relevant initiatives** to enable a better understanding of the problems and their scale posed by different sources of microplastics. The dynamic baseline should include other EU initiatives, measures already taken by Member States, industry-led initiatives, and best practices around circularity. It should set out the overlap and complementarity with existing initiatives in reaching the 30% reduction target and clearly present the specific contribution of this initiative to meeting the target.	The revised IA now only focuses on pellet losses where there is a market and regulatory gap, demonstrated in section 2.3.2. The baseline has been revised to ensure that all existing initiatives that might contribute to reduce pellet losses (i.e. the French legislation, the industry-led OCS certification scheme and the SQAS assessment scheme) are taken into account according to their estimated reduction potential – this is clearly explained in section 5.1 and then further detailed in Annex 9. The limited contribution of the upcoming REACH restriction proposal as to pellet losses (i.e. improving data but not effectively reducing pellet losses) is also explained in that Annex. As laid out in section 4.2, the contribution to the 30% overall reduction target set out in the Zero Pollution Action Plan is now one of the specific objectives of this IA, and of the accompanying legislative proposal. The preferred option, which builds on industry-led efforts, is expected to contribute to 1/4th of the 30% overall reduction target set out in the Zero Pollution Action Plan. The REACH restriction is expected to contribute to a 500 000 tonnes reduction in microplastic releases over 20 year. Initiatives on tyres would possibly contribute to a 10% reduction (with a considerable range, depending on the final measures decided). This leaves a gap (probably around 10%) to reaching the 30% overall reduction target, which will eventually be dealt with via future initiatives. This initiative should also act as a market signal making products which release microplastics less popular, thus market transformation through demand-side.
The report should clarify upfront that **only one specific sectorial issue** together with a limited horizontal one will be tackled in this initiative and the issues related to microplastics releases from other sources are left to future or parallel initiatives, subject to further analysis. The specific objectives are not precise enough to link them	The scope of the current IA has been completely revised, so only the specific issue of pellet losses is being dealt with. The preliminary analysis for the other sources can now be found in Annex 15. As a result of this change in scope, the objectives are now much more specific to the problem identified with the

accurately to the revised set of specific problems. They should be expressed in more SMART terms.	poor handling of pellet losses. The main pellet objective is formulated in SMART terms.
Following a comprehensive problem definition and a clear and redefined scope of this initiative, the report should present those **measures that remain useful** for tackling the specific problems to be addressed by the initiative, discarding all measures clearly outside the scope upfront. It should then present a clear and consistent intervention logic showing how alternative set of measures could deliver on the refined set of specific objectives.	Section 2 lays out the problem definition for the specific problem of pellet losses, following the revised scope of the IA. Section 4 defines the general and specific objectives of the IA. Section 5 then presents in detail the measures and policy options identified as relevant to tackle pellet losses, and includes a graph of the intervention logic. The measures relating to the other sources have all been moved to Annex 15.
The report should revise the impact analysis so that it follows the redefined scope of the initiative. It should analyse the **impacts of the remaining measures** in sufficient depth and be clear about the stakeholder groups affected. It should ensure analytical consistency throughout. It should present the methodologies used for assessing the measures, comparing them and constructing the preferred option. The level of certainty in the analysis and conclusions should be clear.	The identified four policy options of relevance to the issue of pellet losses are outlined in Section 5, and their impacts on the environment, economy and society, as well as administrative burden for public authorities are assessed in Section 6. Insights into stakeholder opinions are also provided for each option. The various policy options are then directly compared in a summary table in Section 7. The methodology used to construct the preferred option is described in Annex 4, which explains the various assumptions that have been made notably to calculate chronic pellet losses and the estimated reduction potential of ongoing pellet initiatives. The resulting preferred option is outlined in Section 8.1. The measures proposed in this option are the ones that, in the short term and with a view of contributing to 30% overall reduction target, are possible to implement at the light of the present state of knowledge and in an economically cost-effective way.
The **views of the different stakeholders** should be discussed throughout the report from the scope of the initiative, the problem definition to the proposed options and their impacts. Dissenting views need to be presented and discussed in the main report.	Stakeholder views have been mainstreamed throughout the revised version of the IA. Section 2.1 outlines stakeholders' unanimous support for the need for action against microplastics. Section 6 assesses the impact of each policy option and includes stakeholders' opinions (where known). Annex 2 has been revised so further information is available about the results of the stakeholder consultation. An additional survey was undertaken during January-March 2023 to specifically target SMEs handling pellets and collect their views on possible actions to reduce pellet losses. The results of this survey are used throughout the IA and summarised in detail in Annex 12 (including dissenting views). Sub-options 2.a, 2.b and 2.c were conceived and assessed specifically to take account of these results.

The revised version of the IA report was submitted to the RSB on 17.05.2023. The RSB consequently gave a positive opinion with reservations on 12.06.2023. The opinion included recommendations, outlined in the table below.

RSB Comment	***How the comment has been addressed***
(B1) The report does not sufficiently justify why only measures for pellets are proposed at this stage and not for other sources, given that the precautionary principle is invoked.	
(C1) The report should reinforce the narrative as to why this impact assessment focusses solely on pellets given that it states that the need to act is justified by the precautionary principle.	The text and structure in section 1 (pp. 10-12) was changed to clarify why pellets are the sole focus of this initiative and highlight several factors that justify the application of the precautionary principle and allow for immediate action: • Contrary to other sources of microplastics unintentionally released, for which an EU legal framework exists or is being negotiated with the European Parliament and the Council, there is no existing or forthcoming EU legislation specifically preventing and reducing pellet losses as a form of pollution occurring along the entire supply chain in the EU. The proposal would remedy a loophole in the current EU legislative framework; • Sufficient evidence is available documenting the problem and the impacts, justifying intervention and allowing the design of specific policy measures, while this is not yet the case for most other sources of unintentionally released microplastics; • Contrary to other sources of microplastics unintentionally released, pellet losses are due to poor handling and therefore largely preventable today in a cost-effective manner. No changes to product or consumer behaviour are required to prevent and reduce pellet losses. They are the third source of releases and account for 7-10% of microplastics unintentionally released in the EU. • Techniques to prevent pellet losses are already available to economic operators at an acceptable cost; and • Preventing and reducing pellet losses now does not impede any future action on other sources later, as there is no interference between the different sources of microplastics.
The report should clarify what additional information would be needed to trigger action for the other sources of unintentional microplastic pollution to improve the analysis.	The changes brought to this section of the report provide further clarity on why the other sources were not pursued in the context of this impact assessment. In particular, the changes point to (1) the importance of the data gaps preventing effective policy action on paints, textiles, detergent capsules and geotextiles at this moment in time; and (2) the existing EU legislative framework or to legislative proposals currently being negotiated by the co-legislators which would allow specific measures to be taken on all other identified sources. In particular: • the Construction Product Regulation and its proposed revision for paints and geotextiles; • the Euro 7 proposal for a Regulation to tackle microplastic releases from tyres by defining abrasion limits for the placing on the market and the existing Tyre Labelling Regulation for the labelling of tyres;

	• the current Ecodesign Directive and the proposal for an Ecodesign for Sustainable product regulation to address microplastics from textiles, and possibly paints; • delegated acts under the future revision of the Detergents Regulation to tackle releases from detergent capsules if new scientific evidence points to the need). This is reflected in the updated conclusions of the preliminary analysis undertaken for the other sources, which can be found in Box 1 & Annex 15.
(C2) The report should discuss the contribution of action on pellets to solving the entire problem of microplastics released in the environment, including from the degradation of macroplastics and define the relative scale of the microplastics from pellets problem. It should discuss if taking measures on pellets first would be most effective and efficient to reach the target of 30% reduction of microplastics from the Action Plan or if measures on other sources would be more urgent and contribute more to this target.	Box 6 (Contribution of the preferred option to the Zero Pollution Action Plan target) has been added to section 8.2 (pp. 60) specifically addressing the contribution of the 'pellets' proposal towards the Zero Pollution Action Plan target. Pellet losses currently account for 7-10% of the microplastics released into the EU environment. It is estimated that the preferred option would result in a 60-83% decrease in these releases. Therefore, it could contribute to achieving a quarter of the target. This is a high contribution relative to its share of microplastic releases (up to a tenth), demonstrating why it is an effective course of action. In addition, this reduction does not require any costly product design changes, but rather the consistent application of existing pellet handling best practices at all stages of the supply chain and by all actors (not just a few as it is now). The preferred option would help bridge a regulatory and market gap to achieve this across the supply chain. There is potential to reduce microplastic releases from sources other than pellets but for the reasons presented in the report, it is not appropriate to pursue them in this initiative. However, based on the data available, a preliminary investigation shows a high cost-effectiveness of measures to reduce pellet losses compared to measures for the other sources (see the abatement curves in Figures 83 and 84). Measures on pellets are clearly 'no regret' measures therefore. The contribution of tyres would further need to be estimated within the context of the EURO 7 Regulation proposal. Regarding paints, textiles, detergent capsules and geotextiles, further data is first needed to allow for effective measures, where necessary, to be drawn up. Only then, their contribution to the target can be fully estimated, which can be done in the context of relevant, upcoming impact assessments. In contrast, enough evidence was available to justify action on pellets and estimate its contribution to the target.
Moreover, it should clarify if this 30% target refers to microplastics in general (including degradation of macroplastics) or if it is for intentionally and unintentionally added microplastics, i.e. excluding degradation from macroplastics.	The introduction of the report has been reworked (pp.9) to clarify that degradation of macroplastics is not addressed as a source in this impact assessment. The 30% reduction target does not apply to microplastics generated by the degradation of macroplastics improperly disposed of into the environment. This is because it is not possible to estimate the volume of microplastics from this source and the most effective policy action is reducing the presence of macroplastics in the environment. The Zero Pollution Action Plan therefore includes a 50% reduction target on marine litter which will help contribute to tackling this source.
(C3) The report should further discuss the magnitude of the environmental impact of	Further evidence has been added to the report to further explore the adverse impacts of microplastics in the environment, on climate and on human health both in the section 2.3 (pp. 21-24) and Annex 7. The introductory text (pp. 21) has also been reworked to highlight the uncertainties surrounding the health

pellets and the reliability of the estimates, including reference to scientific studies to support anecdotal evidence. It should identify the potential harmful climate and human health impacts from pellets specifically and be clear about the strength of scientific evidence in this area, justifying the invocation of the precautionary principle.	impacts of microplastics, which do not preclude the application of the precautionary principle. Further explanations have also been provided (pp. 21) to justify the use of studies that are more general to microplastics to explain the harm of pellets. Indeed, there is a lack of data specific to the adverse impacts of pellets (apart to a certain extent for those related to the ingestion of pellets by a range of marine and costal species like sea turtles, seabirds and shellfish),but as they are a subset of microplastics, it is assumed that most of their impacts are comparable to those of microplastics more generally. In this context, it should be underlined that approximately 80 % of all plastic raw materials produced are approximately 2 mm to 5 mm in diameter, therefore well within the usual size of microplastics (up to 5mm). Of the remaining 20%, a significant portion is even smaller than 2 mm, such as powders, and a minor part can be slightly bigger. In particular, the portion with the smallest size can have an impact on health.
(B2) The design of the options does not bring out clearly all available policy choices.	
(C4) The design of options should bring out clearly the available policy choices. On the one hand, the report should identify and clarify which actors in the supply chain are responsible for most losses.	The estimated losses for the different actors in the value chain have been added to section 2.2 (pp. 20). This IA found that logistics contribute to the most losses (27 870 – 111 480 tonnes, followed by converters (15 600 – 46 800 tonnes), producers (7222 – 21 665 tonnes) and recyclers (1448 – 4345 tonnes). This results in between 52 140 tonnes and 184 290 tonnes of pellets lost to the environment in the EU in 2019, equivalent to 0.08% to 0.28% of total pellet volumes in the EU. A detailed table is added to Annex 8.
It should be more specific on the measures proposed, in particular, on the operational controls, the equipment and the lighter regimes for SMEs, and consider if more targeted alternative options would be feasible regarding some of these measures.	Box 4 (Overview of the measures and procedures included in the preferred option) has been added to the report to provide a clear overview of the measures included in the preferred option (pp. 56-57). It differentiates between micro-, small, medium and large enterprises to clarify the lighter requirements designed for small and micro- companies, in light of the concerns these firms have raised during the consultation targeting SMEs handling plastic pellets (producers, converters, recyclers and transporters/logistics - cf Annex 12). It was determined that the burden would also be too significant for enterprises with capacities below 1 000 t (the average volume handled by small companies). The consultation also indicated that medium enterprises did not require lighter requirements. The design of options was based on best practices already applied in industry, by both large companies and SMEs, in particular for Option 2 where these best practices become mandatory requirements. In line with their current application by the industry (e.g. under Operation Clean Sweep), these requirements were considered a package (regrouping essential actions under prevention, containment and clean-up) and the option of assessing each individual requirement was not considered. The wide variety of actors in the supply chain would make it very complicated to determine which actors could be relieved of certain requirements, what the cost implications would be, and what impact each of these requirements would have on pellet loss reduction. Nevertheless, the possibility of lightening these requirements for smaller firms was assessed due to results of the SME survey. This was done in the form of

	sub-options under Option 2. Further reflections have since led to possible additional lighter requirements, which are explained in box 5 (but which are not part of the preferred option).
It should explain how these measures go beyond existing environmental management systems.	Existing environmental management systems do not explicitly cover pellet losses. Industry's existing voluntary scheme on pellets, Operation Clean Sweep (OCS), is of direct relevance to pellet losses. The measures in Option 2 do not go beyond OCS's best practices. However, OCS has been mainly taken up by larger companies who produce pellets, meaning most of the pellets value chain does not abide by these best practices. In addition, it is difficult to assess the successful implementation of OCS and therefore whether it is significantly reducing pellet losses, although some evidence shows that at certain OCS signatories' sites, pellet losses continue. Option 2 addresses these issues by ensuring all actors in the supply chain are subject to these requirements (thus preventing free riders and levelling the playing field) and enforcing implementation of the requirements (thus reducing pellet losses to the environment).
On the other hand, if combinations of options are considered necessary to tackle all identified problems (such as Option 1 and 2b and potentially different requirements within option 2b) these should be identified up-front and subsequently compared to the other options.	The description of Option 1 (pp. 36) has been updated to clarify that this Option would be beneficial to the success of all of the other options and should feature in the Preferred Option. This has also been clarified in Section 7 where the different options are compared. Indeed, Option 1 should be pursued because it addresses the information failure problem driver. Therefore, its combination with other Options will allow for a more comprehensive response to the identified problems. In addition, Option 1 is complementary to the other Options as it would allow for their effective implementation. A standard methodology is essential to monitor the implementation of Option 2 and the evolution of pellet losses. It would facilitate the comparison of different packaging solutions for pellets, under Option 3. It would also be a necessary condition to set up an EU target under Option 4. Additional wording has also been added to the description of Option 2 (pp. 37) to clarify that lighter requirements were only considered for SMEs (sub-options 2a, 2b and 2c) because large operators did not raise any concerns about the economic burden of complying with mandatory requirements. Indeed, large operators had indicated (see stakeholder consultation, the reaction of PlasticsEurope) that implementation of such requirements would be relatively straight forward and quick as long as they built on existing industry best practices (e.g. Operation Clean Sweep).
(B3) The impact analysis is not sufficiently developed. The comparison of options is not based on an assessment of their effectiveness, efficiency, coherence and proportionality.	
(C5) The report should further clarify and develop the impact analysis. It should quantify the costs to businesses related to the implementation (testing and reporting) of the mandatory standardised methodology to measure pellet losses or better explain why it is	The cost of reporting pellet losses is already accounted for in the REACH restriction on pellets; this proposal brings no additional reporting costs. Further costs related to the definition of a mandatory standardised methodology by mandating CEN to work on a harmonised standard would be paid by the European Commission. These costs are described under Option 1 in the range of 1.3 to 3.2 EUR million in the sections 6.1 (pp. 42) and 8.2.1 (pp. 59), in Annex 3 and Annex 11. Again, the implementation costs incurred to use the common standard, once this is developed and tested, are already considered under the upcoming REACH restriction (as part of the reporting costs) and do not need to be taken into account here as the scope of companies is basically the same (the REACH restriction encompasses all uses, while the upcoming pellet proposal would be

considered that those costs are accounted for under the upcoming REACH proposal given the likely broader scope of businesses covered by this initiative.	limited to uses above 5 tonnes). These costs would consist of the costs for the companies to set up specific reporting systems and for the public authority to set up verification and evaluation systems.
It should also quantify the costs to businesses of the notification of the outcomes of the certification to demonstrate compliance with the defined mandatory requirements to prevent and reduce pellet losses or better explain why those costs are considered "minimal".	There might also be minor reporting costs that were added to the section 6.2 (pp. 47) and in annex 11 (188 000 € per year) for the economic operators (to notify the outcome of the certification), as reporting already exists under REACH.
The report should make an effort to further quantify and monetise the expected benefits. It should monetise the estimated reduction in CO2 emission.	Due to their nature, it is very difficult to monetise the expected benefits: on the environment through improved ecosystems and biodiversity; on the economy through improved eco-systems services; on the sector itself via for instance modernised equipment or reduced waste; on society via reduced costs for monitoring or clean up. There is no data available that would allow further quantification or monetisation of the expected benefits. However, the estimated reduction in CO2 emissions has been monetised and added in the section 6.2 (pp. 45), table 7 (pp. 49) and in Annex 11. Under Option 2 and its sub-options 2a-2c, the reduction of pellet losses is expected to lead to an emission reduction of 84 to 583 ktCO2e, leading to savings of 8 – 58 M EUR/year.
It should also explore whether it is possible to monetise the expected reduction in the spill clean-up costs and improvements in work safety.	There is no data available on the costs of spill clean-ups. Pellet spills refer to situations where pellets escape their primary containment. These spills do not necessarily result in losses to the environment if they are contained inside the operating boundaries. However, the costs of cleaning up spills are considered to be minor, especially when compared to the costs of cleaning up losses (i.e. when the pellets are no longer contained and released into the environment) where efficiency will be much lower. Only limited anecdotal evidence is available on the costs of pellet loss clean-ups making it impossible to extrapolate an EU-wide estimation.
It should provide clear overview tables of costs and benefits. The report should better explain the qualitative scoring of the environmental, economic and social impacts. As most of the impacts are not monetised, it should justify the conclusions on	The summary tables, highlighting the impacts of each policy option in section 6, have been reworked to clarify the benefit to cost assessments for each option. These assessments are not absolute but relative to the other options to allow for more effective comparison of the different options. Table 4 presents the coding used to classify the impacts, and the benefit to cost ratios.

"Low", "Medium" and "High" Benefit Cost Ratios for each option.	
(C6) Once the impact analysis is improved, the report should compare all relevant (combinations of) options in terms of effectiveness, efficiency, coherence and proportionality and present this comparison in a clear comparison table.	The report now includes a new table 11 comparing each option's effectiveness, efficiency, coherence and proportionality (section 7, pp. 55). Text has also been added to the "summary" of the assessment of the individual options' impacts to clarify their effectiveness, efficiency, coherence and proportionality. A simple scoring system has been used to assess each option along the dimensions of effectiveness, efficiency, coherence and proportionality. These assessments are based on each option's relative costs, economic, environmental and social impacts, laid out in Section 6.
It should better justify the selection of the preferred option given the high uncertainties around the scale of the problem and their impacts. These uncertainties should be clearly set out throughout and included when addressing and qualifying the costs and benefits of the measures.	Relevant text has been added to section 6 (pp. 40) and section 8.1 (pp. 50). The report emphasises that the data on pellet losses is the most uncertain, and that there is a degree of uncertainty regarding the efficiency of the measures. This is due to a lack of reliable and comparable data on pellet losses at source. A degree of uncertainty remains around the impact of the policy options on pellet losses as the baseline pellet loss data is based on incomplete data, as highlighted and addressed by the use of ranges to present pellet losses. The preferred option includes a standardised measurement methodology to tackle this information failure and ensure better data is available. The quantification of the costs and comparison of different options has a higher degree of certainty as it is based on data provided by industry which are relatively well informed due to the existing implementation of the OCS-scheme. Therefore, the comparison of the different options is relatively certainty as it shows, how options rank.
When selecting the preferred option, the report should better justify its proportionality.	Relevant text has been added to section 8.1 (pp. 57). The report concludes that this preferred option is a case of formalising best practices in industry which will have an important positive impact on the issue of microplastic releases. Box 4 (overview of the measures and procedures included in the preferred option) has also been added to this section to further clarify the contents of the option, including the different regimes for different sized operators, thus emphasising the efforts put into ensuring the preferred option is proportional. Small and micro companies will benefit from lighter requirements to reduce the costs of the requirements, and further schemes to support these SMEs will be set up. Overall, the costs are low compared to the turnover of the supply chain (estimated cost of option 2b would represent about 0.13% of the EU plastics sector turnover), while still representing a clear cost to the smaller firms. However, the benefits to the environment, to human health and to affected economies and communities are undeniable. It will also be an important contributor to the achievement of the Zero Pollution Action plan target for a 30% reduction in microplastic releases.
It should explain how it was concluded that the benefits significantly outweigh the costs given that the monetised costs	Additional text has been added to section 8.1 (pp. 56) to clarify how the preferred option was constructed. It sets out that the preferred option was selected in light of the impacts of microplastics, including pellets, on the environment and possibly health, and that the benefits of significantly reducing microplastic releases (1/4th) would outweigh the additional costs for industry.

are much higher than the monetised benefits.	
(B4) The analysis of the impacts on SMEs and EU sector competitiveness is inadequate.	
(C7) The concerns of SMEs, even for the lighter regimes, should be highlighted throughout the report.	Relevant text has been added to the sections 6 (pp. 48) and 8 (pp. 60), along with Annexes 3 and 11, to highlight the concerns raised by SMEs which were collected during the targeted SME survey. These concerns included a lack of staff/time, a lack of information on risks and solutions and a lack of financial resources, making certain mandatory requirements too burdensome. The upfront investment costs and costs per tonne of pellets handled are more significant for SMEs, especially for micro-and small enterprises, relative to other enterprises. References to these concerns are made throughout the report and most notably in the sections outlining the impact of each option on SMEs. In light of these, lighter requirements for micro- and small companies were deemed essential to mitigating the impacts on these smaller players present throughout the value chain. These lighter requirements also complement existing EU programmes and support mechanisms which will help SMEs implement these requirements (COSME, Enterprise Europe, InvestEU, Horizon). National support could also be provided through Cohesion policy and NEXTGEN EU.
The report should explain why not all SMEs would be included in the lighter regime, in particular in light of the response of SME stakeholders to the specific consultation.	Relevant text has been added to the section 8.2.2 to clarify why medium companies have not been included in the lighter regime. The targeted SME survey showed that it was micro & small companies who expressed the main concerns about the burden of complying with any mandatory requirements (see Annex 12). In addition, the cost analysis carried out in the context of this impact assessment confirmed that the costs were much less burdensome for medium companies. The preferred option therefore only has lighter requirements for micro & small companies, as well as larger companies who handle less than 1000 tonnes of pellets every year. This threshold was selected because it corresponds to the average volume handled by small companies.
The report should analyse the impact of the preferred option on international competitiveness of the sector as well as SME competitiveness.	A new annex assessing the impact of the preferred option on international and SME competitiveness (Annex 5) has been added to the report to specifically address concerns about competitiveness. It emphasises that: • The costs of the preferred option would represent about 0.13% of the EU plastics sector turnover (2021 was EUR 405 billion) and are considered to be limited. • The additional costs are likely to have a very minor negative impact on the international competitiveness of the EU pellet producers, as their competitors outside the EU will not be subject to the requirements (although logistical operators importing pellets will have to comply within the EU). • There will be some cost savings as a result of reduced losses to the environment (as pellets are a raw material). • EU companies will have a first mover advantage if/when other countries adopt similar requirements, e.g. through an international agreement such as the Global Plastic Treaty. • The proposal will make a positive impact on the capacity to innovate as different actors of the value chain will develop solutions to minimise pellet spills in order to optimise their costs for controlling pellet losses. • The proposal includes lighter requirements for micro and small companies and for all companies with pellet capacities below 1000t and a longer

	implementation period for medium companies to mitigate any potential impacts on their competitiveness, as well as support actions for SMEs.
For the development of the measuring methodology, full coherence with REACH requirements should be further discussed.	Relevant text has been added to the section 5.2.1 to explicitly state that the methodology will need to be fully in line with REACH requirements. In addition, the report now clarifies that the scope of the companies covered by the REACH reporting requirements for pellet losses is similar to this proposal with the exception that this proposal only applies to uses above 5 tonnes.
Other	
(C8) The report should quantify the administrative costs and differentiate those that are in scope of the 'One In, One Out' approach.	The administrative costs for public authorities and businesses have been further detailed in section 8.2.1 and Annex 3, where they are classified into recurrent and one-off costs. This allows for a clearer identification of administrative costs associated with the Commission's one-in-one-out policy. Relevant text has also been added to section 6.2 and in Annex 11. The administrative costs for businesses are associated with internal assessments, external auditing and certification. There will also be minor costs for notifying the public authority of the certification. For micro- and small companies (and companies with a capacity of less than 1000t/year) will be subject to lighter requirements that are described in the new box 4. Costs for internal assessment, external audit and/or certification and notification are expected to be EUR 44 million: internal assessment for businesses – EUR 30.8 million; carrying out external audit and/or application for certificate – EUR 12.9 million; notification (i.e. filling forms and tables) – EUR 0.2 million; setting up systems in businesses for administrative procedures to report pellet losses – EUR 0.1 million (for annualised total net present value over the five year period). For public authorities, administrative costs, the processing costs are estimated, including data collection, verification, correction, and enforcement to be EUR 313 000 (total annualised one-off administrative costs of EUR 36 700, discounted at 3% over 10 years) for the first year and EUR 125 000 per year for the whole EU. These costs will vary across Member States as it would be higher for larger ones and lower for smaller ones.
(C9) As the report is now focused on pellets, this approach should be coherently adopted in the annexes, which should also focus on supporting the assessment for this specific source.	To better reflect the scope of this report, the investigation initially undertaken for the other sources (paints, tyres, pellets, textiles, geotextiles) has been moved to the very last annex (Annex 15). Annex 15 can help serve as a basis for future research into paints, pellets, textiles and geotextiles, as well as guide future analysis and impact assessments for measures tackling microplastic releases. Annex 15 also provides information about the relative merits of action on pellets (compared to other sources) as asked for by the Board. The detailed analysis in the other annexes focuses on pellets.

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Annex 2:
Stakeholder consultation (Synopsis report)

1 INTRODUCTION

The Impact Assessment accompanying the revision of this proposal included a thorough consultation process that included various consultation activities. During the process, the measures proposed for this proposal were consulted with stakeholders through bilateral meetings and stakeholder workshops (general and thematic). Furthermore, an Open Public Consultation and a Targeted Experts Survey and seven Stakeholder workshops have been conducted.

These consultation activities aimed to engage with stakeholders, inform them about the progress of the ongoing analysis, and gather information for the analysis. The starting point for these activities was the consultation strategy which was presented in the inception report. The main consultation activities included an Open Public Consultation (OPC), several workshops and bilateral consultation with different stakeholders. Initially, the consultation activities focused on the unintentional release from three sources: 1) plastic pellets; 2) synthetic textiles; and 3) tyre abrasion. Later, the activities were extended to three additional sources, viz. paints, detergent capsules, and geotextiles.

A summary of these consultation activities is presented below.

2 CONSULTATION STRATEGY

The consultation had the objective of gathering data and information to close the gaps in knowledge related to the following:

- sources, pathways and impacts of microplastics on the environment as well as the potential impact on human health;
- identification of measures to reduce the release of microplastics in the environment, e.g. labelling, standardisation, certification, voluntary and regulatory measures;
- views on possible reduction measures; and
- possible impacts of these measures on different stakeholders.

Through consultation activities, information was gathered on the state of awareness and knowledge of the general public regarding microplastic pollution and more information from experts and stakeholders involved directly or indirectly linked to microplastics release and on who can play an active role in reducing it.

The consultation strategy included these five main elements:

- Stakeholder identification and mapping;
- Open public consultation (OPC) (12-week long), with both closed and open-ended questions and the possibility to upload/send additional material;
- Several workshops with stakeholders; and

- Interviews with selected stakeholders to clarify and/or complement the information received through the targeted stakeholder survey.

3 MAPPING OF STAKEHOLDERS

In the initial steps relevant stakeholders were identified. A dedicated website[4] for the underpinning study for this impact assessment was created where interested stakeholders could register; in total 327 stakeholders registered through the website. Some stakeholders are common to the six sources, while others are specific to each source area. The following are the views of the main groups of stakeholders:

- **Competent authorities in Member States**: Some Member States (e.g. France) have already started taking actions in this regard, and consulting them is crucial to ensure a coordinated effort to efficiently reduce microplastic pollution. In addition, the Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention) has adopted a recommendation on pellets as well as guidelines.

- **Relevant economic actors** along the value chain of the three sources (manufacturers, users, transporters, etc. covered by individual companies and trade associations). Being one of the main actors, they could provide an in-depth understating of microplastics release in the environment and potential reduction measures. Both voluntary commitments and business initiatives need to be understood as there are different industry initiatives that have already been set up by industry members to reduce and/or prevent microplastic pollution.

- **Civil society organisations**: Some NGOs are raising awareness about microplastic pollution and conducting monitoring at local, national and/or international levels.

- **Certification bodies and monitoring organisations**: There is still a lack of standardised methods for monitoring microplastics. These organisations can provide information on what can be achieved with the current state of analytical methods and information on standardisation efforts.

- **Academia, research and think tanks**: Microplastic pollution is an active field of research, and this has helped raise awareness about the impacts of this pollution. They will be able to contribute the latest research evidence and help bridge the science-policy interface.

- **EU Citizens**: User behaviour is an important issue in the case of textiles, tyres, paints and capsules and consulting citizens could provide useful insights on this aspect.

[4] European Commission, Website dedicated to 'Study on unintentional release of microplastics', 2021 (https://microplastics.biois.eu).

4 OPEN PUBLIC CONSULTATION

4.1 Scope and Objective

This public consultation aims to support the European Commission's initiative on microplastic pollution. This initiative focuses on microplastics that are unintentionally released into the environment such as resulting from the use of a product, for instance by fragmentation or abrasion. It focuses on the sources with the highest known releases:

1. Plastic Pellets (intermediate materials used for the fabrication of plastic items)

2. Synthetic Textiles

3. Tyre Abrasion

4. Paints, including Architectural and Marine Paints, Road Markings

5. Geotextiles (used for civil engineering works such as road construction, coastal erosion prevention, drainage, etc.)

6. Detergent Capsules for Laundry and Dishwashers.

This initiative does not address:

- Intentionally added microplastics to products (e.g., cosmetics, detergents, fertilisers coatings): they are subject to a separate initiative under the REACH Regulation.

- Microplastics resulting from the fragmentation of macroplastics: they are addressed by existing legislation such as the Single Use Plastics Directive.

This public consultation will help gather data and information to close the gaps in knowledge related to the following:

- Sources, pathways, and impacts of microplastics on the environment and on human health;

- Identification of measures to reduce the release of microplastics in the environment, e.g., labelling, standardization, voluntary and regulatory measures, behavioural change; and

- Views on possible reduction measures.

4.2 Data Preparation

In total, 411 responses were received, and 410 responses were used for the final analyses, see in Table 2: Final analyses of the received responses. Based on the division of the survey in various sections, some of which were not mandatory to answer, the team employed standard and specific cleaning procedures. Standard procedures consist of dealing with null values and spurious entries, where a respondent may have skimmed through the questionnaire without providing consistent answers. The team also employed a split and pivot to separate and transpose the responses of multiple-choice questions in individual rows.

Table 2: Final analyses of the received responses

Cleaning Criteria	Number
Total Raw Responses	411 (100%)
Number of responses omitted due to spurious personal information	0 (0%)
Number of responses omitted due to being duplicates	0 (0%)
Number of responses omitted for blank or unmeaningful submissions	1 (~2%)
Number of responses requiring altered metadata/stakeholder types	0 (0%)
Responses after Primary Cleaning	410

4.3 Clustering of Responses and Special Processing

The general section of the questionnaire detailed demographic information of the respondents, along with the sources of microplastic emissions that they would like to answer for, with each source having a detailed section later. Hence, the team had to first split and transpose respondents who answered for multiple sources and filter inconsistent answers.

Moreover, the division of general and expert sections of the questionnaire implies that respondents will skip the expert sections if they do not have technical knowledge on the specific industry in question. Here, we encounter primarily two responses for further processing – null values and responses marked *I don't know/Not Applicable*. Since the design of the questionnaire did not separate the latter response, the team was not able to filter spurious entries from the ones where the respondent knows the industry but does not know the answer to specific questions.

The cleaning problem at hand is further accentuated because of the low number of responses in the expert section – in general, nulls/*I don't know* accounted for more than 50% of the total responses and hence, omitting them across all sections will not be valuable.

Table 3: Special Cleaning of the Data

Cleaning Criteria	Number
Sample Size after Primary Cleaning	410 (100%)
Total number of responses after splitting multiple entries	410 (100%)
Number of responses omitted for duplicates after splitting multiple entries	0 (0%)
General Range of Responses in the Expert Sections after filtering	35-154 (8.5% -38%)
Number of responses requiring altered metadata/stakeholder types	0 (0%)
Total Responses for Analysis	410 (100%)

4.4 Open Answer Questions and Campaign Identification

The survey across all sections extracted other information and general comments on specific questions for measures to prevent microplastic emissions, if the respondent believes that more options can be assessed apart from the ones outlined in the survey. Here, the data extracted is qualitative and open ended. Hence, we need to highlight duplicate responses and plagiarized comments that are

usually meant for lobbying purposes and to skew the distribution of responses. Using Tableau Prep, we remove duplicates and null values from the dataset using aggregation and filtering. Owing to the non-mandatory nature of the questions, a vast majority of the responses for open-text questions were nulls (~60-80%). Hence, textual and thematic duplicates that account for more than 2 responses per question were excluded from analysis. Moreover, irrelevant or comments duplicated from the questions themselves were excluded from thematic analysis. A detailed breakdown of the responses is provided in the thematic analysis.

4.5 Methodologies Employed

4.5.1 Analysis of Closed Questions

The questionnaire in general uses a five-pronged scale of agreeability ranging from *completely agree* to *completely disagree* with another response for respondents that do not possess sufficient knowledge to reply. The questionnaire is divided into four sections:

1. General information about the respondent
2. General views and opinions on microplastic and prevention measures
3. Specific sections on each highlighted source of microplastic emissions and prevention measures (subsections A-F)
4. Questions directed at all sources of microplastic emissions and prevention measures

The analysis of the consultation responses is purely descriptive, using visuals such as pie and stacked bar charts for composition of respondents based on demographics and general responses. For the bulk of the questionnaire including the expert sections, the team has employed highlighted tables. Such tables are quite informative as they are colour coded based on the observed frequency of the agreeability scale used for each question – the highest frequency of agreeability is coded with the deepest shade. Based on highlighted tables, one can immediately infer the general attitude towards an aspect of microplastic emissions and associated policy measures. For questions that outline a list of potential policy measures, the tables are broadly segregated into themes wherever applicable to enable a better understanding of thematic measures. Tables for each question per section are captioned with the number of respondents and an associated brief on frequencies as percentages of total count.

4.5.2 Analysis of Open Text Questions

The questionnaire includes 15 open text questions where respondents can provide more information about their attitude and position on a specific aspect of microplastics and associated policy. In such questions, respondents primarily are asked to provide more information if they agree with other aspects of microplastics than those specifically identified in the question. The thematic analysis of responses is done manually with the following broad steps:

> **Step 1:** *Exploring an analytical framework and discovering general content. We identified keywords and an inspection of the topics relating to the key word. Then, we logically deduce general topics for inclusion into the analytical framework. We also highlight and discard the presence of campaigns and duplicate/plagiarized responses in absolute number and percentage of total count. The purpose of this analytical framework is to ensure that the analysis is rooted in and builds upon core topics of interest.*

Step 2: *Revising keywords and exploring themes. We revisit the keywords defined in Step 1 and check for dominating correlations among them. Recurrent and similar keywords are discarded or merged to form another synonymous keyword. Based on the assignment outlined, we then segment responses based on the frequency of the keyword embedded in it using tables with grand totals.*

4.6 Part I. Respondent Profile

This section summarizes the distribution of respondents across Europe and other general indicators of their demographics such as the percentage share of stakeholders, composition of organization respondents, and sources of microplastic emissions answered for. Figures 7-9 visually detail the same.

Most respondents were from France and Germany, with an equal split of about 28%, followed by Italy and Spain with 14% and 6% respectively.

EU citizens represented the highest share in total responses (30%), followed by company/business organisations (20%), business associations (18%), consumer and environmental NGOs (14%) and academic/research institutions (10%). Public authorities represented 4% of the respondents, and non-EU citizens and other respondents 2% each, as shown in Figure 2.

Among Company/Businesses Organizations, respondents were divided into four groups depending on company size. Micro enterprises (1-9 employees) were represented by 24%, small enterprises (10-49 employees) 11%, medium enterprises (50-249 employees) 15%, large-sized companies (employing 250 or more employees) about 50%. A full breakdown of companies by size is presented in Figure 3.

Most respondents wished to address Textiles as a source of microplastic emissions (21%), followed by Pellets (19%) and Detergent Capsules (17%). Paints and Tyres were addressed by 15% of the respondents while Geotextiles by 11%.

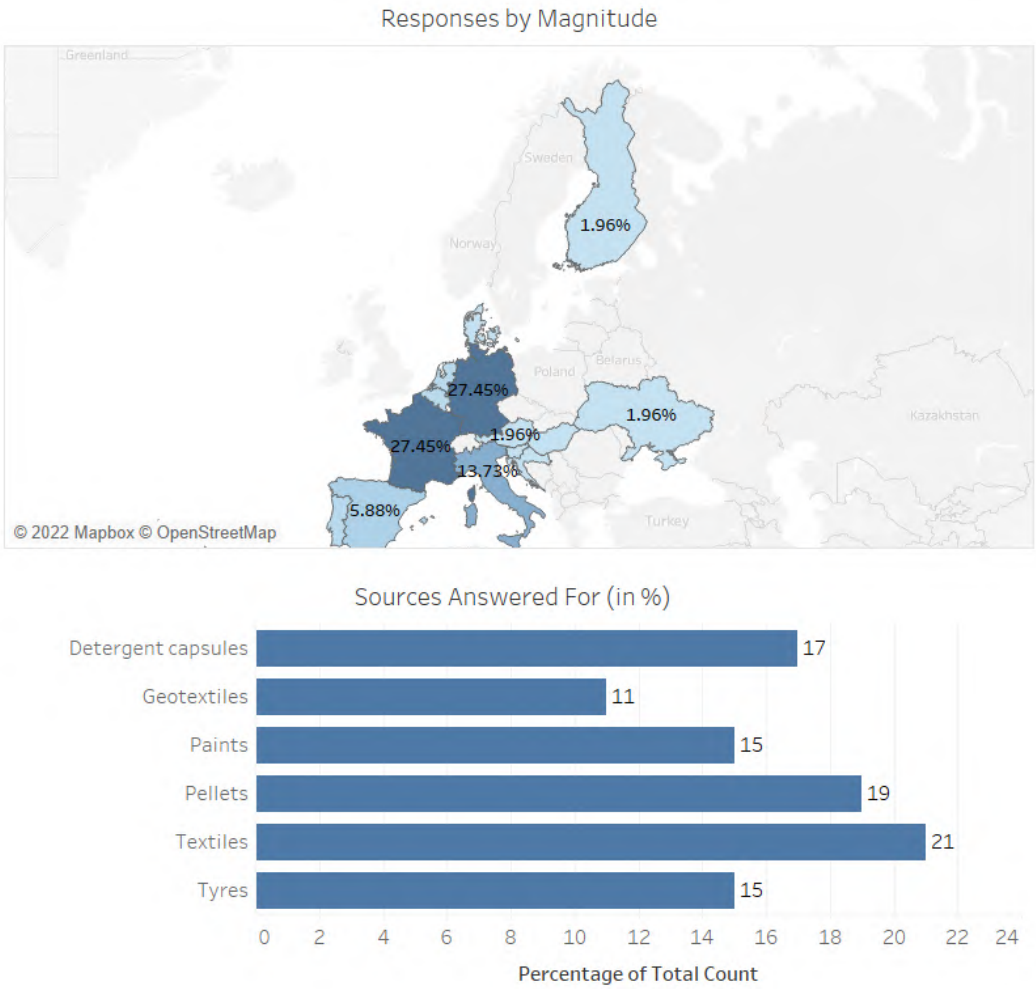

Figure 1: Composition of Responses by Country and Sources Answered

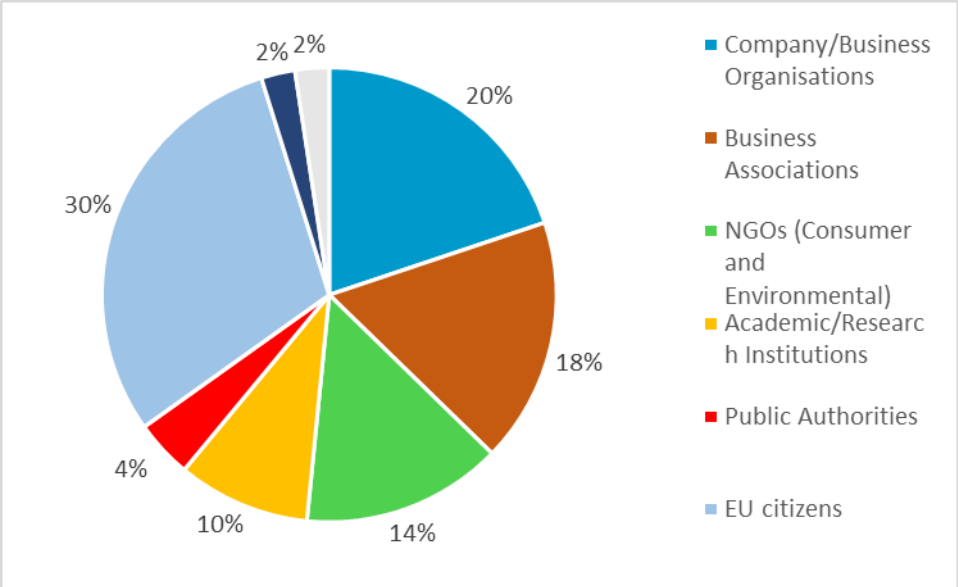

Figure 2: Distribution of Responses, Total

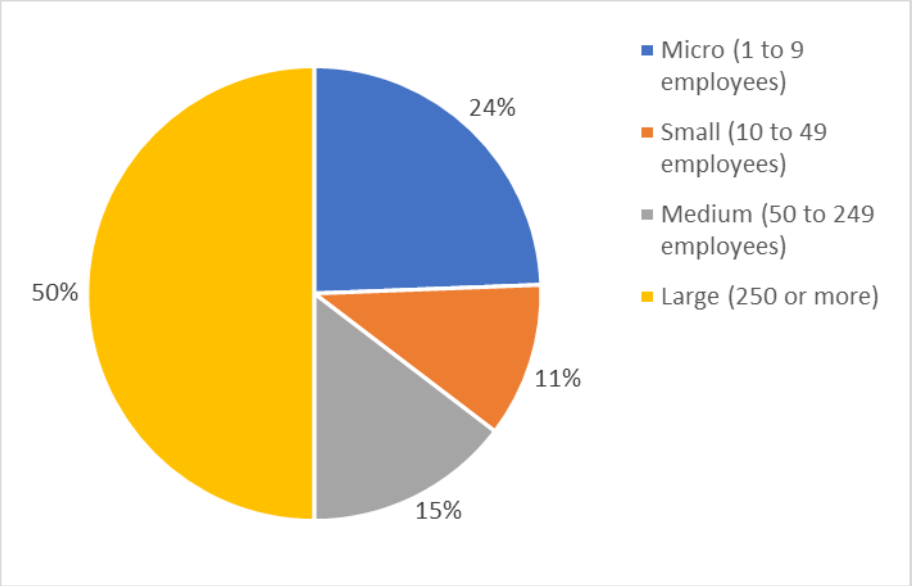

Figure 3: Size of Organisations

4.7 OPC Results

The following section details visuals and summarizes the responses received within each section of the questionnaire. The highlighted tables are populated and aggregated by stakeholder composition. The summary following each table briefly explains general attitudes for each aspect of microplastics by country of origin with the highest responses. Creating visuals for attitudes by country has been omitted due to low response shares and the lack of a representative sample.

4.7.1 Part II. General Public

1. Please indicate to which extent you agree with the following concerns as to microplastic pollution (N=410)

a) Overall, 76% of EU citizens agree with the **hazardous nature of microplastic** emissions, while about 16% somewhat agree. About 91% of NGOs, 67% of research institutions and 56% of business organisations completely recognise the hazards of microplastics. EU citizens (67%) completely agree with the **harmful effects of microplastics on humans via ingestion and inhalation**, whereas about 19% somewhat agree. About 41% and 20% of business organisations completely and somewhat agree on the same. More details on health concerns are shown in Figure 4.

b) NGOs (88%), research institutions (77%), public authorities (69%), EU citizens (70%) and non-EU citizens (90%) completely agree with the **long-distance transmission of microplastics**, while 58% of business organisations and 24% of business associations completely agree to the same.

c) Among EU citizens 75% and NGOs 88% completely agree with the **persistence of microplastics**. About 48% of business organisations and about 31% of business associations agree completely with the same. More details on the accumulations and persistence of microplastics are shown in Figure 5.

d) Regarding the **harmful economic effects of microplastics**, EU citizens overall were spread out across the scale, where about 43% completely agree, 15% somewhat agree, and 29%

maintain a neutral stance. Business associations showed a similar pattern, and around 50% of business organisations agreed or somewhat agreed, while 65% of NGOs completely agreed with the statement.

e) Around 25% of Company/Business Organisations and Public Authorities completely agree with **plant assimilation of microplastics** while 68% of NGOs and 43% or EU Citizens are in the same scale.

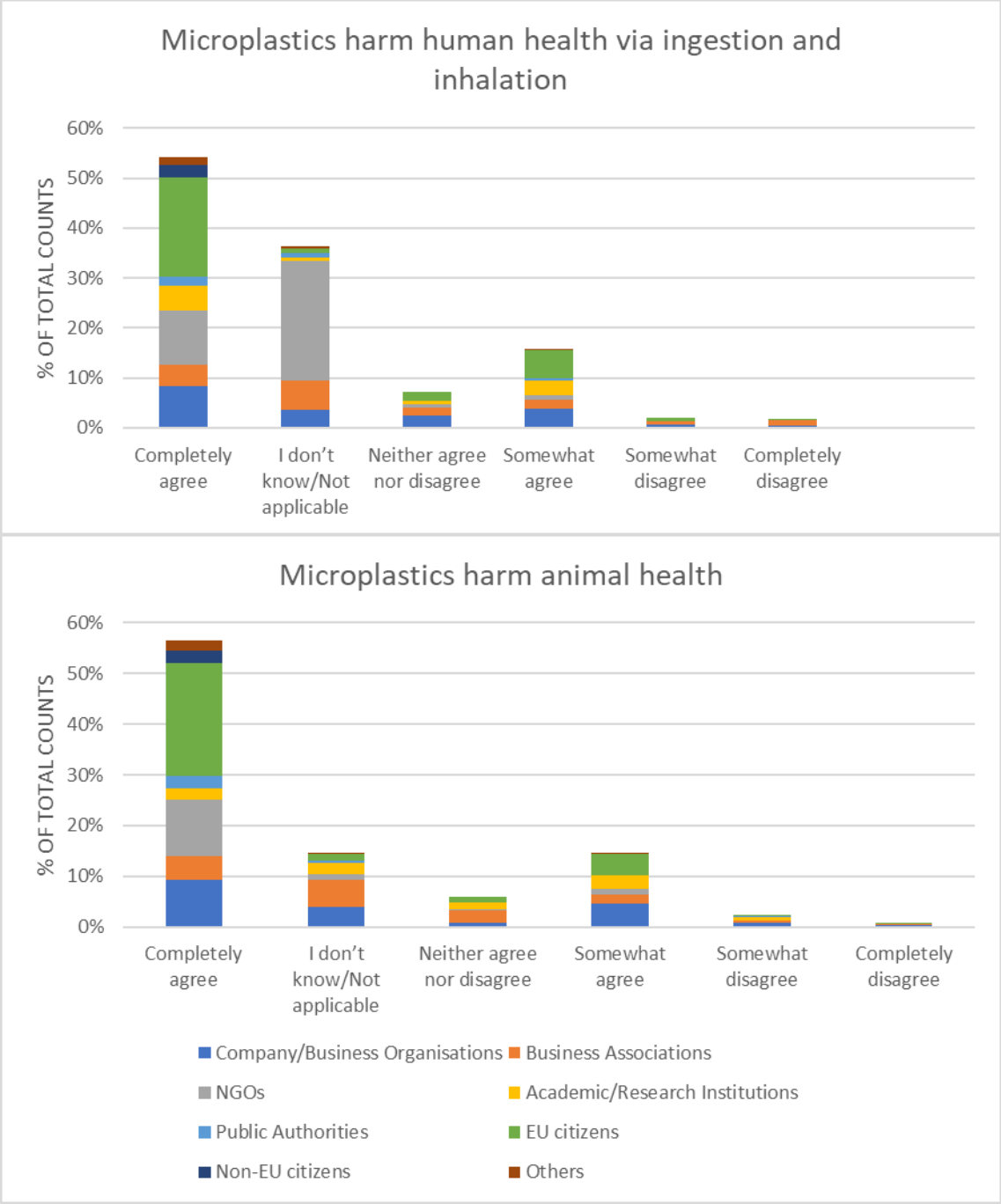

Figure 4: Microplastic Pollution: Health Concerns

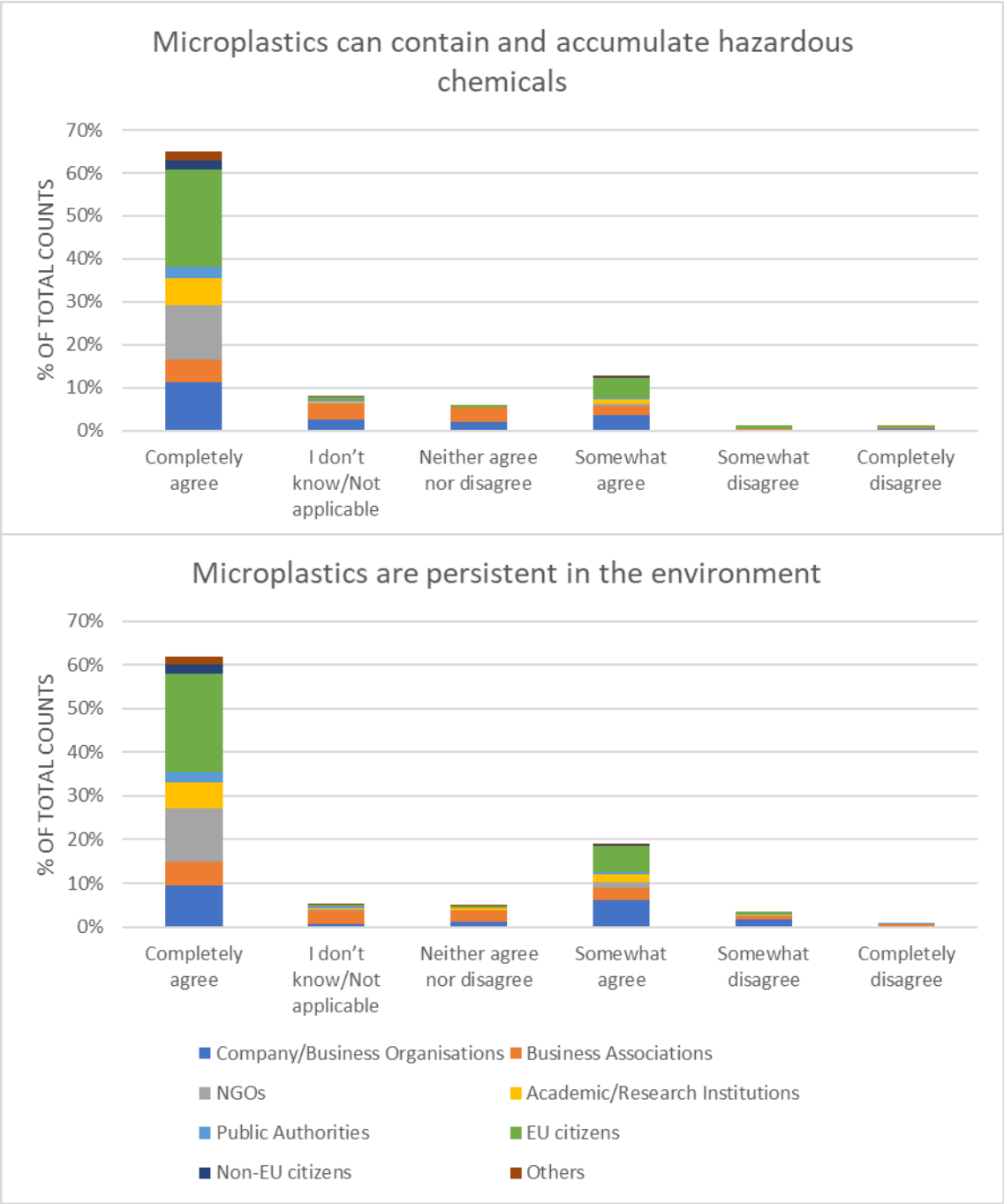

Figure 5: Microplastic Pollution: Accumulation and Persistence

Table 4: Microplastic Pollution: Other Concerns – Plants Assimilate Microplastics and Microplastics Harm the Economy

Plants Assimilate Microplastics						
Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	24%	6%	42%	14%	10%	
Business associations	13%	6%	43%	11%	5%	4%
NGOs	68%		17%	2%	12%	
Academic/Research Institutions	17%	2%	12%	18%	38%	5%
Public Authorities	25%		31%	6%	19%	
EU citizens	43%	5%	22%	8%	16%	4%
Non-EU citizens	90%		10%			
Others	50%		20%	10%	20%	

Microplastics Harm the Economy						
Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	29%	4%	20%	11%	21%	11%
Business associations	15%	7%	29%	14%	8%	13%
NGOs	65%	2%	14%	4%	12%	4%
Academic/Research Institutions	21%		23%	3%		
Public Authorities	31%		31%	13%	6%	
EU citizens	43%	5%	10%	19%	15%	5%
Non-EU citizens	80%				10%	10%
Others	50%		10%		30%	10%

2. To reduce microplastics pollution, how and at what level should the action be (N=410)

There is an overwhelming agreement among all stakeholders to undertake action at all levels of authority. Almost all respondents agree with voluntary measures (64%), regulatory measures (87%) and international action (95%).

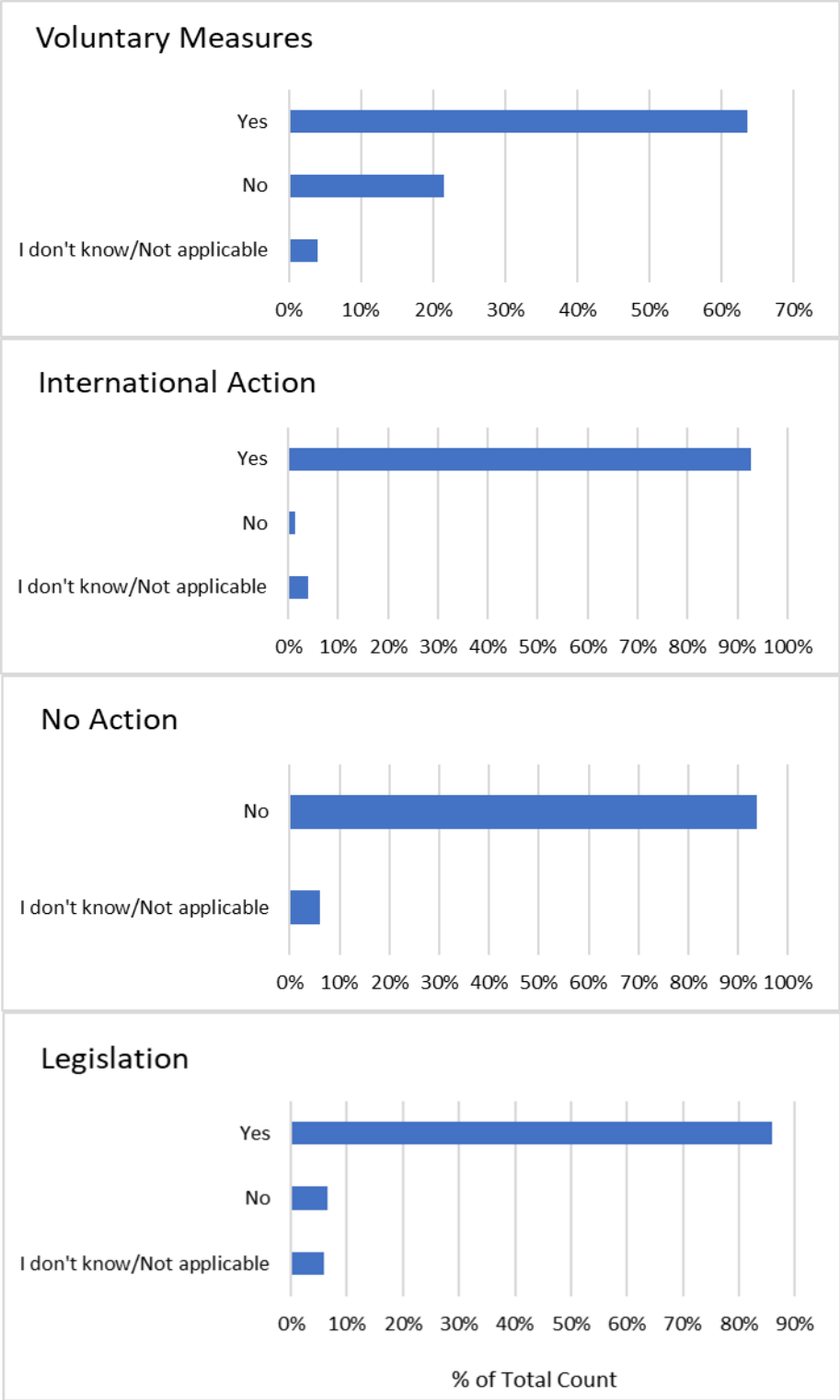

Figure 6: Agreement on the Level of Measures

3. *To what extent would you agree to buy a product that releases less microplastics, even if it costs more? (N=357)*

a) There is general agreement on buying a variety of products if they're made to be sustainable but expensive, except Business Association where more than 50% remained neutral.
b) Academic/Research Institutions (75%) completely agree to buy sustainable clothing and around 70% of EU citizens and NGOs and 47% of Company/Business Organisations are on the same opinion.
c) Most of all stakeholders completely or somewhat agree to buy sustainable furniture, sustainable detergent capsules, sustainable painted products, sustainable paints and sustainable tyres at higher prices while Business associations remain rather neutral. More details are show in Table 5 and Table 6.

Table 5: Sustainable Choices for Households (1-3): Would you buy sustainable clothing at higher prices? – Would you buy sustainable furniture at higher prices? – Would you buy sustainable detergent capsules at higher prices?

Would you buy sustainable clothing at higher prices?

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	47%		27%	3%	19%	3%
Business associations	32%		56%	2%	9%	
NGOs	69%	2%	17%	3%	7%	
Academic/Research Institutions	76%		8%	3%	14%	
Public Authorities	67%		25%		8%	
EU citizens	72%	2%		6%	18%	2%
Non-EU citizens	80%				20%	
Others	50%		20%	10%	20%	

Would you buy sustainable furniture at higher prices?

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	38%	3%	27%	8%	18%	5%
Business associations	30%		56%	5%	5%	2%
NGOs	68%	2%	17%	3%	8%	
Academic/Research Institutions	62%		8%	8%	14%	5%
Public Authorities	50%		25%	8%	17%	
EU citizens	67%	3%	2%	7%	17%	3%
Non-EU citizens	80%				20%	
Others	60%		20%		20%	

Would you buy sustainable detergent capsules at higher prices?

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	49%		27%	5%	17%	
Business associations	28%		60%	4%	5%	
NGOs	68%	2%	20%	3%	5%	
Academic/Research Institutions	73%		8%	5%	8%	
Public Authorities	67%		25%		8%	
EU citizens	72%	2%	6%	5%	14%	2%
Non-EU citizens	80%				20%	
Others	60%		20%		20%	

Table 6: Sustainable Choices for Other Durables (1-3): Would you buy sustainable painted products at higher prices? – Would you buy sustainable paints at higher prices? – Would you buy sustainable tyres at higher prices?

Would you buy sustainable painted products at higher prices?

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	38%	6%	27%	8%	17%	3%
Business associations	23%	5%	56%	2%	9%	2%
NGOs	47%	2%	19%	20%	8%	2%
Academic/Research Institutions	62%		8%	5%	19%	
Public Authorities	50%		25%	8%	8%	
EU citizens	63%	2%	4%	11%	19%	2%
Non-EU citizens	80%				20%	
Others	60%		20%		20%	

Would you buy sustainable paints at higher prices?

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	42%	3%	26%	8%	14%	6%
Business associations	26%	2%	56%	2%	7%	4%
NGOs	63%	2%	19%	7%	8%	
Academic/Research Institutions	65%		8%	3%	19%	
Public Authorities	50%		25%	8%	8%	
EU citizens	63%	3%	4%	7%	21%	1%
Non-EU citizens	90%				10%	
Others	50%		20%	10%	20%	

Would you buy sustainable tyres at higher prices?

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	43%	1%	30%	5%	16%	5%
Business associations	28%	2%	58%	2%	5%	4%
NGOs	69%		17%	3%	8%	2%
Academic/Research Institutions	73%		5%		14%	3%
Public Authorities	67%		25%		8%	
EU citizens	69%	2%	4%	7%	16%	2%
Non-EU citizens	80%		10%		10%	
Others	50%		20%		30%	

4.7.2 Part III. Expert Section

Part III contains questions for which expert knowledge is required, but all types of respondents are welcome to respond. It includes questions on the sources of microplastics pollution being assessed by the European Commission (pre-production pellets, tyre wear particles, synthetic textiles, paints, geotextiles, and detergent capsules) and on the policy measures reducing unintentional release of microplastics.

Note: Based on the pattern of responses, it appears from preliminary analysis that all Business Associations (n=12) tend to skew responses using neutral or moderate scales. While open text comments cannot throw conclusive light on the issue, this can appear as a campaign and must be examined and further discounted.

4.7.2.1 Pre-Production Pellets (N=164)

1. *To what extent would you agree with the following weaknesses on how current systems deal with pellets?*
   - *a)* Most of Public Authorities (75%), NGOs (76%), Academic/Research Institutions (67%) and EU Citizens (64%) and half of the Company/Business Organisations *completely or somewhat agree* on the **lack of risk assessment of pellet handling activities by companies**, however, Business Associations are more widespread on the scale and maintain a rather neutral stance. (See Table 7)
   - *b)* Most NGOs (74%), Company/Business Organisations (52%), Academic/Research Institutions (75%) and EU Citizens (51%), *completely or somewhat agree* on the **lack of independent audit policies**, but Business Associations and Public Authorities remain neutral. (See Table 7Table 7)

c) NGOs, Business Associations and Company/Business Organisations stay rather neutral on the **lack of economic incentives** while half of Academic/Research Institutions and EU citizens *completely agree*. (See Table 7)

d) NGOs (64%) *completely agree* with the **improper handling of pellet-related activities** and with the **improper transferring protocols** while other stakeholders remain rather neutral. (See Table 8)

e) NGOs (68%), Public Authorities (54%) and Company/Business Organisations (41%) *completely or somewhat agree* on **improper worker training** while Business Associations remain neutral. (See Table 8)

f) NGOs (65%) *completely agree* on **improper sealing of packages** and on **improper handling of pellets**, while Business Associations, Company/Business Organisations and Public Authorities maintain a neutral position. (See Table 8)

g) NGOs (68%) *completely disagree* while other stakeholders remain rather neutral on **the expensive cost of prevention equipment**. (See Table 9)

h) There is general agreement among almost all stakeholders for **the lack of accounting for pellet discharge.** Business Associations mostly however *completely or somewhat disagree* with the statement. (See Table 9)

Table 7: Specific Shortfalls (1-3): Lack of Risk Assessment of Pellet Handling Activities by Companies; Lack of Independent Auditing and Lack of Economic Incentives

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Lack of Risk Assessment of Pellet Handling Activities by Companies						
Company/Business Organisations	34.48%	20.69%	3.45%	10.34%	17.24%	13.79%
Business associations		36.36%	9.09%	13.64%	22.73%	18.18%
NGOs	69.49%	1.69%	16.95%	3.39%	6.78%	
Academic/Research Institutions	33.33%		16.67%		33.33%	8.33%
Public Authorities	67%		25.00%		8.33%	
EU citizens	47.17%	5.66%	13.21%	3.77%	16.98%	5.66%
Non-EU citizens	100%					
Others			66.67%		33%	
Lack of Independent Auditing						
Company/Business Organisations	34.48%	20.69%	17.24%	6.90%	17.24%	3.45%
Business associations	18.18%	22.73%	13.64%	22.73%	9.09%	13.64%
NGOs	67.80%		25.81%		6.45%	
Academic/Research Institutions	50.00%		25.00%		25.00%	
Public Authorities	36.36%		36.36%	27.27%		
EU citizens	39.62%	5.66%	18.87%	13.21%	11.32%	
Non-EU citizens	67%		33.33%			
Others	33.33%		67%			
Lack of Economic Incentices						
Company/Business Organisations	31.03%	17.24%	10.34%	24.14%	17.24%	
Business associations	13.64%	27.27%	9.09%	22.73%	13.64%	9.09%
NGOs	19.35%	9.68%	25.81%	29.03%	12.90%	
Academic/Research Institutions	50.00%	8.33%	8.33%	25.00%	8.33%	
Public Authorities	45.45%	9.09%	18.18%		18.18%	
EU citizens	56.60%	9.43%	3.77%	9.43%	11.32%	1.89%
Non-EU citizens	100%					
Others			67%		33.33%	

Table 8: Operational Issues (1-5): Improper Transferring Protocols; Improper Worker Training; Improper Storage Protocols; Improper Sealing of Packages and Improper Handling

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Improper Transferring Protocols						
Company/Business Organisations	20.69%	17.24%	24.14%	3.45%	24.14%	10.34%
Business associations		27.27%	18.18%	13.64%	22.73%	13.64%
NGOs	64.52%		25.81%	3.23%	6.45%	
emic/Research Institutions	16.67%		33.33%	8.33%	41.67%	
Public Authorities	27.27%		36.36%	9.09%	18.18%	
EU citizens	24.53%	7.55%	26.42%	13.21%	11.32%	9.43%
Non-EU citizens	67%				33.33%	
Others			100%			
Improper Worker Training						
Company/Business Organisations	20.69%	17.24%	13.79%	6.90%	20.69%	17.24%
Business associations	9.09%	31.82%	13.64%	9.09%	18.18%	18.18%
NGOs	61.29%		25.81%	6.45%	6.45%	
emic/Research Institutions	25.00%		33.33%	16.67%	25.00%	
Public Authorities	45.45%		27.27%	18.18%	9.09%	
EU citizens	33.96%	5.66%	20.75%	9.43%	18.87%	5.66%
Non-EU citizens	67%		33.33%			
Others			100%			
Improper Storage Protocols						
Company/Business Organisations	17.24%	20.69%	24.14%	3.45%	20.69%	13.79%
Business associations		36.36%	13.64%	13.64%	4.55%	27.27%
NGOs	64.52%		25.81%	3.23%	6.45%	
emic/Research Institutions	16.67%		33.33%	25.00%	16.67%	8.33%
Public Authorities	18.18%		45.45%	18.18%	18.18%	
EU citizens	20.75%	11.32%	24.53%	13.21%	16.98%	7.55%
Non-EU citizens	67%		33.33%			
Others			100%			

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Improper Sealing of Packages						
Company/Business Organisations	13.79%	17.24%	20.69%	10.34%	17.24%	20.69%
Business associations	4.55%	31.82%	22.73%	13.64%	9.09%	18.18%
NGOs	64.52%		25.81%	3.23%	6.45%	
lemic/Research Institutions	25.00%		25.00%	25.00%	25.00%	
Public Authorities	27.27%		36.36%	18.18%	18.18%	
EU citizens	32.08%	5.66%	13.21%	15.09%	15.09%	13.21%
Non-EU citizens	67%		33.33%			
Others	33.33%		67%			
Improper Handling						
Company/Business Organisations	31.03%	31.03%	13.79%	6.90%	6.90%	10.34%
Business associations		31.82%	18.18%	13.64%	4.55%	27.27%
NGOs	64.52%		25.81%	3.23%	6.45%	
lemic/Research Institutions	25.00%		25.00%	16.67%	25.00%	8.33%
Public Authorities	36.36%	9.09%	27.27%	18.18%	9.09%	
EU citizens	26.42%	7.55%	24.53%	7.55%	20.75%	5.66%
Non-EU citizens	100%					
Others			100%			

Table 9: Miscellaneous Operational Issues (1-2): Expensive Prevention Equipment and Not Accounting for Pellet Discharge

	Expensive Prevention Equipment					
Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	13.79%	20.69%	24.14%	13.79%	10.34%	13.79%
Business associations		4.55%	22.73%	31.82%	18.18%	22.73%
NGOs	3.23%	67.74%	22.58%	3.23%	3.23%	
Academic/Research Institutions		16.67%	33.33%	25.00%	16.67%	8.33%
Public Authorities	9.09%	9.09%	36.36%	36.36%	9.09%	
EU citizens	11.32%	9.43%	39.62%	15.09%	11.32%	5.66%
Non-EU citizens	33.33%		67%			
Others			100%			
	Not Accounting for Pellet Discharge					
Company/Business Organisations	37.93%	13.79%	3.45%	10.34%	20.69%	10.34%
Business associations	18.18%	13.64%	13.64%		13.64%	36.36%
NGOs	70.97%		22.58%		6.45%	
Academic/Research Institutions	83.33%				16.67%	
Public Authorities	54.55%		9.09%	18.18%	18.18%	
EU citizens	62.26%	7.55%	7.55%	1.89%	11.32%	3.77%
Non-EU citizens	100%					
Others	33.33%		67%			

2. *To what extent would you agree with the following non-regulatory measures improving voluntary schemes?*

   a) There is general agreement with all stakeholders that the **industry should prioritize preventive measures**. Most of the NGOs (63.16%), Academic/Research Institutions (100%), EU citizens (67.92%), Non–EU citizens (100%), and Public Authorities (63.64%) *completely agree* that clearer **public reporting,** transparency and tracking of progress measures improve voluntary schemes. (See Table 10)

   b) Most of the Academic/Research Institutions (58%), EU citizens (49.6%) and Non–EU citizens (100%) *completed agree*, while Businesses Associations (40%) *completely disagree* with an initiative on the **industry to create a remediation fund**. (See Table 10)

   c) All stakeholders *completely or somewhat agree* on **independent auditing**. (See Table 11)

   d) Academic/Research Institutions (92%), Company/Business Organisations (59%), Business Associations (59%) and EU citizens (61%) *completely or somewhat* agree on the importance of **multi stakeholders' governance**, while 42% EU Citizens *completely agree* on the same. (See Table 11)

Table 10: Industry Measures (1-3): Industry to Prioritise Preventive Measures; Industry to Create Remediation fund and Public Reporting

Industry to Prioritise Preventive Measures

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	59%			7%	31%	3%
Business associations	55%			14%	32%	
NGOs	65%		26%	3%	6%	
Academic/Research Institutions	67%	8%	8%		17%	
Public Authorities	64%		18%		18%	
EU citizens	72%	2%	2%	4%	13%	4%
Non-EU citizens	67%			33%		
Others	33%		67%			

Industry to Create Remediation fund

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	31%	24%	21%	10%	7%	7%
Business associations	14%	41%	18%	9%	14%	5%
NGOs	26%		19%	3%	6%	6%
Academic/Research Institutions	58%			17%	25%	
Public Authorities	36%		9%	36%	9%	
EU citizens	49%	11%	8%	11%	15%	2%
Non-EU citizens	100%					
Others	33%		67%			

Public Reporting

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	32%	7%	11%	18%	29%	4%
Business associations	32%	5%	9%	23%	32%	
NGOs	63%		21%	5%	5%	5%
Academic/Research Institutions	100%					
Public Authorities	64%	9%	18%		9%	
EU citizens	68%			6%	19%	4%
Non-EU citizens	100%					
Others			67%		33%	

Table 11: Miscellaneous Measures (1-2): Independent Auditing and Multi Stakeholders' Governance

Independent Auditing

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	38%	7%	3%	14%	28%	7%
Business associations	45%	5%		23%	23%	5%
NGOs	68%		26%		6%	
Academic/Research Institutions	83%		8%		8%	
Public Authorities	64%		18%	9%	9%	
EU citizens	64%	2%	9%	4%	13%	2%
Non-EU citizens	100%					
Others	33%		67%			

Multi Staleholders' Governance

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	38%	3%	21%	14%	21%	
Business associations	36%	5%	5%	32%	23%	
NGOs	44%	6%	28%		17%	6%
Academic/Research Institutions	50%			8%	42%	
Public Authorities	27%		36%		27%	
EU citizens	42%	4%	11%	15%	19%	2%
Non-EU citizens	67%		33%			
Others			100%			

3. *To what extent would you agree with the following regulatory measures for pellet loss prevention?*
   - *a)* Business Associations and Company/Business Organisations are widespread on the agreement scale while for other stakeholders there is general agreement on the need for **EU legislation to set up a comprehensive system for pellet handling companies**. (See Table 12)
   - *b)* There is a general agreement (*completely or somewhat agree*) among all stakeholders for **international measures**. The same inference applies to **extended producer responsibility** where only Business Associations (50%) remain rather neutral**.** (See Table 12)

Table 12: Regulatory Measures (1-3): International Approaches; Extended Producer Responsibility and EU Legislation for Pellet Handling

International Approaches

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	48%	3%	21%		24%	3%
Business associations	32%		27%	23%	18%	
NGOs	87%		10%		3%	
Academic/Research Institutions	67%			8%	25%	
Public Authorities	73%		9%		18%	
EU citizens	79%	2%		2%	13%	2%
Non-EU citizens	100%					
Others	33%		67%			

Extended Producer Responsibility

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	41%	10%	7%	10%	14%	17%
Business associations	23%	27%	14%	9%	14%	9%
NGOs	90%		10%			
Academic/Research Institutions	75%				25%	
Public Authorities	64%	9%	9%		9%	9%
EU citizens	75%	2%	2%	4%	9%	4%
Non-EU citizens	100%					
Others	33%		67%			

EU Legislation for Pellet Handling

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	38%	21%	7%	3%	17%	14%
Business associations	23%	36%	14%		18%	9%
NGOs	81%		10%		10%	
Academic/Research Institutions	50%			8%	42%	
Public Authorities	91%		9%			
EU citizens	66%	6%		8%	17%	2%
Non-EU citizens	100%					
Others			67%		33%	

4. Open Text Comments

a) Respondents (n=1) maintain that the main issue is **awareness of pellets as hazardous substances**. As an application, they consult on using **International Maritime Dangerous Goods (IMDG) Codes on pellet transportation** with contingency plans for safe transport along with emergency policies among companies to manage pellet spills.

b) Another respondent (n=2) agrees on **improper management at the plant and transportation network.** Apart from **legislative penalties**, they consult **on tracers for pellets** to pinpoint producer responsibility during transport. There also exists awareness that the **level of measures undertaken are voluntary at the industry level**, which needs more control to ensure compliance.

c) There is another suggestion (n=1) on **balancing legislative compliance between consumers and producers**, where the respondent observes the incidence of excessive burden on EU producers.

d) There is disagreement (n=1) on **the extent of knowledge among public authorities of the modus operandi** of the industry as well as the concepts of **extended producer responsibility.**

4.7.2.2 Tyre Wear Particles (N=154)

1. To what extent would you agree with the following measures to reduce microplastic emissions from tyres?

a) All stakeholders *completely or somewhat agree* to have **tyres designed to reduce abrasion**. (See Table 13)

b) There is support among most stakeholders to propose **labelling of tyres in terms of abrasion**, whereas Business Associations (42%) remain neutral. (See Table 13)

c) All stakeholders *completely or somewhat agree* on **legal limits on tyre abrasion** (see Table 14)

d) Businesses associations (52%), Company/Business organisations (55%) and EU citizens (52%) *completely agree* on **requirements on road infrastructure** while Academic/Researchers Institutions (46%) and Public Authorities (55%) *somewhat agree*. (See Table 14)

e) All stakeholders *completely or somewhat agree* on the **capture and treatment of road run-off water** where NGOs are split between agreement (44%) and disagreement (40%). All stakeholders *completely or somewhat agree* for **improvements in road cleaning in high-emission spots.** (See Table 15)

f) Businesses Associations, NGOs and EU citizens *somewhat or completely agree* with implementing **AI and advanced assisted driving technologies**, whereas Academic/Researchers Institutions and Public Authorities are neutral or somewhat agree. (See Table 15)

Table 13: Design Parameters (1-2): Tyres Designed to Reduce Abrasion and Labelling of Tyres in terms of Abrasion

Tyres Designed to Reduce Abrasion

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree
Company/Business Organisations	72%				28%
Business associations	42%	37%			21%
NGOs	95%				3%
Academic/Research Institutions	54%			8%	38%
Public Authorities	67%		22%		11%
EU citizens	70%	4%	7%	7%	13%
Non-EU citizens	100%				
Others	100%				

Labelling of Tyres in terms of Abrasion

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree
Company/Business Organisations	50%			6%	44%
Business associations	37%			42%	21%
NGOs	85%		3%	3%	10%
Academic/Research Institutions	62%				38%
Public Authorities	56%		11%	11%	22%
EU citizens	59%	4%	9%	7%	20%
Non-EU citizens	100%				
Others	100%				

Table 14: Regulations (1-3): Legal Limits on Tyre Abrasion; Requirements on Road Infrastructure and Higher Fees in Extended Producer Responsibility

Legal Limits on Tyre Abrasion

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	53%		12%	12%	24%	
Business associations	68%			16%	16%	
NGOs	95%		3%		3%	
Academic/Research Institutions	54%			31%	15%	
Public Authorities	44%		11%	11%	33%	
EU citizens	59%	4%	9%	4%	20%	4%
Non-EU citizens	100%					
Others	100%					

Requirements on Road Infrastructure

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	56%			6%	33%	
Business associations	53%		11%	11%	16%	11%
NGOs	25%		8%	43%	15%	10%
Academic/Research Institutions	23%			23%	46%	8%
Public Authorities	11%		22%		56%	11%
EU citizens	52%	2%	4%	11%	22%	9%
Non-EU citizens	100%					
Others	25%		25%		25%	25%

Higher Fees in Extendedd Producer Responsibility

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	50%		22%	11%	11%	6%
Business associations	37%	42%	5%		16%	
NGOs	80%	3%			13%	5%
Academic/Research Institutions	38%	8%		23%	31%	
Public Authorities	33%				67%	
EU citizens	65%	7%	2%	11%	15%	
Non-EU citizens	100%					
Others	50%				50%	

Table 15: Tech Improvements (1-3): Improve Road Cleaning in High Emission Spots; Artificial Intelligence and Advanced Driver Technology and Capture and Treat Road Run-Off Water

Improve Road Cleaning in High Emission Spots

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	44%		11%	11%	28%	
Business associations	53%			11%	21%	11%
NGOs	23%		3%	13%	55%	5%
Academic/Research Institutions	54%			23%	23%	
Public Authorities	44%		22%	11%	22%	
EU citizens	65%	2%	9%	11%	13%	
Non-EU citizens	100%					
Others				25%	75%	

Artificial Intelligence and Advanced Driver Technology

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	39%		17%	22%	6%	11%
Business associations	11%		5%	21%	58%	5%
NGOs	13%	5%	8%	15%	55%	5%
Academic/Research Institutions	15%	15%	15%	31%	15%	8%
Public Authorities	11%		44%		44%	
EU citizens	30%	13%	11%	17%	24%	4%
Non-EU citizens	100%					
Others			50%		50%	

Capture and Treat Road Run-Off Water

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	50%		6%	22%	17%	
Business associations	21%			11%	58%	11%
NGOs	33%		3%	13%	13%	40%
Academic/Research Institutions	54%			8%	38%	
Public Authorities	44%		11%	11%	33%	
EU citizens	67%	2%	4%	9%	17%	
Non-EU citizens	100%					
Others	50%				50%	

1. *Open Text Comments*
   a) Responses (n=2) include an emphasis on **improving public transport** to reduce traffic congestion and regulate demand for private vehicles, along with better **management of freight transport.**
   b) Another respondent points **out potential emission issues with the measures listed** on the survey – the intentional and inevitable nature of tyre production vis-à-vis microplastic emissions, AI as a redundant solution, and further contamination from cleaning roads with brushes**.**

4.7.2.3 Synthetic Textiles (N=154)

1. *During which phase of the life cycle, microplastics emissions from textiles are the most significant?*
   a) Most stakeholders believe that emissions from **manufacturing of synthetic fibres, thread, yarn, and other raw material for garment production** are very significant while the response of Business Associations is spread across the significance chart. (See Table 16)
   b) All stakeholders believe that **emissions from garment production** are very significant while the responses of Business Associations and EU citizens' responses are spread across the significance scale**.** (See Table 16)
   c) **Emissions from pre-wash cycles after production** are very significant for all the stakeholders. (See Table 16)
   d) On the consumer end, **garment wear** contributes significantly to emissions for most EU Citizens (62%), while Business Associations (40.6%), and Public Authorities (44.4%) find it very little significant. (See Table 17)
   e) All stakeholders overwhelmingly attribute **use-phase washing cycles** as a very significant contributor to microplastic emissions while **use-phase drying cycles** as a source is more distributed in scale of significance – 70.8% of Academic/Researchers Institutions find it very significant and 44% of Public Authorities find it little significant. (See Table 17)
   f) A garment's **end of life** holds high significance for the stakeholders in terms of emissions. Here, only Public Authorities (44%) believe it is completely insignificant. (See Table 17)

Table 16: Production and Consumer Usage I (1-3): Manufacturing of Synthetic Fibres, Thread, Yarn, other Raw Materials for Garment Production; Emission from Garment Production and Emission from Pre-Wash Cycles after Production

Manufacturing of Synthetic Fibres, Thread, Yarn, other Raw Materials for Garment Production

Contribution As	Completely insignificant	Very little significant	Somewhat significant	Very significant	I don't know/Not applicable
Company/Business Organisations	3%	10%	23%	50%	15%
Business associations		31%	28%	22%	19%
NGOs		4%	10%	67%	18%
Academic/Research Institutions		8%	29%	50%	13%
Public Authorities		30%	20%	40%	10%
EU citizens	3%	12%	22%	41%	22%
Non-EU citizens		10%	10%	70%	10%
Others			33%	50%	17%

Emission from Garment Production

Contribution As	Completely insignificant	Very little significant	Somewhat significant	Very significant	I don't know/Not applicable
Company/Business Organisations	3%	8%	30%	40%	20%
Business associations		34%	25%	25%	16%
NGOs		2%	18%	57%	22%
Academic/Research Institutions			26%	52%	22%
Public Authorities		11%	33%	44%	11%
EU citizens	1%	15%	27%	33%	24%
Non-EU citizens			20%	70%	10%
Others			33%	50%	17%

Emission from Pre-Wash Cycles after Production

Contribution As	Completely insignificant	Very little significant	Somewhat significant	Very significant	I don't know/Not applicable
Company/Business Organisations	2%	2%	17%	63%	15%
Business associations		6%	31%	50%	13%
NGOs		2%	8%	76%	14%
Academic/Research Institutions		4%	25%	58%	13%
Public Authorities			20%	70%	10%
EU citizens		6%	27%	76%	19%
Non-EU citizens			30%	70%	
Others			17%	83%	

Table 17: Production and Consumer Usage II (1-4): Emission from Garment Wear; Emission from Use-Phase Washing Cycles; Emission from Use-Phase Drying Cycles and Emission from Garment End of Life

Emission from Garment Wear

Contribution As	Completely insignificant	Very little significant	Somewhat significant	Very significant	I don't know/Not applicable
Company/Business Organisations	5%	15%	25%	43%	13%
Business associations	3%	41%	28%	19%	9%
NGOs		2%	55%	24%	18%
Academic/Research Institutions		22%	35%	39%	4%
Public Authorities		44%	44%		11%
EU citizens	6%	17%	20%	36%	21%
Non-EU citizens		10%	20%	60%	10%
Others			17%	67%	17%

Emission from Use-Phase Washing Cycles

Contribution As	Completely insignificant	Very little significant	Somewhat significant	Very significant	I don't know/Not applicable
Company/Business Organisations		5%	24%	61%	10%
Business associations		25%	44%	28%	3%
NGOs			18%	71%	10%
Academic/Research Institutions			25%	75%	
Public Authorities			20%	70%	10%
EU citizens	1%	4%	25%	53%	16%
Non-EU citizens			10%	90%	
Others				100%	

Emission from Use-Phase Drying Cycles

Contribution As	Completely insignificant	Very little significant	Somewhat significant	Very significant	I don't know/Not applicable
Company/Business Organisations		15%	24%	44%	17%
Business associations		19%	41%	31%	9%
NGOs	2%	2%	41%	35%	20%
Academic/Research Institutions		4%	25%	71%	
Public Authorities		11%	44%	33%	11%
EU citizens	6%	13%	21%	41%	19%
Non-EU citizens			40%	50%	10%
Others		17%	17%	50%	17%

Emission from Garment End of Life

Contribution As	Completely insignificant	Very little significant	Somewhat significant	Very significant	I don't know/Not applicable
Company/Business Organisations	5%	5%	21%	46%	23%
Business associations	3%	6%	19%	38%	34%
NGOs	2%		10%	67%	20%
Academic/Research Institutions		4%	38%	42%	17%
Public Authorities	44%		11%	11%	33%
EU citizens	3%	9%	20%	46%	22%
Non-EU citizens		10%		90%	
Others		17%	33%	33%	17%

2. *To what extent would you agree with the following measures to reduce microplastic emissions specifically from clothing, carp fabrics for furniture and similar?*

a) *During Design or Production Phase* –
Business Associations and Public Authorities *somewhat agree* to a **restriction of all synthetic fibres for certain applications** and **those with high microplastic content** while 63% and 85% EU Citizens are respectively of the same opinion. (See Table 18)

Among all stakeholders there is *complete agreement* on **product design requirements** and **specific waste-water treatment in production plants.** (See Table 19)

Business Associations are spread across agreement scale on **mandatory pre-washing before market placement** while 45% Academic/Researchers Institutions and 56% EU Citizens *completely agree*. (See Table 19)

There is majority agreement among stakeholders on **emissions limit during production** and **emissions limit on textiles on the EU Market.** (See Table 20)

b) During Use-Phase –
Most stakeholders *completely or somewhat agree* on **consumer awareness**, **washing machine filters**, and **laundry emission limits.** (See Table 21)

c) *Transversal Policies –*

There is overwhelming agreement among all stakeholders for **all measures listed** in the questionnaire. (See Table 21)

Table 18: During design and production phase I (1-2): Restriction of all Synthetic Fibers for Certain Applications and Restriction on Synthetic Fibers with High Microplastic Content

Restriction of all Synthetic Fibers for Certain Applications

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	30%	28%	3%	10%	23%	8%
Business associations	15%	45%	9%	12%	12%	6%
NGOs	61%	6%	6%	8%	12%	6%
Academic/Research Institutions	33%	17%		17%	13%	21%
Public Authorities	30%	10%	10%		30%	20%
EU citizens	63%	4%	1%	4%	24%	3%
Non-EU citizens	80%				20%	
Others	67%				17%	17%

Restriction on Synthetic Fibers with High Microplastic Content

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	51%	7%	5%	5%	22%	10%
Business associations	27%	12%	9%	9%	24%	18%
NGOs	82%		8%		10%	
Academic/Research Institutions	63%				29%	8%
Public Authorities	60%	10%			30%	
EU citizens	86%	1%		1%	12%	
Non-EU citizens	100%					
Others	83%				17%	

Table 19: During design and production phase II (1-3): Product Design Requirements; Specific Waste Water Treatment in Production Plants and Mandatory Pre-Washing before Placing on the Market

Product Design Requirements

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	66%	2%		2%	27%	2%
Business associations	48%		9%	12%	27%	3%
NGOs	90%		2%		8%	
Academic/Research Institutions	75%			8%	13%	4%
Public Authorities	70%			10%	20%	
EU citizens	80%		1%	4%	13%	1%
Non-EU citizens	60%				40%	
Others	50%				50%	

Specific Waste Water Treatment in Production Plants

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	65%	3%		5%	25%	3%
Business associations	39%	3%	9%		42%	6%
NGOs	90%		2%		8%	
Academic/Research Institutions	83%			4%	8%	4%
Public Authorities	89%				11%	
EU citizens	77%		3%		16%	4%
Non-EU citizens	70%				30%	
Others	83%				17%	

Mandatory Pre-Washing before Placing on the Market

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	48%	15%	3%	10%	25%	
Business associations	24%	9%	15%	15%	21%	15%
NGOs	71%	4%	6%	2%	14%	2%
Academic/Research Institutions	46%	4%		13%	25%	13%
Public Authorities	40%			10%	50%	
EU citizens	57%	3%	9%	10%	20%	1%
Non-EU citizens	30%		10%	10%	50%	
Others	50%		17%	17%	17%	

Table 20: During design and production phase III (1-2): Emission Limit During Production and Emission Limit on Textiles in the EU Market

Emission Limit During Production

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	58%	5%	5%	10%	20%	3%
Business associations	21%	9%	18%	15%	21%	15%
NGOs	57%		4%		37%	2%
Academic/Research Institutions	54%			8%	33%	4%
Public Authorities	40%			10%	50%	
EU citizens	70%		1%	7%	22%	
Non-EU citizens	70%				30%	
Others	33%				67%	

Emission Limit on Textiles in the EU Market

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	65%	5%	5%	10%	13%	3%
Business associations	24%	9%	15%	18%	18%	15%
NGOs	86%		6%		8%	
Academic/Research Institutions	50%		4%	13%	29%	4%
Public Authorities	30%			30%	40%	
EU citizens	77%	1%	1%	6%	13%	1%
Non-EU citizens	80%			10%	10%	
Others	50%			17%	33%	

Table 21: Use phase and transversal policies (1-3): Consumer Awareness; Filters in Washing Machines and Regulate Emissions from Laundries

Consumer Awareness

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	80%		2%	2%	15%	
Business associations	47%		6%	6%	41%	
NGOs	49%			4%	45%	2%
Academic/Research Institutions	67%			4%	25%	4%
Public Authorities	20%			10%	60%	10%
EU citizens	87%	3%		3%	6%	1%
Non-EU citizens	70%				30%	
Others	100%					

Filters in Washing Machines

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	63%		2%	17%	17%	
Business associations	36%	3%		21%	33%	6%
NGOs	41%			31%	27%	2%
Academic/Research Institutions	42%	4%		25%	25%	4%
Public Authorities	40%			10%	40%	10%
EU citizens	75%	6%	3%	1%	12%	3%
Non-EU citizens	70%			10%	20%	
Others	33%				67%	

Regulate Emissions from Laundries

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	56%	2%	5%	5%	32%	
Business associations	27%	3%	24%	12%	30%	3%
NGOs	43%		4%	2%	51%	
Academic/Research Institutions	50%			13%	33%	4%
Public Authorities	50%		10%		30%	10%
EU citizens	79%	6%	1%	4%	10%	
Non-EU citizens	90%				10%	
Others	67%			17%	17%	

3. Open Text Comments
   a) Responses emphasize the **incontrollable release of microplastics** and the **intentional spill over of emissions from microplastics** during production. Improvements include **sustainable materials such as polyester.**
   b) Apropos washing cycles of textiles, one respondent proposes **incineration methods for microplastics** that end up in waste-water treatment plants because filters in washing machines are insufficient for full treatment.
   c) Other measures include **taxation on polluting textiles** and emphasis on **eco-conception** and **regulations on fast fashion.**
   d) Among design related regulations, suggested measures include **recycling modifications for single type textiles** and **strict limits/possible phase out of elastane in fabrics.**
   e) One respondent claimed that **pre-use washing of fabrics before market placement** reduces microplastic emissions more significantly than use-phase washing and hence, they emphasize this measure over others. This highlights the **need to include microplastics as an important step of Life-Cycle Assessment** for textiles.

4.7.2.4 Paints (N=98-105)

a. During which phase of the life cycle, microplastics emissions from paints are the most significant?

Initial spray painting and **end of life** hold high significance for the stakeholders in terms of microplastic emissions. However, for spray painting, Academic/Researcher Institutions are split between believing it to be very little significant (42%) and very significant (42%) and 59% of NGOs believe that it is somewhat significant. (See Table 22)

b. Wear and tear of paints from –

Wear and Tear from **Infrastructure, Cars, and Buildings** hold very high significance among many stakeholders. NGOs, Academic/Research Institutions, Public Authorities, EU citizens believe that wear and tear from Cars, Infrastructure are significant while Business Associations do not find it to be significant. (See Table 23)

Almost all stakeholders believe **that roads, ships, and boats** are significant for wear and tear while the opinion of Business Associations and Company/Business Organisations is spread across the significance scale**.** (See Table 24)

c. Emissions from the maintenance of –

Maintenance emissions from ships and boats are very significant for most stakeholders except Business Associations and Companies/Business Organisations. (See Table 25)

NGOs, Business Associations and Companies/Business Organisations are split between significance and insignificance for **maintenance emissions from cars**. NGOs (59%) and Academic/Research Institutions (57%) find **maintenance emissions from infrastructure** to be somewhat significant while Public Authorities (57%) and EU citizens (43%) gave a neutral response. (See Table 26)

Almost all stakeholders find **maintenance emissions from roads and buildings** to be significant. However, Business Associations (50%) and Companies/Business Organisations (42%) gave a neutral response on the significance scale for the **maintenance emissions from roads**. (See Table 26)

Table 22: Life cycle emissions (1-2): Initial Spray Painting and Paint End of Life

Initial Spray Painting

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	4%	26%	9%	43%	17%
Business associations	6%	28%	6%	44%	17%
NGOs		19%	59%	4%	19%
Academic/Research Institutions			14%	43%	43%
Public Authorities		43%	43%		14%
EU citizens	3%	38%	26%	10%	23%
Non-EU citizens					100%
Others			50%		50%

Paint End of Life

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	22%	26%	13%	4%	35%
Business associations	17%	28%	11%	33%	11%
NGOs		11%	11%		78%
Academic/Research Institutions				14%	86%
Public Authorities		43%	43%		14%
EU citizens	3%	33%	8%	3%	54%
Non-EU citizens	70%				100%
Others			50%		50%

Table 23: Wear and tear I (1-3): Wear and Tear from Cars; Wear and Tear from Infrastructure and Wear and Tear from Buildings

Wear and Tear from Cars

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	26%	17%	17%	22%	17%
Business associations	50%	25%		13%	13%
NGOs		7%	67%	11%	15%
Academic/Research Institutions	14%		57%	29%	
Public Authorities		57%		43%	
EU citizens	5%	35%	19%	14%	27%
Non-EU citizens					100%
Others				100%	

Wear and Tear from Infrastructure

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	9%	22%	26%	30%	13%
Business associations	13%	25%	19%	38%	6%
NGOs		15%	56%		30%
Academic/Research Institutions			29%	29%	43%
Public Authorities		57%	14%	14%	14%
EU citizens		41%	16%	5%	38%
Non-EU citizens		75%	50%		100%
Others					

Wear and Tear from Buildings

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	4%	26%	22%	30%	17%
Business associations	18%	29%	18%	29%	6%
NGOs		7%	7%	4%	81%
Academic/Research Institutions			29%	43%	29%
Public Authorities		43%	29%		29%
EU citizens	3%	42%	16%	8%	32%
Non-EU citizens					100%
Others			50%		50%

Table 24: Wear and tear II (1-2): Wear and Tear from Roads and Wear and Tear from Ships and Boats

Wear and Tear from Roads

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations		17%	17%	35%	30%
Business associations		25%	25%	38%	13%
NGOs		11%	7%		81%
Academic/Research Institutions			14%	29%	57%
Public Authorities		29%	14%	14%	43%
EU citizens	3%	35%	16%		46%
Non-EU citizens					100%
Others					100%

Wear and Tear from Ships and Boats

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations		22%	17%	26%	35%
Business associations	6%	25%		50%	19%
NGOs		7%			93%
Academic/Research Institutions			14%		86%
Public Authorities		25%	25%	13%	38%
EU citizens	3%	32%	16%	3%	46%
Non-EU citizens					100%
Others					100%

Table 25: Maintenance emissions I (1-3): Maintenance Emission from Ships and Boats; Maintenance Emission from Cars and Maintenance Emission from Infrastructure

Maintenance Emission from Ships and Boats

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	27%	23%	14%	9%	27%
Business associations	25%	25%		31%	19%
NGOs	49%			4%	45%
Academic/Research Institutions			14%		86%
Public Authorities		25%	25%		50%
EU citizens		38%	16%	5%	41%
Non-EU citizens		7%	7%		85%
Others			50%		50%

Maintenance Emission from Cars

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	36%	23%	14%	23%	5%
Business associations	44%	25%		19%	13%
NGOs	41%			31%	27%
Academic/Research Institutions			29%	57%	14%
Public Authorities		57%		43%	
EU citizens	8%	38%	16%	16%	22%
Non-EU citizens					100%
Others	50%			50%	

Maintenance Emission from Infrastructure

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	27%	23%	18%	14%	18%
Business associations	19%	25%	31%	13%	13%
NGOs		15%	59%		26%
Academic/Research Institutions			57%	29%	14%
Public Authorities		57%	14%	14%	14%
EU citizens		43%	22%	5%	30%
Non-EU citizens					100%
Others		50%	50%		

Table 26: Maintenance Emissions II (1-2): Maintenance Emission from Buildings and Maintenance Emission from Roads

Maintenance Emission from Buildings

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	24%	19%	14%	19%	24%
Business associations	18%	24%	18%	35%	6%
NGOs		7%	11%	4%	78%
Academic/Research Institutions			29%	29%	43%
Public Authorities		29%	43%	14%	14%
EU citizens	3%	39%	18%	11%	29%
Non-EU citizens					100%
Others			50%		50%

Maintenance Emission from Roads

Contribution As	Completely insignificant	I don't know/Not applicable	Somewhat significant	Very little significant	Very significant
Company/Business Organisations	10%	43%	5%	24%	19%
Business associations	6%	50%	19%	19%	6%
NGOs		7%	19%		74%
Academic/Research Institutions			43%	29%	29%
Public Authorities		29%	43%	14%	14%
EU citizens	3%	38%	11%	8%	41%
Non-EU citizens					100%
Others			50%		50%

d. How much do you agree with the following measures to reduce microplastic pollution due to paints, depending on the application?

a) Among most stakeholders, there is *complete agreement* on the **Promotion of alternative solutions without paint** to reduce microplastic pollution. However, Business Associations (52%) and Companies/Business Organisations (40%) *completely disagree*. (See Table 27)

b) Most of the stakeholders agree with the measure of **Including aspects of microplastics in EU ecolabel and Green Public Procurement** to reduce microplastic pollution. (See Table 27)

c) Almost all stakeholders agree on the measures of **Regulated Dust Protection and Capture for key industries** and **Regulation of plastic shares in paints** to reduce microplastic pollution while Business Associations (47%) *completely disagree* with the measure of **Regulation of plastic shares in paints**. (See Table 28)

d) Business Associations (42%) completely *or somewhat disagree,* and Companies/Business Organisations (56%) *completely or somewhat agree* for **Increasing the share of biodegradable plastics in paint** as a measure to reduce microplastic pollution. While Academic/Research Institutions (42%) *completely disagree* and the rest of stakeholders *completely or somewhat agree* with the measure. (See Table 29)

e) Most of the stakeholders agree with the measure of **Increasing Application yield** and **Improving Lifetime of paints** while NGOs (55%) are neutral about the measure to reduce microplastic pollution. (See Table 29)

f) Most of the stakeholders agree with the measures of **Dust cover improvements** and **Capture scrap road markings** to reduce microplastic pollution. (See Table 30)

g) Most of the stakeholders agree on the measure of **Gypsum waste management in construction and demolition waste** while NGOs (55%) and Public Authorities (50%) take a neutral stance**.** (See Table 31)

h) EU Citizens are broadly in agreement over all measures listed in the question.

Table 27: Paint Emission Measures: Promotion and Awareness (1-3): Promotion of Alternative Solutions without Paints; Awareness of Unused Purchases and Include Aspects of Microplastics in EU Ecolabel and Green Public Procurement

Promotion of Alternative Solutions without Paints

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	32%	41%	9%		14%	5%
Business associations	21%	53%	16%		5%	5%
NGOs	30%		4%	4%	63%	
Academic/Research Institutions	29%		14%	14%	14%	29%
Public Authorities	63%		13%		25%	
EU citizens	67%	8%	3%	15%	5%	3%
Non-EU citizens	100%					
Others				50%	50%	

Awareness of Unused Purchases

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	27%	14%		18%	41%	
Business associations	39%	6%	11%	6%	33%	6%
NGOs	15%		4%	19%	15%	48%
Academic/Research Institutions	14%		14%	14%	43%	14%
Public Authorities	38%	13%	13%	13%	25%	
EU citizens	59%	13%	5%	8%	13%	3%
Non-EU citizens	100%					
Others				50%	50%	

Include Aspects of Microplastics in EU Ecolabel and Green Public Procurement

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	41%	27%	5%	5%	14%	9%
Business associations	26%	32%	5%	16%	11%	11%
NGOs	89%		4%	7%		
Academic/Research Institutions	29%			14%	43%	14%
Public Authorities	50%		13%	13%	25%	
EU citizens	77%	5%	3%	5%	8%	3%
Non-EU citizens	100%					
Others	50%			50%		

Table 28: Paint Emission Measures: Regulation and Operational Improvements (1-2): Regulate the Share of Plastic in Paints and Regulate Dust Protection and Capture for Key Industries

Regulate the Share of Plastic in Paints

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	27%	23%	14%	14%	14%	9%
Business associations	21%	47%	16%		11%	5%
NGOs	85%				15%	
Academic/Research Institutions	14%	14%			57%	14%
Public Authorities	50%	13%	13%	13%	13%	
EU citizens	68%	3%	8%	5%	13%	5%
Non-EU citizens	100%					
Others	50%				50%	

Regulate Dust Protection and Capture for Key Industries

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	43%		4%		30%	22%
Business associations	33%	6%	11%		33%	17%
NGOs	85%		12%	4%		
Academic/Research Institutions	43%				57%	
Public Authorities	63%		25%	13%		
EU citizens	70%	3%	8%	8%	11%	
Non-EU citizens	100%					
Others	50%		50%			

Table 29: Paint Emission Measures: Regulation and Operational Improvements (contd., 1-4): Increase Biodegradable Paint Content; Increase Application Yield; Increase Lifetime of Paint and Localised Preventive Maintenance

Increase Biodegradable Paint Content

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	26%	4%		4%	30%	35%
Business associations	21%	21%	11%	26%		21%
NGOs	15%	11%	59%		15%	
Academic/Research Institutions	14%	43%		14%	14%	14%
Public Authorities	38%				38%	25%
EU citizens	65%	5%	3%	5%	18%	5%
Non-EU citizens	100%				30%	
Others	50%				50%	

Increase Application Yield

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	18%	5%	9%	18%	36%	14%
Business associations	26%	16%	11%	16%	32%	
NGOs	15%		19%	56%	11%	
Academic/Research Institutions	29%		14%	14%	14%	29%
Public Authorities	50%		25%	25%		
EU citizens	56%	8%	3%	10%	21%	3%
Non-EU citizens	100%					
Others			50%		50%	

Increase Lifetime of Paint

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	27%		14%	32%	27%	
Business associations	37%		5%	42%	16%	
NGOs	67%		7%	11%	15%	
Academic/Research Institutions	43%		14%	14%	29%	
Public Authorities	75%				25%	
EU citizens	58%		8%	10%	20%	5%
Non-EU citizens	100%					
Others				50%	50%	

Localised Preventive Maintenance

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	36%		23%		36%	5%
Business associations	32%		26%	5%	32%	5%
NGOs	81%		7%	7%	4%	
Academic/Research Institutions	29%		14%	14%	43%	
Public Authorities	38%		38%	13%	13%	
EU citizens	56%		8%	10%	23%	3%
Non-EU citizens	100%					
Others			50%	50%		

Table 30: Paint Emission Measures: Operational Improvements (1-3): Use Technologies Increasing Dust Cover; Capture Scrapped Road Markings and Capture and Treat Road Run-Off Water

Use Technologies Increasing Dust Cover

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	45%		9%		45%	
Business associations	32%		11%	21%	37%	
NGOs	81%		15%		4%	
Academic/Research Institutions	57%		14%		29%	
Public Authorities				25%	75%	
EU citizens	58%		5%	8%	26%	3%
Non-EU citizens	100%					
Others			50%		50%	

Capture Scrapped Road Markings

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	52%		26%	4%	17%	
Business associations	26%		47%	5%	21%	
NGOs	81%		7%		11%	
Academic/Research Institutions	57%				29%	14%
Public Authorities	50%		25%	13%	13%	
EU citizens	54%		10%	10%	23%	3%
Non-EU citizens	100%					
Others					100%	

Capture and Treat Road Run-Off Water

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	41%		41%	9%	9%	
Business associations	16%	5%	37%		32%	11%
NGOs	19%		4%	11%	63%	4%
Academic/Research Institutions	86%				14%	
Public Authorities	50%		25%	13%	13%	
EU citizens	67%		8%	10%	15%	
Non-EU citizens	100%					
Others					100%	

Table 31: Paint Emission Measures: Operational Improvements (contd., 1-2): Cleaning Shipyards Prior to Refloating of Ships and Boats and Gypsum Waste Management in Construction and Demolition Waste

Cleaning Shipyards Prior to Refloating of Ships and Boats

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	45%		18%	27%	9%	
Business associations	37%		26%	16%	21%	
NGOs	81%		19%			
Academic/Research Institutions	57%			14%	29%	
Public Authorities	50%		25%	13%	13%	
EU citizens	72%		8%	3%	18%	
Non-EU citizens	100%					
Others			100%			

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	36%		23%	23%	18%	
Business associations	32%	5%	26%	16%	21%	
NGOs	15%		22%	56%	7%	
Academic/Research Institutions	43%	14%	14%		29%	
Public Authorities	25%		50%	13%	13%	
EU citizens	64%		8%	5%	15%	8%
Non-EU citizens	100%					
Others			100%			

4.7.2.5 Detergent Laundry and Automatic Dishwasher Capsules (N=35-42)

Some of these capsules have a plastic shell around the detergent that consists of polyvinyl alcohol (PVA), a synthetic polymer, intended to dissolve in water, but that may not fully biodegrade, leaving microplastics in the environment. The Detergents Regulation, currently under revision, already regulates certain aspects of biodegradability of these capsules

a. *Please provide any information regarding this shell and its biodegradability in wastewater and its treatment, including possible releases of microplastics. (Open Text Comments)*
   i. While responses recognize the extant use of PVA in capsule shells, one response highlights **recent advances in using Casein**, a milk protein, **as a polymeric film** which is water-soluble and biodegradable. The comment encourages the recognition and further examination of other alternatives apart from PVA shells.
   ii. Another response highlights examining proper definitions of biodegradability in legislation and regulation of microplastic emissions that include a temporal and location-based degradation limit.
b. *If there would be sufficient evidence about the microplastics emissions of detergent capsules, to which extent would you agree with the following measures?*
   i. Almost all the stakeholders *completely or somewhat agree* of **all the measures listed** in the

      Table 32.
   ii. However, Business Associations were neutral on the measures of **Incentivise Eco-friendly Alternatives** and **Improve Waste-Water Treatment Plants**. Public Authorities were neutral

on the measures of **Improve Waste-Water Treatment Plants** and **Monitoring of PVA in Waste-Water Treatment Plants.** (See Table 32)

iii. All stakeholders *completely or somewhat agree* with the measures of **restriction of non-biodegradable water-soluble capsule shells, protocol to address the biodegradability of dissolvable capsule shells in real life conditions** and **extended producer responsibility.** Business Associations are neutral with the measure of **restriction of non-biodegradable water-soluble capsule shells.** (See Table 33)

Table 32: Emissions of detergent capsules I (1-4): Consumer Awareness; Incentivise Eco-Friendly Alternatives; Monitoring of PVA in Waste-Water Treatment Plants and Improve Waste-Water Treatment Plants

Consumer Awareness

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	47%			13%	40%	
Business associations	71%			7%	21%	
NGOs	29%		4%	7%	61%	
Academic/Research Institutions	67%				33%	
Public Authorities	33%	11%		33%	22%	
EU citizens	79%			2%	19%	
Non-EU citizens	100%					
Others	50%				50%	

Incestivise Eco-Friendly Alternatives

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	60%			13%	27%	
Business associations	29%		7%	43%	21%	
NGOs	25%	43%	7%	11%	14%	
Academic/Research Institutions	50%	17%			17%	17%
Public Authorities	78%			11%	11%	
EU citizens	89%	2%			9%	
Non-EU citizens	100%					
Others	50%				50%	

Monitoring of PVA in Waste-Water Treatment Plants

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	43%			21%	29%	7%
Business associations	7%		21%	7%	57%	7%
NGOs	11%		11%	7%	68%	4%
Academic/Research Institutions	50%			17%	17%	17%
Public Authorities	22%	22%	22%		22%	11%
EU citizens	77%		2%		17%	4%
Non-EU citizens	100%					
Others	50%				50%	

Improve Waste-Water Treatment Plants

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	40%	7%	7%	13%	20%	
Business associations	21%		7%	43%	14%	14%
NGOs	14%	7%	11%	14%	50%	4%
Academic/Research Institutions	50%	17%		17%	17%	
Public Authorities	11%		33%	33%	22%	
EU citizens	77%			4%	17%	2%
Non-EU citizens	100%					
Others	50%				50%	

Table 33: Emissions of detergent capsules II (1-3): Protocol to Address the Biodegradability of Dissolvable Capsule Shells in Real Life Conditions; Extended Producer Responsibility and Restrict Non-Biodegradable Water Soluble Shells for Capsules

Protocol to Address the Biodegradibility of Dissolvable Capsule Shells in Real Life Conditions

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	64%	7%		7%	21%	
Business associations	71%		7%	7%	14%	
NGOs	36%		7%	7%	50%	
Academic/Research Institutions	67%				17%	17%
Public Authorities	67%		22%		11%	
EU citizens	89%	2%			4%	4%
Non-EU citizens	100%					
Others	50%				50%	

Extended Producer Responsibility

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	50%	14%	7%	7%	21%	
Business associations	50%	21%	14%		7%	7%
NGOs	43%		4%	4%	50%	
Academic/Research Institutions	67%				33%	
Public Authorities	44%	22%	11%		22%	
EU citizens	83%	2%			13%	2%
Non-EU citizens	100%					
Others	50%				50%	

Restrict Non-Biodegradable Water Soluble Shells for Capsules

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	73%		7%		20%	
Business associations	43%		14%	36%	7%	
NGOs	89%			7%	4%	
Academic/Research Institutions	50%			17%	33%	
Public Authorities	89%				11%	
EU citizens	91%				9%	
Non-EU citizens	100%					
Others	100%					

c. Open Text Comments

All unique responses received agree on **regulating use by households**, where suggestions include **promotion of manual dish washing** and **prohibition of plastic pot cleaners**. Comments also mention **regulation of detergent discharge** into water bodies.

4.7.2.6 Geotextiles (N=49-112)

1. How much do you agree with the following measures to reduce microplastic pollution from geotextiles?

1.1. Most stakeholders *completely agree* with the following measures, **Regulate the type of fibre or polymer used** and **Promote alternatives and eco-friendly materials**, to reduce microplastic pollution while Business Associations are split on the agreement scale (40% agreement; 45% disagreement). (See Table 34)

1.2. Business Associations *completely or somewhat disagree* (50%) with the measure to **regulate the range of applications** while the rest of the stakeholders agree. (See Table 34)

1.3. Business Associations and Public Authorities take a neutral stance with the measure of **regulating emission limits** while the rest of the stakeholders *completely or somewhat agree***.** (See Table 35)

Table 34: Emissions from Geotextiles I (1-3): Regulate the Types of Polymers and Fibers Used; Regulate the Range of Applications for Geotextiles and Promote Alternatives

Regulate the Types of Polymers and Fibers Used

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	47%	7%		13%	27%	7%
Business associations	30%	40%		15%	10%	5%
NGOs	87%	4%		9%		
Academic/Research Institutions	43%			14%	43%	
Public Authorities	33%		11%	11%	44%	
EU citizens	83%	3%		3%	7%	3%
Non-EU citizens	75%				25%	
Others	67%			33%		

Regulate the Range of Applications ofr Geotextiles

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	60%		13%	13%	13%	
Business associations	15%	30%		15%	20%	20%
NGOs	83%	4%	4%	9%		
Academic/Research Institutions	43%				29%	29%
Public Authorities	33%		11%	11%	44%	
EU citizens	71%	3%		3%	16%	6%
Non-EU citizens	75%				25%	
Others	33%			67%		

Promote Alternatives

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	56%	25%		6%	6%	6%
Business associations	25%	50%		5%	15%	5%
NGOs	96%	4%				
Academic/Research Institutions	57%					43%
Public Authorities	44%		11%	11%	33%	
EU citizens	77%	3%		6%	10%	3%
Non-EU citizens	100%					
Others	67%	33%				

Table 35: Emissions from Geotextiles II (1-2): Promote Eco-Friendly Materials and Regulate Emission Limits

Promote Eco-Friendly Materials

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	69%				25%	6%
Business associations	45%		5%		45%	5%
NGOs	96%				4%	
Academic/Research Institutions	57%			14%	14%	14%
Public Authorities	67%		11%	11%	11%	
EU citizens	81%			6%	13%	
Non-EU citizens	100%					
Others	100%					

Regulate Emission Limits

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	53%		7%	27%	13%	
Business associations	21%	26%	5%	26%	16%	5%
NGOs	78%	4%		9%	9%	
Academic/Research Institutions	43%			29%	14%	14%
Public Authorities	11%		11%	33%	33%	11%
EU citizens	83%		3%		13%	
Non-EU citizens	75%				25%	
Others	67%			33%		

a. How much do you agree with the following statements related to the applications of geotextiles?

i. *Geotextiles for Coasts*

Almost all Public Authorities and EU citizens take a neutral stance when it comes to the **types of geotextiles** that can protect the coast – **either woven, non-woven, or made with natural fibres**. (See Table 36)

Businesses Associations, on the other hand, are in complete agreement of the efficacy of geotextiles of all types. NGOs completely agree (70%) for **geotextiles made with natural fibres** to protect the coast from erosion. They mostly disagree with non-woven geotextiles (60%) and woven geotextiles (60%). (See Table 36)

Table 36: Coastal Erosion (1-3): Non-Woven Geotextiles can Protect Coasts from Erosion; Woven Geotextiles can Protect Coasts from Erosion and Geotextiles from Natural Fibres can Protect Coasts from Erosion

Non-Woven Geotextiles can Protect Coasts from Erosion

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	53%	7%	27%	7%	7%	
Business associations	56%		17%	17%	11%	
NGOs	4%	61%	17%		17%	
Academic/Research Institutions	14%	29%	14%	29%	14%	
Public Authorities	13%	13%	50%		25%	
EU citizens	13%	17%	50%	7%	7%	7%
Non-EU citizens	67%				33%	
Others	33%		33%		33%	

Woven Geotextiles can Protect Coasts from Erosion

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	47%	7%	27%	13%	7%	
Business associations	59%		18%	24%		
NGOs	4%	61%	17%		17%	
Academic/Research Institutions	29%		14%	29%	29%	
Public Authorities	13%	13%	50%		25%	
EU citizens	21%	17%	48%	7%	7%	
Non-EU citizens			67%		33%	
Others	33%		33%		33%	

Geotextiles from Natural Fibers can Protect Coasts from Erosion

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	50%		25%	6%	6%	13%
Business associations	6%	11%	28%	11%		44%
NGOs	70%		17%		9%	4%
Academic/Research Institutions	14%		14%	14%	43%	14%
Public Authorities	38%	13%	50%			
EU citizens	42%		35%	6%	10%	6%
Non-EU citizens	25%		25%	25%	25%	
Others	33%		33%		33%	

ii. *Geotextiles for Roads*

All Academic/Researchers Institutions and Public Authorities remain neutral when it comes to the **types of geotextiles** that can be used to build roads – either **woven, non-woven, or made with natural fibres**. (See Table 37)

Businesses Associations on the other hand, are in *complete agreement* of the efficacy of geotextiles of all types except natural fibres where they weakly agree (43%). (See Table 37)

EU Citizens (45%) largely prefer **geotextiles made with natural fibres** as material to build roads. While they are mostly neutral on woven and non-woven geotextiles. NGOs *completely disagree* on woven (60%) and non-woven (60%) geotextiles while *completely agree* on natural fibres. (69.5%) (See Table 37)

Table 37: Road Construction I (1-3): Woven Geotextiles can be Used to Build Roads; Non-Woven Geotextiles can be Used to Build Roads and Geotextiles from Natural Fibres can be Used to Construct Roads

Woven Geotextiles can be Used to Build Roads

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	53%	7%	20%	7%	7%	7%
Business associations	58%		16%	21%	5%	
NGOs	4%	61%	17%		17%	
Academic/Research Institutions	14%		14%	29%	29%	14%
Public Authorities	25%	13%	63%			
EU citizens	20%	10%	50%	7%	10%	3%
Non-EU citizens	33%		33%		33%	
Others	33%		33%		33%	

Non-Woven Geotextiles can be Used to Build Roads

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	60%	7%	20%	7%	7%	
Business associations	53%		16%	16%	16%	
NGOs	4%	61%	17%		17%	
Academic/Research Institutions	14%	14%	14%	43%	14%	
Public Authorities	25%	13%	63%			
EU citizens	17%	10%	50%	3%	7%	13%
Non-EU citizens	33%		33%		33%	
Others	33%		33%		33%	

Geotextiles from Natural Fibers can be Used to Construct Roads

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	57%	7%	21%	14%		
Business associations	39%		28%	11%	6%	17%
NGOs	70%		17%		9%	4%
Academic/Research Institutions	14%		14%	14%	29%	29%
Public Authorities	13%	13%	75%			
EU citizens	45%		39%	6%	6%	3%
Non-EU citizens	50%		25%	25%		
Others	33%		33%		33%	

iii. All Public Authorities and EU citizens are neutral for the **non-existence of alternatives to geotextiles for drainage** while NGOs (82%) and Academic/Research Institutions (57%) *completely or somewhat agree* with the statement. (See Table 38)

Table 38: Road Construction II

There are no Alternatives to Geotextiles for Drainage

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	6%	13%	31%	25%	19%	6%
Business associations	17%		17%	39%	28%	
NGOs	74%		17%		9%	
Academic/Research Institutions	43%		14%	29%	14%	
Public Authorities	25%		50%	13%	13%	
EU citizens	13%	13%	50%	13%	7%	3%
Non-EU citizens	33%		33%			33%
Others			33%	33%	33%	

4.7.3 Part IV. All Addressed Sources: Pellets, Synthetic Textiles, Tyres, Geotextiles, Detergent Capsules and Paints

1. *How much do you agree with the following measures to reduce microplastic pollution in general? (N=357)*
   a) Apart from Business Associations who are neutral, all other stakeholders at large completely agree with a common system to monitor and report microplastic release throughout the lifecycle of the source. All stakeholders completely or somewhat agree on the measure on specific waste-water treatment in urban wastewater plants to reduce microplastic pollution. (See Table 39)
   b) There is an overwhelming support for international agreements across all stakeholders. Business Associations are neutral and almost all other stakeholder groups completely or somewhat agree on specific wastewater treatment in recycling plants to reduce the microplastic pollution. (See Table 40)

Table 39: General Emissions I (1-2): Common System to Monitor and Report Microplastic Releases throughout Life-Cycle and Specific Waste Water Treatment in Urban Waste Water Plants

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Common System to Monitor and Report Microplastic Releases throughout Life-Cycle						
Company/Business Organisations	43.04%	11.39%	11.39%	2.53%	30.38%	1.27%
Business associations	25.00%	22.06%	11.76%	10.29%	26.47%	4.41%
NGOs	77.97%		3.39%		18.64%	
Academic/Research Institutions	70.27%			8.11%	21.62%	
Public Authorities	43.75%		12.50%	12.50%	18.75%	12.50%
EU citizens	66.67%	1.71%	1.71%	5.98%	22.22%	1.71%
Non-EU citizens	80.00%				20.00%	
Others	60.00%		10.00%		30.00%	
Specific Waste Water Treatment in Urban Waste Water Plants						
Company/Business Organisations	46.91%	2.47%	18.52%	2.47%	28.40%	1.23%
Business associations	32.84%	2.99%	20.90%	11.94%	23.88%	7.46%
NGOs	42.37%	5.08%		11.86%	11.86%	28.81%
Academic/Research Institutions	56.76%			8.11%	24.32%	10.81%
Public Authorities	25.00%		18.75%	6.25%	31.25%	18.75%
EU citizens	69.75%	0.84%	2.52%	5.88%	19.33%	1.68%
Non-EU citizens	100%					
Others	40.00%	10.00%	10.00%	10.00%	30.00%	

Table 40: General Emissions II (1-2): Specific Waste Water Treatment in Recycling Plants and International Agreements

Specific Waste Water Treatment in Recycling Plants

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	43%	1%	19%	6%	29%	1%
Business associations	25%	1%	39%	10%	22%	1%
NGOs	47%	2%	3%	8%	14%	25%
Academic/Research Institutions	57%		6%	6%	31%	
Public Authorities	44%		19%	13%	25%	
EU citizens	76%		2%	3%	19%	
Non-EU citizens	90%		10%			
Others	40%		20%	10%	30%	

International Agreements

Contribution As	Completely agree	Completely disagree	I don't know/Not applicable	Neither agree nor disagree	Somewhat agree	Somewhat disagree
Company/Business Organisations	56%		5%	7%	32%	
Business associations	42%		10%	15%	31%	1%
NGOs	54%		2%	5%	24%	15%
Academic/Research Institutions	84%		5%		11%	
Public Authorities	63%		6%		25%	6%
EU citizens	80%		1%	6%	13%	1%
Non-EU citizens	90%				10%	
Others	70%		10%		20%	

2. *Please provide any additional information regarding microplastics and the reduction of emissions, in particular for paints, geotextiles, and detergent capsules. (Open Text Comments)*

   While responses in this section are along the lines of those described in Section 6.1.2.1 (d.), one comment further accentuated the monitoring of and recognition of microplastic emissions at the industrial site level, while also suggesting the development of up-to-date databases on sustainable and eco-friendly alternative raw material. There is also a mention of studying fishing nets in agriculture as a major emitter of microplastics.

3. *Please provide any information if a significant fraction of the release might be in form of very fine particles (smaller than 1 micron, also called nano plastics), either in general, either for one of the specific sources, and the consequences that might have on possible measures. (Open Text Comments)*

   In general, valid responses mention a lack of research for nano plastics, especially in terms of their rate of degradability (or lack thereof) vis-à-vis microplastics and their rate of accumulation over time.

   One response claims that paints and tyres contribute the most to the emission of nano plastics. There is also a need to examine forest ecosystems and micro-organisms where a lot of emissions are bioaccumulated over time, especially for nano plastics.

5 STAKEHOLDER WORKSHOPS

To complement the OPC, several online stakeholder workshops were organised to inform and engage stakeholders.

5.1 First stakeholder workshop: 16 September 2021

This first workshop had over 150 attendees from the industry, including SMEs, NGOs, Member States, and researchers. It presented the overall context of the European Strategy for Plastics in a Circular Economy as a part of Circular Economy Action Plan (CEAP) as well as the series of initiatives to tackle all types of plastics in general and microplastics in particular.

The presentation of the study was made along with the problem definition specific to the three sources (pellets, tyres, and textiles). The discussion also focused on additional sources of microplastics on which the study could focus.

5.2 Second series of thematic stakeholder workshops: 22, 24, 25 November 2021

This workshop was of three half-day dedicated sessions, each dealing with a specific source. The goal of this workshop was to update the participants on the state of the analysis and to identify possible measures to reduce the unintentional release of microplastics, including pellets, into the environment. A background note was sent out in advance to all participants to enable a useful discussion.

The participants were split into 4 groups to increase participation and discussion. The groups performed two activities:

1. Identification of measures and classification into different categories and vote from the participants on which were their preferred measures to reduce emissions to the environment.

2. Analysis of the 20 measures which received the most votes using a matrix of effectiveness against technical feasibility. The scale was from 0 to 5, with 0 being an ineffective measure or a non-feasible measure and 5 being an extremely effective measure to tackle emissions or a measure that could be easily implemented.

- 22 November 2021 – Textiles

Overall, 155 measures (including duplicates and measures that could be grouped together) were identified by 44 participants (actively involved in the activities) out of more than 152 participants in total to the workshop.

- 24 November 2021 – Tyres

Overall, 205 measures (including duplicates and measures that could be grouped together) were identified by 49 participants (actively involved in the activities) out of more than 80 participants in total to the workshop.

- 25 November 2021 – Pellets

Overall, 173 measures (including duplicates and measures that could be grouped together) were identified by 41 participants (actively involved in the activities) out of more than 70 participants in total to the workshop.

After the breakout sessions, a plenary session was organised where the measures were presented and discussed with stakeholders.

5.3 Third stakeholder workshop: 17 February 2022

This workshop focused on the new sources (paints, detergent capsules and geotextiles) as the scope of the analysis was expanded to these sources. It was attended by more than 100 participants. The presentation of the analysis was made along with the problem definition specific to the new sources. The methodological approach was explained to stakeholders and inputs were requested.

5.4 Fourth stakeholder workshop: 17 March 2022

The goal of this workshop was to update the participants on the state of the analysis and to identify possible measures to reduce unintentional release of microplastics, including pellets, into the environment. A background note was sent out in advance to all participants to enable a useful discussion. It was organised in 3 breakout sessions, one each on paints, detergent capsules and geotextiles.

The paint session was attended by 42 participants and 61 ideas about potential measures were collected.

The geotextiles session was attended by 28 participants and 58 ideas about potential measures were collected.

The detergent capsules session was attended by 25 participants and 9 ideas about potential measures were collected.

After the breakout sessions, a plenary session was organised where the measures were presented and discussed with stakeholders.

5.5 Fifth stakeholder workshop: 21 March 2022

This workshop presented the progress on tyres, pellets and textiles, in particular the screening of measures and initial analysis of impacts of these measures. The workshop was attended by more than 200 participants.

5.6 Sixth stakeholder workshop dedicated to Member States representatives: 23 March 2022

This dedicated workshop presented the progress on all six sources and feedback was collected from MS representatives. The meeting was attended by 27 participants including participants from the Commission.

5.7 Seventh stakeholder workshop on pellets: 12 December 2022

This dedicated workshop engaged in an in-depth discussion on baseline and policy options related to pellets. The meeting was attended by 53 participants covering NGOs, industry, and some Member States.

6 SME CONSULTATION

As an important part of the pellets volume is handled by SMEs, a dedicated SME consultation was carried out. The results can be found in Annex 12.

7 BILATERAL CONSULTATIONS

Extensive consultations were made with stakeholders (in particular, industry representatives relevant for the six sources, NGOs, as well various Commission services and other EU organisations such as EEA). An online tracker was maintained on the status and outcome of these meetings, which was regularly shared with DG ENV.

The objective of these meetings was to collect feedback on different steps of the analysis and seek additional data and evidence. The excel file indicating these consultations was made available through Teams.

Annex 3:
Who is affected and how?

1 PRACTICAL IMPLICATIONS OF THE INITIATIVE ON PELLETS

This annex sets out the practical implications of the preferred option for the various types of stakeholders concerned. The table below summarises such implications. This is followed by a summary per impact (economic, environmental, social), and overview tables for the preferred option.

Stakeholders	
Businesses and the economy at large	Businesses will benefit from the reduction of pellet losses and, therefore, from the reduction of adverse impacts linked to pellet losses. Reducing pellet losses will have positive knock-on economic effects on pellet businesses including reduced waste, less legacy pellet pollution, modernised equipment, improved staff awareness, reduced fire risk and improved reputation. On reduced waste, the analysis has demonstrated that for businesses owning the pellets, there would be an economic gain of EUR 25-141 million, thanks to the 25-141 thousand tonnes of pellets that would not be lost anymore (1000 EUR/t). It will also save annually 98 000 – 551 000 tonnes of GHG emissions. It is also expected that the playing field will be levelled, thus reinforcing the position of companies applying measures vis-à-vis companies that do not apply such measures, which would be beneficial for the sector as a whole. In areas that are particularly affected by pellet losses, reducing such losses will also have positive knock-on economic effects on commercial fishing and agriculture as well as recreation and tourism. At the same time, Option 1 "Mandatory standardised methodology" will have one-off costs for developing and testing the methodology that would have a higher impact on SMEs. Option 2b "Mandatory requirements" will entail direct compliance costs for every pellet handling company. In particular, the option will entail both adjustment (e.g. investing in equipment) and administrative (e.g. notifying certification) costs, as well as charges (i.e. auditing and certification by independent private bodies). The pellet industry will bear these costs. As it is already moving towards both the application of measures and a system of external auditing and certification, the direct economic costs will only be higher than those envisaged in the baseline for those firms that will not take actions in the meanwhile. In addition, this option foresees a series of mitigation measures (Option 2b) to alleviate the direct economic costs on the micro and small companies present in the pellet supply chain to mitigate concerns from SMEs (e.g. lack of staff/time, lack of information on risks and solutions and lack of financial resources). These measures will prevent these actors, who only represent a minor share of pellet losses, to make these costly investments which would have limited environmental benefits. It can thus be recommended. There would be cost savings thanks to the single harmonised measurement methodology to assemble the loss data and lower verification costs (option 1). The subsequent implementation costs of this methodology will be for industry, but they are already fully covered by their reporting obligation under the new REACH restriction. Therefore, the additional reporting under Option 2b (compliance) would result only in a very minor cost. The analysis undertaken shows that the market benefits of reducing pellet losses outweigh the costs of the measures needed to meet mandatory requirements.

Public authorities/administrations	Under Option 1, there will be costs for developing the harmonised measurement methodology, which could be borne by industry and/or public authorities. There could be cost for public authorities to assemble the loss data. Under option 2, increasing the stringency of requirements and of implementation can be expected to lead to an increase in direct administrative and enforcement costs on public authorities (e.g. public register, data collection, verification, correction and in the case of non-compliance, corrective measures and, where relevant, penalties).
End Users	Citizens, consumers and the society in general will benefit from better understanding of pellet losses under Option 1. Option 2b "Mandatory requirements" will result in a reduction of pellet losses to a level consistent with the Commission's overall microplastic releases reduction target of 30% by 2030, thus bringing overall benefits for citizens, consumers and the society in general.

Economic impacts on businesses - summary

Impact categories	Qualitative scoring of impact	Affected stakeholders	Description of impact
Adjustment costs and conduct of business	-	Pellet manufacturers (virgin pellets), plastics recyclers (recycled pellets), pellet convertors, pellet transporters and storage operators	There will be additional costs to put in place measures to prevent and contain pellet spills and losses. However, as the industry is already moving towards an OCS certification scheme, a part of industry will have anticipated these additional costs. Operators (including SMEs) will also benefit economically thanks to modernised equipment, improved reputation, reduced waste and a level playing field.
Administrative burdens on businesses	-	Same as above	The administrative burden will increase because of reporting requirements for the certification scheme, beyond the existing voluntary scheme.
Operation / conduct of SMEs	- /0	SMEs represent a significant share of the pellet supply chain, especially converters and logistics, and will be affected	The impact will be in terms of measures needed to prevent and contain pellet spills and losses and reporting requirements for the certification scheme. Option 2b sets lighter requirements for micro- and small enterprises.
Functioning of the internal market and competition	0	All actors in the pellet supply chain	If action is taken at EU level, the functioning of the internal market can be improved (same obligations on every operator, level playing field among them). The additional estimated cost of option 2b would represent about 0.13% of the EU plastics sector turnover, which would have a minor impact on its competitive advantage.

Impact categories	Qualitative scoring of impact	Affected stakeholders	Description of impact
Public authorities: Change in costs to authorities for compliance and enforcement activities	0/-	Member State competent authorities	The impact would be low or negative. Depending on their pellet responsibilities (data collection, verification, correction and enforcement), they will need to manage the monitoring, enforcement and receive the data from companies, so there might be additional human resources needed.
Public authorities: Change in costs to the Commission	-	European Commission / and EU institutions	There might be costs involved with the development of a measurement standard, but there are cost savings in the existing reporting obligations towards ECHA.
Innovation and research	-/+	Researchers	The development of a measurement standard (under option 1) will improve knowledge on plastic pellet losses.
Third countries and international relations	+/-	Third countries	No direct effects expected. As with other legislation, third countries could set up similar measures as a consequence of this initiative.
Consumers and household (end users)	0/-	Households	Measures could lead to a very slight increase in the price of plastic pellets, and therefore plastic products. However, industry might choose to absorb this increase, meaning consumers would not be impacted.

Environmental impacts - summary

Impact category	Qualitative scoring of impact	Affected stakeholders	Description of impact
Quality of natural resources	+++	General public	Reduced pellets loss to the environment will results in a better quality of natural resources, improved eco-systems, improved biodiversity and improved services for the economy and society (e.g. fisheries), with the general public being the affected group.
Efficient use of raw materials	+	Plastic industry	Less pellet losses leads directly to the more efficient use of pellets
International environmental impacts	++	General public, sea food industry	Pollution caused by pellet loss affects both cross-border river basins and the seas and is, therefore, an important international impact. Reduced pellet loss will therefore lead to improved ecosystems and biodiversity globally.
Waste production, generation and recycling and its impact on land use	+	Wastewater treatment companies Potentially tourism and agricultural sectors	The accumulation of pellets may impact wastewater treatment infrastructure. If not properly managed, pellets can pile up in certain areas (such as coastal areas) and negatively impact other activities (tourism). As well as agriculture as around half of the sludge from wastewater is applied on agricultural land.
Climate change	+	No specific group is impacted	Reducing pellet loss will lead to less GHG emissions, as less plastics will be needed. There could be indirect effects on plankton growth.

Social impacts - summary

Impact category	Qualitative scoring of impact	Affected stakeholders	Description of impact
Public health and safety	+	Public & pellet value chain employees	There are potential health impacts caused by microplastics, thus a reduction in pellet loss will reduce risks to human health. Fewer pellet spills will also increase safety at work.
Affected populations	+	Populations in affected areas	Reducing pellet losses will alleviate negative effects on affected populations, for example, by improving tourism, recreation, agriculture, and fishing.
Employment	+	Plastics industry & public authorities	The measures will create more job opportunities in the plastic sector, and more widely in public authorities if additional resources are required for the compliance checks.

2 SUMMARY OF COSTS AND BENEFITS

The following table outlines the benefits, both direct and indirect, of the preferred option.

I. Overview of Benefits (total for all provisions) – Preferred Option		
Description	***Amount***	***Comments***
Direct benefits		
Reduction in pellet losses	Measures under the preferred option could potentially result in the reduction of pellet losses to the environment in the range of 25 142 to 140 621 tonnes by 2030, which will reduce adverse impacts on water resources (both marine and freshwater and management wastewater).	As the reduction potential of all measures under the preferred option cannot be calculated, this estimation is conservative. All stakeholders will benefit because this will result in better environmental quality.
Improved understanding of pellet loss pathways and mechanisms in reaching the environment	The measurement standard and reporting will improve the availability of data on pellet losses.	This benefit will be mostly for the industry and public authorities. This will be of much use in designing better products, monitoring the effectiveness of reduction measures.
Creation of a level-playing field	Option 2b will create a level playing field among different actors within the plastic value chain. It will also bring a competitive advantage to the EU industry by improving its global reputation around environmental protection and moving towards a circular economy. Better pellet management will increase the image of the EU industry.	It could also negatively affect the competitiveness of the EU industry if a downstream actor in the value chain imports pellets from outside the EU, which could be cheaper in the absence of regulatory requirements.
Indirect benefits		
Safer work environment	The measure will reduce the amount of pellet spills and benefit the safety of employees working throughout the pellet chain by reducing their chances of falling. As a result, there will be fewer work accidents contributing to a safer work environment.	
Healthier soil	The measure will reduce the quantities of pellets in soil due to less losses through direct spills or through the use of sewage sludge as a fertiliser.	

Benefits to ecosystem services	The measure will reduce the quantities of pellets in affected areas, having knock-on effects on sectors such as tourism and recreation (increased attractivity of the region), fisheries (less pellets being absorbed by marine animals) and agriculture (less pellets being released on soils).	
Reduced costs for affected populations	The measure will reduce the need for local populations to finance clean-up operations following a spill.	

(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate which stakeholder group is the main recipient of the benefit in the comment section;(3) For reductions in regulatory costs, please describe details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.;).

The following table provides an overview of the costs of the preferred option.

II. Overview of costs – Preferred option							
		Citizens/Consumers		**Businesses**		**Administrations**	
		One-off	**Recurrent**	**One-off**	**Recurrent**	**One-off**	**Recurrent**
Action (a)	Direct adjustment costs	No one-off cost	A possible minor increase in the price of pellets could be passed on to the downstream users and, ultimately citizens because of an increase in the price of plastic products.	The businesses need to adapt their operations and administrative procedures to the new requirements by the preferred option. Developing the measurement standard (option 1) will entail adjustment costs between EUR 1.3 – 3.2 million, however compensated by recurrent savings in using a single method and in reporting.	Costs for applying the methodology developed under option 1 for monitoring however compensated by recurrent savings on reporting. Actions for implementing pellet loss reduction measures (EUR 332 to 447 million of pellets handled during production, processing or logistics operations). Businesses could choose to absorb these or pass them on to consumers.	Administrations would potentially directly support the investments needed to develop new methodologies and standards (option 1).	Administrations will need to ensure the enforcement of EU law on pellets and review the reports submitted.
	Direct administrative costs	None	None	Setting up systems in businesses for administrative procedures to report pellet	EUR 43.9 million from the costs for internal assessment (EUR 30.8 million), external audit and/or certification and	Setting up systems in Member States for administrative procedures (EUR 36	Costs (EUR 125 000) for enforcement and analysis of the reported data.

				losses (EUR 0.1 million [5]).	notification (EUR 12.9 million), and minor costs (EUR 0.2 million) for data collection, verification, correction and enforcement, but more cost savings expected in the existing reporting.	700 [6]), including setting up a register of certified companies.	
	Direct regulatory fees and charges	None	None	None	Only if public authorities decide to put fees in place.	None	None
	Direct enforcement costs	None	None	Putting in place administrative procedures.	Minor costs for notification.	Putting in place administrative procedures, including measures for ensuring compliance.	Costs for enforcement and analysis of the reported data.

(1) Estimates (gross values) to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (adjustment costs, administrative costs, regulatory charges, enforcement costs, indirect costs;).

[5] Total initial cost are EUR 0.5 million for businesses, which have been annualised over a 5 year period using a discount rate of 3% (0.5 hour for medium and large businesses and 0.25 hour for small and micro businesses and using EU average wages (29 €/hour)). It is estimated that the internal assessment is already covering most of the related cost.

[6] Total initial cost are EUR 313 000 million for public authorities, which have been annualised over a 10 year period using a discount rate of 3% (50 person days in average for each Member State using EU average wages (29 €/hour)).

III. Application of the 'one in, one out' approach – Preferred option			
[44 M€]	**One-off** (annualised total net present value over the relevant period)	**Recurrent** (nominal values per year)	**Total**
Businesses			
New administrative burdens (INs)	Setting up systems in businesses for administrative procedures to report pellet losses (EUR 0.1 million[7]).	Costs for internal assessments, external auditing and certification of about EUR 43.9 million: - internal assessment – EUR 30.8 million - external audit and/or certificate – EUR 12.9 million - filling forms and tables – EUR 0.2 million (for notifying public authorities of the certification).	EUR 44 mln €
Removed administrative burdens (OUTs)	None	None	None
Net administrative burdens*	EUR 0.1 mln €	EUR 43.9 mln €	EUR 44 mln €
Adjustment costs**	The businesses need to adapt their operations and administrative procedures to the new requirements by the preferred option. Developing the measurement standard (option 1) will entail adjustment costs between EUR 1.3 – 3.2 million, however compensated by recurrent savings in using a single method and in reporting.	Costs for applying the methodology developed under option 1 for monitoring however compensated by recurrent savings on reporting. Actions for implementing pellet loss reduction measures (EUR 332 to 447 million of pellets handled during production, processing or logistics operations). Businesses could choose to absorb these or pass them on to consumers.	
Citizens			
New administrative burdens (INs)	None	None	None
Removed administrative burdens (OUTs)	None	None	None
Net administrative burdens*	None	None	None
Adjustment costs**	None	A possible minor increase in the price of pellets could be passed on to the downstream users and, ultimately citizens because of an increase in the price of plastic products.	

[7] Total initial cost are EUR 0.5 million for businesses, which have been annualised over a 5 year period using a discount rate of 3% (0.5 hour for medium and large businesses and 0.25 hour for small and micro businesses and using EU average wages (29 €/hour)). It is estimated that the internal assessment is already covering most of the related cost.

Total administrative burdens* **	EUR 0.1 mln €	EUR 43.9 mln €	EUR 44 mln €

(*) Net administrative burdens = INs – OUTs;
(**) Adjustment costs falling under the scope of the OIOO approach are the same as reported in Table 2 above. Non-annualised values;
(***) Total administrative burdens = Net administrative burdens for businesses + net administrative burdens for citizens.

3 RELEVANT SUSTAINABLE DEVELOPMENT GOALS

The following table sets out the Sustainable Development Goals which are of relevance to the preferred option.

III. Overview of relevant Sustainable Development Goals – Preferred Option		
Relevant SDG	**Expected progress towards the Goal**	**Comments**
SDG 14 – Conserve and sustainably use the oceans, seas and marine resources for sustainable development	A reduction in the amount of pellet losses to the marine environment.	
SDG 2 – Ensure healthy lives and promote well-being for all at all ages	Reduced microparticles from degradation and fragmentation of pellets also contribute to air pollution that is one of the causes for respiratory diseases. Similarly, reducing pellets losses into water will also ensure a less polluted food chain.	
SDG 12 - Ensure sustainable consumption and production patterns	Reducing pellet losses leads to a more efficient use of resources (here, pellets) and thus more sustainable production patterns.	

Annex 4:
Analytical methods

1 METHODOLOGY USED FOR THE INITIATIVE ON PELLETS

The methodology to develop this initiative follows the Commission Better Regulation Guidelines. These guidelines place an emphasis on the need for analysis to rely on evidence-based knowledge and scientifically robust methods.

There are significant knowledge gaps in the field of pellet losses, but it is an active field of research, and new evidence is appearing every day in scientific journals, national policy and international initiatives from multilateral organisations (e.g. OECD, UN), industry-led voluntary initiatives and civil society organisations. Main assumptions used in this impact assessment are presented below. Stakeholders were consulted to ensure the plausibility of these assumptions.

All calculations were done for a base year, 2030.

Assumptions for pellet production in the EU

The data sources and assumptions used to estimate the total quantity of pellet production volumes and projections until 2030 are the following:

- 2019 is taken as the base year, as 2020 is an outlier because of COVID, and we are seeing positive growth trends again from 2021;
- For virgin pellets, the projections are made from 2019 figures[8]; a growth rate of 0.9% per year is assumed till 2030[9];
- The source for recycled pellets production data (2019-2021) is Plastic Recyclers Europe; a growth rate of 5.6% per year is assumed[10];
- The source for bio-based pellets production data (2019-2021) is Plastics Europe; for a growth rate CAGR of 14% for 2022-2027[11], and the same trend is assumed to continue till 2030;
- Pellets imports and exports figures for virgin pellets are from Eurostat; a growth rate of 0.9% is assumed till 2030.

Assumptions for quantifying chronic pellet losses

There is no harmonised methodology for measuring pellet losses. Neither pellet loss measurements have been made at different steps of the value chain, nor are any systemic monitoring and reporting data available within the Member States or the industry to calculate the pellet losses. Hence, it is impossible to establish exact figures on pellet losses at each step because it depends on the installation size, actors involved, management practices, etc., and all these aspects are very heterogeneous in the

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[8] Plastics Europe changed the calculation method in 2021, excluding adhesives, paints and coatings, thus not used to be coherent with previous year estimates and also with import/export figures

[9] Plastics Europe and SystemIQ

[10] K 2022 - Trend Report Europe https://www.k-online.com/en/Media_News/Press/Technical_article/K_2022_-_Trend_Report_Europe

[11] Nova Institute (2023) Bio-based Building Blocks and Polymers Global Capacities, Production and Trends 2022–2027 https://renewable-carbon.eu/publications/product/bio-based-building-blocks-and-polymers-global-capacities-production-and-trends-2022-2027-short-version-pdf/

EU. Approaches to quantifying the amount of pellets entering the environment typically apply a 'loss rate' to the pellet volume handled. Robust empirical evidence is scarce to inform a 'loss rate' at different steps. However, the greater the number of steps at which pellets are handled, the greater the opportunities for loss.

The following loss rates were assumed for calculating the losses occurring at four major steps: production, processing, recycling and logistics. It is estimated that losses happen at a higher rate at processing and recycling installations because of relatively small installations and a large number of steps than at production ones, and at an even higher rate during logistics operations.

- Production: 0.01% - 0.03%
- Processing: 0.02%-0.06%
- Recycling: 0.02%-0.06%
- Logistics: 0.03%-0.12%

These rates account for the major handling steps in production, processing, recycling and logistics phases and do not take account of other handling steps occurring in other phases (e.g. distribution), for which no information is available. These figures are, therefore, at the same time uncertain due to the lack of a standardised methodology to measure pellet losses and scarce data.

Pellet loss calculations were made using these ranges of pellet loss ratios (lower and higher figures) for the four types of operations, namely virgin pellet production, recycling, pellet processing and logistics. These pellet loss ratios are applied to the volume of pellets handled during different steps of the plastic value chain.

Table 41: Pellet losses (tonnes per year) per sector and per size of the companies in 2030

	Micro	Small	Medium	Large	Total
Production	0	0	0	8051 – 24 153	8051 – 24 153
Waste management, including recycling	0	0	0	2743 – 8228	2743 – 8228
Conversion	727 – 2182	2909 – 8727	6644 – 19 930	8284 – 24 852	18 564 – 55 691
Logistics	2801 – 11 203	5334 – 21 334	8372 – 33 488	16 314 – 65 258	32 821 – 131 283
Total	3528 – 13 385	8243 – 30 061	15 015 – 53 418	35 392 – 122 491	62 178 – 219 355

Impact of existing initiatives in reducing pellet losses

The assumptions used for estimating the impact of the voluntary initiatives (OCS certification and RecyClass) and legislation in Member States (France) in terms of reduction of pellet losses in 2030 are the following.

- Production: 90% of the total virgin pellet volume produced (by the members of Plastics Europe) and 5% for the non-Plastics Europe members will be certified compliant against OCS new rules and will be effectively implementing such rules with a success rate ranging from 60% to 80%;
- Recycling: 20% of the total recycled pellet volume will be certified compliant against RecyClass pellet provisions and will be effectively implementing the new provisions with a success rate ranging from 40% to 60%;
- Processing: 30% of the total volume processed will be certified compliant against OCS' new rules and will be effectively implementing such rules with a success rate ranging from 40% to 60%;
- Logistics: 40% of the total volume handled by logistics companies will be SQAS assessed and will be effectively implementing such a scheme with a success rate ranging from 40% to 60%.
- French legislation: It will cover about 85% of the French pellet volume (about 10% of the EU volume), leading to a 60-80% pellet loss reduction in 2030.

Assumptions taken in the calculation of the impacts of certain options

The assumptions used for estimating the costs of the measures for the relevant industry were based on data from the industry and Eurostat and are the following:

- Converters: The average costs for a small, medium and large converting enterprise, were calculated based from the converting industry data. They were based on Belgium and West-European figures. A correction factor (based on the relation between a Belgium and EU average salary) was used. The costs for the micro-enterprises were extrapolated from the three other categories.
- Producers: Large enterprise costs for converters were applied to plastic producers (including virgin and recycled plastics, export and import) as they are generally large companies.
- Logistics: It was also assumed that the structure of the whole transport sector (goods) could be applied on the subsector of transport dealing with pellets. The same assumption was made to the storage providers. The costs for the logistics operators (transport and storage providers, cleaning stations) were based on the basic assumption that the measures needed to be taken by a logistics enterprise are largely similar to a plastic converter enterprise. As an important part of the cost are related to personnel, it was assumed that an enterprise with the same number of persons would occur the same cost structure, and this for the main types: micro-, small, medium and large enterprises. Assumptions per industry (for each enterprise type):
    - storage providers, the same cost as for converters;
    - transport providers, no costs related to equipment and investments, only to personnel, external auditing and miscellaneous. It was assumed that 50% of the micro-enterprises in the transport sector will be subject to additional costs.
    - no additional costs for tank cleaning stations as those dealing with pellets are already complying with SQAS which has similar requirements.

As the industry has already started implementing some of the proposed measures through their voluntary programs, such as OCS CS and RecyClass, some of these costs will already be incurred in the business-as-usual scenario, i.e. under the baseline. For this, the average of the assumptions used under "*Impact of existing initiatives in reducing pellet losses*" were used.

The total cost for enterprises was then calculated based on the volume (tonnes) of pellets handled by enterprise type. For the plastic converters and producers, it was calculated on a per tonne basis, using cost figures for a typical plant for each enterprise type. For the transport and storage providers, it was calculated per enterprise within each enterprise type. The cost calculation was made using ranges (lower and higher figures). Therefore, lower figure of the cost scenario is linked with lower figure of the pellet reduction scenario and higher costs are linked to higher pellet reduction. Therefor one should compare lower figure of a range of one option with the lower figure of a range of another option, (or the higher figure of a range over the different options).

Uncertainties and data gaps

The principal uncertainty comes from the loss rates used for production, recycling, processing, and logistics. There are uncertainties regarding the potential success of existing and upcoming measures on the reduction of pellet loss.

There are data gaps on the structure of the sector (except for converters and producers), as well as on the exact costs and benefits that should be attributed under the different options, leading to some uncertainties. However, this could be solved using the assumptions as explained before.

There are very few data available on the packaging used within the sector, and the impact packaging has on pellet losses.

2 OVERVIEW OF METHODOLOGICAL STEPS

1. The first step was to define the problem for which extensive desk research was conducted, as well as workshops with stakeholders and experts. The objective was to identify the main sources of microplastics and their relative contribution to microplastics present in the environment. While three main sources (pellets production and use, tyre abrasion, and synthetic textiles) were evident from the existing knowledge, more research and consultation led to the addition of three sources in the scope of this initiative: paints, detergent capsules, and geotextiles. These six sources were chosen due to the magnitude of their contribution to microplastic releases in the environment. Overall, these six sources cover up around 90% of the total microplastic emissions in the EU.
2. While this initiative in the end only focusses on pellets, analytical work was first undertaken for all the sources identified. The analytical work on the other sources (paints, tyres, geotextiles, textiles and detergent capsules) is presented in Annex 15 and shows that there is potential to reduce and prevent unintentional microplastic releases from these 5 sources. In line with Better Regulation guidelines, they were not pursued here as the preliminary analysis demonstrated that existing or forthcoming instruments were better suited to targeting those sources, and/or that additional data needs to be collected on cost-effectiveness and on the impacts of alternatives. A major conclusion of this preliminary analysis is the lack of established methodology to estimate the amount of microplastics released of these six product groups.
3. The information collected on pellets was, however, deemed sufficient for action to be taken. Especially, as there is currently no existing EU legislation specifically addressing plastic pellets as a form of pollution occurring along the entire supply chain.
4. While analysing pellets' contribution to microplastic releases, a major problem was identified: current practices for handling pellets lead to losses at each stage in the supply chain, causing adverse environmental and (potential) human health impacts.
5. Deriving from this problem, several problem drivers were identified, namely market failure due to prices not reflecting negative externalities, market failure in the shape of imperfect information, and regulatory failure as existing EU legislation does not address pellets sufficiently.

6. The problem and its drivers led to the overall objective to prevent and reduce pellet losses to the environment that are due to current handling pellet practices at all stages of the supply chain. Three more specific objectives were also set out: reduce pellet losses to a level consistent with the 30% reduction target for microplastic releases by 2030 set out by the EU Zero Pollution Action Plan, improve information on pellet losses, and ensure appropriate mitigation of impacts for SMEs.
7. To achieve these objectives, it was essential to identify policy options that could reduce pellet losses. These options were selected based on available literature and input from stakeholders, either bilateral or in stakeholder workshops, including a workshop organised in December 2022 to specifically address pellets, the related baseline and preferred option. Information provided in response to the Inception Impact Assessment and the Public Consultation was also taken into account along with the findings of a survey carried out between January and February 2023 targeting only SMEs active in the pellet supply chain.
8. The measures within these policy options had previously been selected been selected from a first long list of measures, according to the screening criteria of the Better Regulation Guidelines and in coordination with stakeholders and the Inter-Service Consultation group.
9. Following the assessment of the different options in terms of their environmental, economic and social impacts on different stakeholders and society, these options were compared, and a preferred option was constructed.
10. To calculate the impact for the enterprises, who are dealing with the plastics pellets in the supply chain, data from industry and Eurostat was taken into account.

Annex 5: Competitiveness Check

1 OVERVIEW OF IMPACTS ON COMPETITIVENESS

Aspect of competitiveness	*Magnitude (++, +, 0,, -, -- or n.a.)*	*Reference to description in main IA report or annex*
Costs and prices	-	Sections 6 and 8.2 Annexes 3 and 11
Capacity to innovate	N/A	N/A
International competitiveness	-	Sections 6 and 8.2 Annexes 3 and 11
SME competitiveness	-	Section 8.2.3 Annex 12

2 ASSESSMENT AND EXPLANATION

The turnover of the plastics sector in the EU27 in 2021 was EUR 405 billion. Therefore, the additional estimated **costs** of the preferred option would represent about 0.13% of the EU plastics sector turnover and are considered to be limited. The costs are expected to be greater in the short term but lower in the longer term once the appropriate systems and processes are in place and training undertaken. There will be some cost savings as a result of reduced losses to the environment (as pellets are a raw material). The proposal will encompass all actors in the pellet supply chain creating a level playing field in the EU. Some sectors currently impacted by pellet losses will benefit from the proposal e.g. agriculture, tourism.

The additional costs are likely to have a very minor negative impact on the **international competitiveness** of the EU pellet producers, as their competitors outside the EU will not be subject to the requirements (although logistical operators importing pellets will have to comply within the EU). However, the EU companies will have a first mover advantage if/when other countries adopt similar requirements, e.g. through an international agreement such as the Global Plastic Treaty.

The proposal will make a positive impact on the **capacity to innovate** as different actors of the value chain will develop solutions to minimise pellet spills in order to optimise their costs for controlling pellet losses.

A targeted SME consultation was undertaken to understand the potential impacts of different options for **SMEs including on their competitiveness**. Feedback indicated that the direct economic impacts of all the requirements would be too high to be sustainable for micro and small companies, as well as companies with capacities below 1000t. As a result, the proposal includes lighter requirements for SMEs to mitigate potential impacts by setting less obligations (e.g. no internal assessment) for micro- and small companies and a longer implementation period for medium companies. There is a balance to be sought between the magnitude of cost effects on SMEs, and reducing pellet losses. We believe that the preferred option reaches the appropriate balance, but should the college want to go further, additional lighter requirements (not foreseen in sub-option 2b) are assessed and outlined in Box 4 and Box 5. These might help reduce administrative costs for micro-, small and medium companies, along with carriers transporting pellets, but will increase pellet losses.

Annex 6:
Legislation and actions relevant to reducing pellet losses to the EU environment

1 EU POLICIES

1.1 The REACH restriction on intentionally added microplastics

A REACH restriction dossier has been in preparation since 2018 on intentionally added microplastics, covering also some aspects related to pellets. The Commission published a proposal for a restriction under Annex XVII of REACH. It was adopted on 25 September 2023[12]. The EU-wide restriction covers intentionally added microplastics in multiple applications including agriculture, horticulture, cosmetic products, paints, coatings, detergents, maintenance products, medical and pharmaceutical applications, and rubber infill in artificial sport surfaces. It is estimated that the proposed restriction could result in a reduction in microplastics emissions of about half a million tonnes including infill material over 20 years, at an estimated total cost of up to 19 billion euros.

Pellets are very partially covered by the REACH restriction on microplastics intentionally added to products[13]. The restriction does not prevent the placing on the market of pellets but does foresee lighter measures for so-called 'derogated' uses, meaning uses of microplastics at industrial sites, including plastic pellet sites, where releases can be prevented through risk management measures. These lighter measures are namely an 'instructions for use and disposal' requirement along the supply chain, and a 'reporting' requirement. The latter applies to pellets manufacturers and downstream users[14] and aims to gather information on three aspects:

a) the uses of such microplastics;

b) the generic identity of the polymers used; and

c) an estimate of the quantity of microplastics released to the environment on an annual basis, via a prescribed electronic format.

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[12] Commission Regulation (EU) …/… amending Annex XVII to Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards synthetic polymer microparticles.

[13] European Chemicals Agency, Opinion of the Committee for Risk Assessment and Opinion of the Committee for Socio-economic Analysis on an Annex XV dossier proposing restrictions on intentionally-added microplastics, ECHA/RAC/RES-O-0000006790-71-01/F and ECHA/SEAC/RES-O-0000006901-74-01/F, 2020, p.49 (https://echa.europa.eu/documents/10162/a513b793-dd84-d83a-9c06-e7a11580f366).

[14] In REACH, 'downstream users' are defined as "any natural or legal person established within the Community, other than the manufacturer or the importer, who uses a substance, either on its own or in a mixture, in the course of his industrial or professional activities. A distributor or a consumer is not a downstream user. A re-importer exempted pursuant to Article 2(7)(c) shall be regarded as a downstream user". Concretely, pellet converters, recyclers as well as storing operators who own the pellets would be considered as downstream users under REACH. Transporters are not all downstream users but emissions during transport would also need to be reported by the relevant downstream user. Instead, would not be covered by the reporting obligation: distributors, storing operators who store the pellets for third parties, retailers and consumers. A transitional period of 24 months is set for the entry into force of the reporting requirement.

The reported information on all 'derogated' uses would help identify high releases and prioritise them for further regulatory risk management. However, as they apply to all 'derogated' uses, these lighter measures are generally defined and not specific to each single 'derogated' use. Also, they do not help as such to effectively reduce pellet losses or prevent them (e.g. they are not a requirement on their handling), and the reporting requirement is not based on a methodology to measure pellet losses (it was left to the industry to develop a methodology).

Moreover, where 'instructions for use and disposal' and 'reporting' requirements are proposed, a largely qualitative analysis of expected incremental costs to industry was presented based on the arguments that the effort needed to fulfil these requirements is expected to be limited and that sufficient time is given to the industry to established the efforts needed. In its conclusions, the Committee for Socio-economic Analysis (SEAC) agrees that the costs incurred to provide 'instructions for use and disposal' is likely to be moderate as cost effective communication tools are available, the extent of information required is limited and the transition period give actors sufficient time to smoothly implement the requirements. Instead, for the reporting requirement, the total costs of reporting could be substantial as the number of companies affected is likely to be large. SEAC considers that there are different options to reduce such costs, e.g. by excluding certain actors (small or micro-sized companies) from the requirement or by setting a threshold for microplastics volumes used or released to be reported. However, SEAC cannot draw a firm conclusion on how these different options would compromise the value of information obtained and hence the benefits of reporting in terms of facilitating better risk management. Moreover, SEAC considers that for certain actors in the supply chain, e.g. manufacturers of microplastics, a shorter transition period, i.e. 12 months, seems to be justified.

The Commission received the final ECHA opinion on the restriction proposal on 23 February 2021[15]. Following discussions with Member States, the Commission published its restriction proposal on 30 August 2022, and it was voted in the REACH Committee on 26 April 2023. The proposal was adopted on 25 September by the Commission.

1.2 The Marine Strategy Framework Directive (MSFD)

The Marine Strategy Framework Directive (MSFD) addresses the monitoring and assessment of the impacts of microlitter, including microplastics, in coastal and marine environments in a way that they can be linked to sources[16]. Currently, an update of the first MSFD guidance on monitoring marine litter guidance document is under development in view of harmonised methodologies, including to the monitoring of the presence and distribution of plastic pellets along the coastline. However, this work does not include specific requirements concerning the prevention or reduction of pellet losses at the source.

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[15] European Chemicals Agency, Opinion of the Committee for Risk Assessment and Opinion of the Committee for Socio-economic Analysis on an Annex XV dossier proposing restrictions on intentionally-added microplastics, ECHA/RAC/RES-O-0000006790-71-01/F and ECHA/SEAC/RES-O-0000006901-74-01/F, 2020, p.49 (https://echa.europa.eu/documents/10162/a513b793-dd84-d83a-9c06-e7a11580f366).

[16] "…micro-litter shall be monitored in the surface layer of the water column and in the seabed sediment and may additionally be monitored on the coastline. Micro-litter shall be monitored in a manner that can be related to point-sources for inputs (such as harbours, marinas, waste-water treatment plants, storm-water effluents), where feasible."

1.3 The Urban Wastewater Treatment Directive and its revision

The Urban Wastewater Treatment Directive (UWWT Directive) aims to protect the water environment from the adverse effects of discharges of urban wastewater and from certain industrial discharges.

In October 2022, the Commission adopted a proposal for a revised UWWT Directive which contains provisions on microplastics (including pellets). The revised Directive proposes to monitor microplastics in UWWT plants (including in sludge). It also contains new requirements on storm water and urban runoff management (see Article 5 and Annex 15), which will have an impact on microplastics.

Microplastics found in domestic wastewaters originate from the washing of textile, tyre abrasion on the roads, detergent capsules, and also from the bad handling of plastic pellets during transport when spilled pellets can reach urban wastewater through urban runoff entering combined sewer systems.[17] Heavy rains may lead to overflows which bypass the treatment facilities and result in releases of pellets and other (micro)plastics to the environment. If properly implemented, the revised UWWTD is expected to cut microplastics emissions by 9% from stormwater overflows by 2040. However, this estimate excludes the amount of microplastics coming back to environment with the sewage sludge.

Most large pellet producers are connected to industrial wastewater treatment plants but some small recyclers and processors are connected to UWWT plants[18]. If a spill happens within these connected facilities, they may enter the urban wastewater collecting system and reach Urban Wastewater Treatment plants.

Microplastics, including pellets, would appear to be relatively well captured in urban wastewater treatment plants,[19] where it is retained in sludge. The UWWTD revision also includes additional treatment requirements for larger facilities[20] meaning more microplastics, including pellets, will be captured in sludge in the future. The most common use of sludge is to spread it on agriculture so about half of microplastics captured in urban wastewater treatment facilities will be released into the environment. Sludge, however, also contains valuable nutrients which are beneficial for agriculture, so the revised UWWTD will seek to avoid the pollution of sludge, notably by proposing to track and trace industry wastewater that is not easily treatable in conventional treatment plants (Art. 14 and Art. 20).

Although we do not have exact estimates, only a minor part of plastic pellets would seem to be captured by the urban sewage system and only when connected to urban wastewater treatment. This revision would therefore have a limited impact on the overall reduction pellet losses to the environment.

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[17] Hann, S., Sherrington, C., Jamieson, O. et al., *Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products*, Eunomia report for the Directorate-General for Environment, 2018.

[18] As informed by recyclers

[19] According to the UWWTD impact assessment, 80.5% of microplastics are captured after primary treatment, 97.5% after secondary treatment and 99.2% after tertiary treatment.

[20] The revision of the UWWTD introduces mandatory tertiary treatments for all larger facilities treating a load equal to or greater than 100 000 p.e. (population equivalent). All agglomerations with a p.e. of 1.000 or more (compared to 2.000 p.e. and more in the existing Directive), are obliged to proceed to two treatments.

1.4 The Sewage Sludge Directive

The Sewage Sludge Directive (SSD) covers the use of sewage sludge in agriculture, while preventing harmful effects on soil, waters, vegetation, animals, and humans. The Directive prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. It also requires that sludge is used in such a way that plants' nutrient requirements are satisfied and that the soil and surface and groundwater quality is not impaired. Microplastics are not addressed in the current Directive.

Recent research from the Norwegian Water Institute estimated that "between 110 000 and 730 000 tonnes of microplastics are transferred every year to agricultural soils in Europe and North America".[21,22]

The Sewage Sludge Directive is currently under evaluation. During this evaluation, the concept of source control, i.e. targeting substances such as microplastics and micropollutants at source, was widely supported by stakeholders to improve circularity in the wastewater treatment sector. Indeed, if sludge and/or water is reused, stakeholders highlighted that pollution must be tracked and prevented at source. It is not yet clear however which measures will be proposed in its future revision, and whether these would target microplastic pollution.

Other water legislation

The recast of the Drinking Water Directive (DWD), the update of the Groundwater Directive (GWD) and the Environmental Quality Standards Directive (EQSD) all include provisions related to downstream microplastics monitoring. Methodologies to monitor microplastics under the DWD will be further developed, to the extent possible, for use in groundwater, surface waters and coastal waters. Once a harmonised monitoring methodology is in place, microplastics may be included in the surface and groundwater watch lists and may be monitored. Subsequently, harmonised monitoring data on microplastics will be collected during a period of at least 2 years resulting in quality standards for microplastics in surface and groundwater. As for the drinking water, the Commission should adopt (by delegated acts) a methodology to measure microplastics by 12 January 2024 with a view to including them on the watch list. In addition, the Commission will submit, no later than 12 January 2029, a report on the potential threat to sources of water intended for human consumption from microplastics, pharmaceuticals and, if necessary, other contaminants of emerging concern. The report will also address the potential associated health risks.

1.5 The Industrial Emissions Directive

The Industrial Emissions Directive (IED)[23] regulating prevention and control of pollution arising from industrial activities in large industrial installations is only partially suited to address pellet losses as a form of pollution occurring along the entire supply chain. While activities like the production of polymeric materials on an industrial scale fall under the scope of the IED, other activities like the conversion, storage or transport of pellets, usually operated by small and medium enterprises, are not

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[21] Hurley, R., & Nizzetto, L., 'Fate and occurrence of micro(nano)plastics in soils: Knowledge gaps and possible risks', *Current Opinion in Environmental Science & Health*, Vol. 1, 2018, pp. 6-11, Elsevier BV.

[22] Water Briefing. (2016, November 7). Sewage sludge: new research warns over microplastics in soil.

[23] Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) (recast)

covered. Moreover, the BAT Reference Document (BREF) for the production of polymers was adopted in 2007 and does not address the specific issue of pellet losses.

1.6 The Waste Framework Directive

The Waste Framework Directive (WFD)[24] lays down basic waste management principles and imposes general obligations to Member States to take measures to prevent waste generation. As for industrial production and manufacturing those measures shall, at least, contribute to reducing waste generation, considering the best available techniques adopted under the IED. Pellets may become waste as a substance or object which the holder discards intentionally or unintentionally.

Member States shall establish waste prevention programmes setting out waste prevention measures. Examples of possible measures to be adopted by Member States addressing industrial production and distribution are listed in the Directive and include the provision of information on waste prevention techniques intending to facilitate the implementation of best available techniques by industry, the organisation of training of competent authorities as regards the insertion of waste prevention requirements in permits under the WFD and the IED, the inclusion of measures to prevent waste production at installations not falling under the IED, awareness campaigns or the provision of financial, decision making or other support to businesses, especially small and medium-sized enterprises, the use of voluntary agreements, or sectoral negotiations in order that the relevant businesses or industrial sectors set their waste prevention plans and the promotion of creditable environmental management systems.

According to Article 29 (5) of the WFD, the Commission shall adopt guidelines to assist Member States in preparing their programmes and preventive measures.

The generic provisions mentioned above have not resulted in any significant reduction of pellet losses and there is however no specific action or measure included in the WFD focussing on pellets.

2 ACTIONS IN MEMBER STATES

Several EU27 member states have been conducting research on microplastic (including pellets) emissions and some of them have even implemented measures to tackle pellet loss as presented in Table 42.

For example, France and Austria have taken legislative measures to curb this pollution.

The French legislation[25] covers businesses making and handling pellets in quantities higher than 5 tonnes including logistic platforms but not transporters. The threshold has been reduced from what initially proposed i.e. 10 tonnes following public consultation. Businesses are subject to equipment and procedural obligations to prevent the loss and leakage of pellets, and are required to be regularly audited by independent and accredited certification bodies[26]. Obligations remain of a relatively

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[24] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705).

[25] Décret no 2021-461 du 16 avril 2021 relatif à la prévention des pertes de granulés de plastiques industriels dans l'environnement [Decree n. 2021-461 of 16 April 2021 related to the prevention of the leakage of industrial plastic pellets into the environment], Journal official "Lois et Décrets" no. 0092 du 18 avril 2021 [JORF] [Official journal "Laws and Decrees" no. 0092 of 18 April 2021], 18 April 2021, Fr.

[26] Décret no 2021-461 du 16 avril 2021 relatif à la prévention des pertes de granulés de plastiques industriels dans l'environnement [Decree n. 2021-461 of 16 April 2021 related to the prevention of the leakage of industrial plastic

generic nature. For instance, a business must identify areas where pellets are more likely to spill, check that the packaging used is designed to minimise the risk of spills and train and raise awareness among staff. As a unique transparency measure, the company must make the summary of the auditing report available on its website. The Decree entered into force on January 1, 2022 for new sites, while for existing sites, it will enter into force in 2023, at the same time as equipment obligations.

The Austrian government has set a threshold for the emissions of filterable substances (pellets are considered filterable substances) to the environment. [27] However, the emission level (30mg/L) allowed is significant since companies can release up to 94.5 tonnes of pellets annually into the environment.[28] This legislation does not address pellets directly but rather "filterable substances", to which pellets belong. In light of the high volume of pellets losses allowed, it seems that the current Austrian legislation on wastewater emissions is not sufficient to reduce pellet loss.

In 2021, in response to a clear call for sufficiently reliable and comparable data on pellets at the European level from OSPAR and the European Task Group for Marine Litter, the Netherlands carried out a pilot monitoring project[29] showing that significant amounts of pellets and mesoplastics are present on Dutch beaches[30]. In view of these encouraging first results, they will continue the monitoring in coming years. Apart from this monitoring activity, there is no Dutch scheme or process to tackle pellet losses. Denmark launched a monitoring program, as a part of the Danish Marine Strategy (2018-2024), including monitoring of marine litter, analyses of microplastic in sediments, as well as analyses of macro and microplastics in the stomachs of two fish species[31].

In 2022, the Flemish Authorities consulted with stakeholders on techniques and measures to prevent and reduce plastic losses and which Best Available Techniques (BAT) to select. On the basis of this consultation, they hope to produce recommendations for Flemish environmental legislation (general binding rules and specific environmental permit conditions). In a recent meeting with the Commission, an OVAM representative reported that "there are pellet losses around the Port of Antwerp". In recognition of this, the Port of Antwerp has been running the Antwerp Zero Pellet Loss Platform since 2017, to optimize the implementation of the European plastic industry voluntary programme called 'OCS' (see under industry initiatives), in the port of Antwerp.

Spain's actions are limited to promoting the implementation of the recently launched European plastic industry's voluntary certification scheme called 'OCS certification scheme' (see under industry initiatives). Other countries are similarly relying on the industry efforts in this field.

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pellets into the environment], Journal official "Lois et Décrets" no. 0092 du 18 avril 2021 [JORF] [Official journal "Laws and Decrees" no. 0092 of 18 April 2021], 18 April 2021, Fr.

[27] Lechner, A. and Ramler, D., 'The Discharge Of Certain Amounts Of Industrial Microplastic From A Production Plant Into The River Danube Is Permitted By The Austrian Legislation', *Environmental Pollution*, Vol. 200, 2015, pp. 159-160. Elsevier BV.

[28] Lechner, Aaron, and David Ramler. "The Discharge Of Certain Amounts Of Industrial Microplastic From A Production Plant Into The River Danube Is Permitted By The Austrian Legislation". Environmental Pollution, vol 200, 2015, pp. 159-160. Elsevier BV, doi:10.1016/j.envpol.2015.02.019. Accessed 28 Mar 2022.

[29] Dutch Government, Policy Programme on (micro) plastics – European Marine Strategy Framework Directive, 2020 (https://g20mpl.org/partners/netherlands).

[30] Dutch Ministry of Infrastructure and Water Management, 'Monitoring of pellets and mesoplastic fragments on Dutch beaches in 2021: a pilot study', 2022 (https://puc.overheid.nl/rijkswaterstaat/doc/PUC_721767_31/1/)

[31] Ministry of Environment and Food of Denmark; Microplastics: Occurrence, effects and sources of releases to the environment in Denmark, Environmental project No. 1793, 2015

In Sweden, the 2020 guidelines on measures to minimise microplastic emissions from manufacturing and management of plastics are still used.[32] In order to promote upcoming standards and certification schemes to reduce the loss of plastic pellets throughout the entire plastic supply chain, there are plans to revise the Swedish guidelines to make them more comprehensive and include more actors along the plastic pellet value chain.

Table 42: Selected actions in Member States

Countries	Measure
Austria	Threshold for the emissions of filterable substances (including pellets)
Belgium (Flanders)	Environmental permit system to be put in place/ Best Available Techniques Examining the option of an environmental management system with possible certification
Denmark	Monitoring Waiting for OCS certification scheme implementation and Commission's proposal
France	Law adopted providing minimum obligations to prevent pellet losses for all actors in the supply chain along with mandatory external auditing
Netherlands	Research program on mitigation measures to avoid microplastic emissions, including from pellets, and monitoring Waiting for OCS certification scheme implementation
Spain	Promoting OCS certification scheme implementation
Sweden	Revision of current guidelines to make them more comprehensive and include more actors across the supply chain.

3 INTERNATIONAL ACTIONS ON PELLETS

Some countries, outside of the EU, have also started taking actions against pellet losses, as captured in Table 43.

In 2021, the British Standards Institution published the Publicly Available Specification (PAS) PAS 510:2021[33]. This PAS is for use by any organisation of any size in any part of the supply chain that handles pellets, including raw material manufacturers, distributors, storage facilities, recyclers, transporters, and plastics processors. It builds on the groundwork laid by the industry-led Operation Clean Sweep® (OCS) programme (see under industry initiatives) by creating a standardised and consistent approach to risk management and the containment of pellets in order to prevent losses to the environment throughout the plastic supply chain[34]. The PAS may be considered for further

[32] Swedish Government, 'Microplastics', 2022 (https://www.naturvardsverket.se/amnesomraden/plast/om-plast/mikroplast/).

[33] Plastic pellets, flakes and powders. Handling and management throughout the supply chain to prevent their leakage to the environment. Specification - PAS 510:2021101

[34] The PAS provides requirements in the following areas: a) Organizational responsibilities; b) Leadership and commitment; c) Competence, training and awareness; d) Risk assessment of pellet loss to the environment; e) Operational controls, i.e. prevention, containment and clean-up, procurement and suppliers; f) Internal and external communication; g) Performance evaluation, i.e. monitoring and documentation, auditing and verification of

development as a British standard or constitute part of the UK input into the development of a European or International standard on pellets.

The USA has enforced the "Break Free from Plastic Pollution Act of 2021",[35] prohibiting the emissions of pellets to wastewater, spills and runoff from plastics production facilities. Three years from when the senate passed the Bill (on 26 March 2021), Best Available Technology Economically Achievable (BAT) and New Source Performance Standards (NSPS) regarding pollution prevention will have to be available. Under the current regime, pellet manufacturers must obtain a National Pollutant Discharge Elimination System (NPDES) permit to produce pellets. The permit comes with a set of Best Management Practices (BMPs) that aim to prevent pellet losses to the environment.[36]

Prior to this national Bill, the Assembly Bill (AB) 258, which became effective in 2008, added Chapter 5.2 to Division 7 of the California Water Code, section 13367, entitled "Preproduction Plastic Debris Program."[37] It enables the Regional and State Water Board to perform compliance inspections on pellets production, transportation and handling, enforcing action, in particular, to improve storm water discharges. They also facilitate multi-stakeholders actions, such as meetings between pellets producers and environmental action groups.

Table 43: Selected international actions

Countries	Measure
UK	New PAS 510:2021 technical specifications provides requirements for the handling and managing of plastic pellets, flakes and powders throughout the supply chain to prevent spills, leaks and losses to the environment.
USA	The "Break Free from Plastic Pollution Act of 2021",[38] prohibiting the emissions of pellets to wastewater, spills and runoff from plastics production facilities. Any plastic sector company needs to get a National Pollutant Discharge Elimination System (NPDES) permit to produce pellets. The permit comes with a set of Best Management Practices (BMPs) that aim to prevent pellet losses to the environment.[39]
USA (California)	The California Water Code, section 13367, entitled "Preproduction Plastic Debris Program."[40] enables the Regional and State Water Board to perform compliance inspections on pellets production sites, transportation vehicles and during handling operations.

conformity; h) Improvement, i.e. internal and external non-conformity and corrective action, and continual improvement.

35 US Congress, Break Free from Plastic Pollution Act of 2021, H.R. 2238, 2021 (https://www.congress.gov/bill/117th-congress/house-bill/2238/text).

36 US Environmental Protection Agency, 'Industrial Stormwater fact sheet: Sector Y: Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries', 2006 (https://www3.epa.gov/npdes/pubs/sector_y_rubberplastic.pdf).

37 California Environmental Protection Agency, 'Preproduction Plastic Debris Program', 2008 (https://www.waterboards.ca.gov/water_issues/programs/stormwater/plasticdebris.shtml).

38 US Congress, Break Free from Plastic Pollution Act of 2021, H.R. 2238, 2021 (https://www.congress.gov/bill/117th-congress/house-bill/2238/text).

39 US Environmental Protection Agency, 'Industrial Stormwater fact sheet: Sector Y: Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries', 2006 (https://www3.epa.gov/npdes/pubs/sector_y_rubberplastic.pdf).

40 California Environmental Protection Agency, 'Preproduction Plastic Debris Program', 2008 (https://www.waterboards.ca.gov/water_issues/programs/stormwater/plasticdebris.shtml).

4 MULTILATERAL ACTIONS

Multilateral action targeting pellets is so far limited to the **OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic**. This Convention is an international legal instrument bringing together 16 signatories to coordinate the protection of the North-East Atlantic marine environment. In 2021, signatories adopted the non-binding Recommendation 2021/06[41] to reduce the loss of plastic pellets in the marine environment. The recommendation invites contracting parties to promote pellet loss prevention standards and certification schemes according to a specific hierarchy of measures i.e. prevention, mitigation, cleaning and reporting. It provides minimum requirements for certification schemes to de developed. Detailed guidelines were also approved. This impact assessment builds on this non-binding recommendation, as explained in the relevant parts.

In particular, the Recommendation contains the following guidance:

Pellet handling standards:

- Documentation of an Organisation's Responsibilities identifying which are the operations during which spills can and cannot occur;
- Management should demonstrate leadership to prevent pellet losses;
- Training and awareness-raising of employees;
- Risk assessment of pellet losses to be done by all members of the supply chain;
- Operational controls are to be established by the business to prevent spills (by avoiding unnecessary handling and having best handling practices in place), mitigate and contain spills whenever they occur, and clean up spills after they have occurred;
- Businesses should implement procurement policies relating to pellet handling;
- Implemented measures should be communicated by businesses;
- Businesses' performances regarding pellet loss prevention measures should be evaluated regularly; and
- Businesses should improve their practices whenever they are non-conform.

A pellet certification scheme:

- It should be international to ensure a level playing field for all businesses;
- A database should be created to form a public Register storing all data related to the scheme;
- The management and governance of the scheme should be developed and managed by an independent organisation;
- To be certified, any site must have been audited first and passed an appropriate standard;
- Joining the scheme should be simple;
- The auditing should be regular and performed by an independent accredited auditor;
- The certification body should be independent and well trained in the standard they are auditing; and

[41] www.ospar.org/convention/strategy

- The scheme should acknowledge that a company has been accepted or that an update has occurred.

The first full implementation report is due in January 2025. However, an interim report on the progress made will be published in 2024. OSPAR shared a preliminary interim report in February 2023 and the actions reported by the Member States that are parties to the OSPAR Convention are presented in Table 42.

In March 2022, the second session of the 5th **United National Environment Assembly** unanimously adopted resolution 14: End Plastic Pollution: towards an international legally binding instrument42 (hereafter referred to as the resolution). The preamble to the resolution highlights that "*plastic pollution includes microplastics*". This inclusion indicates that that intergovernmental negotiating committee (INC) will have to consider how to address microplastics in a forthcoming global agreement.

In May 2019, the Conference of the Parties to the **Basel Convention** adopted a decision by which it amended Annexes II, VIII and IX of the Convention in relation to plastic waste. A Plastic Waste Partnership was created with the aim, among other things, to significantly reduce and eliminate waste discharge of plastics and microplastics in the environment.

The **OECD** Council Recommendation on Water calls for Adherents to prevent, reduce and manage water pollution from all sources, while paying attention to pollutants of emerging concern, such as microplastics.

In the **International Maritime Organization** (IMO), a Correspondence Group on Marine Plastic Litter from Ships looked at measures that could be relevant in reducing the environmental risks associated with the maritime transport of plastic pellets. While three primary measures including packaging were identified as particularly relevant (and a voluntary circular to this effect was drafted as a guidance document), the Group was not in a position to conclude on the most appropriate instrument for mandatory measures[43]. The Group noted that experience gained from the implementation of the voluntary measures could be useful in the further consideration of the most appropriate instrument for mandatory measures.

A similar international initiative is ongoing on containers lost at sea, and discussions are held on the possibility of making the information on containers lost at sea available publicly (to date, sufficient information is reported only to insurance companies). If retained, this measure would allow for a better understanding of the scale and magnitude of pellets lost at sea and would facilitate liability identification and compensation arrangements in line with the polluter pays principle.

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[42] United Nations Environment Assembly, Resolution – End plastic pollution: towards an international legally binding instrument, UNEP/EA.5/Res.14, 02.03.2022.

[43] The three primary measures identified as relevant are: Packaging provisions for plastic pellets carried at sea; Provisions for notifying the carrier so that containers containing plastic pellets can be identified; Stowage provisions for freight containers containing plastic pellets. Among the options for mandatory measures, the Group considered the three following options/instruments: Assignment of an individual UN Number (class 9) for plastic pellets transported at sea in freight containers (UN Number); Amendment to Appendix I of MARPOL Annex III that would recognize plastic pellets as a "harmful substance" (Harmful substance); A new chapter to MARPOL Annex III that would prescribe requirements for the transport of plastic pellets in freight containers without classifying the cargo as a harmful substance/dangerous goods.

5 VOLUNTARY ACTIONS ON PELLETS

5.1 Industry actions

The problem of pellet losses has been known about since the 1980s with the US Environmental Protection Agency (EPA) and the Center for Marine Conservation (now known as the Ocean Conservancy) "detecting plastic pellets in US waterways from the Atlantic to the Pacific"[44]. In 1986, SPI (the US Plastics Industry Trade Association, now known as the Plastics Industry Association) established the Resin Pellet Task Force to "educate the plastics industry [….] about the negative consequences of plastic pellets in the marine environment". In 1991 the industry-led Operation Clean Sweep (OCS) initiative was created by SPI, with companies voluntarily signing a pledge to work towards zero plastic pellet losses.

Since 2015, the European plastics manufacturing industry has also progressively adopted the international Operation Clean Sweep® (OCS) programme as a voluntary free pledge.[45] Under this programme, each company making or handling pellets recognises the importance of making zero pellet losses and 1) improves worksite set-up to prevent and address spills; 2) creates and publish internal procedures to achieve zero pellet loss; 3) provides employee training and accountability for spill prevention, containment, clean-up and disposal; 4) audits performance regularly; 5) complies with all applicable local and national regulations governing industrial pellet containment; 6) encourages partners to pursue the same objectives. Recommendations on how to deliver on each of these six actions are given in the form of a manual. The Operation Clean Sweep® (OCS) manual contains in particular the following guidelines to help plastics industry operations managers reduce the loss of pellets to the environment:

Under 'Work site set-up':

- Pave loading/unloading areas where unavoidable spills occur to facilitate clean-up
- For clean-up in gravel yards, consider fitting vacuums with screen or mesh on intake hoses to collect pellets without disturbing gravel
- Provide catch trays for use at all car/truck unloading valves
- Use bulk-handling equipment that is designed to minimise pellet leakage
- Install central vacuum systems where practical
- Install connecting hoses equipped with valves that will close automatically when the connection is broken
- Properly empty and seal bulk containers (rail or truck) after unloading
- Assure proper handling when storing and removing waste pellets
- Seal expansion joints in concrete floors with flexible material to avoid pellet accumulation in hard to clean spaces
- Conduct routine inspections and maintenance of equipment used to capture and contain pellets
- Install zero loss containment systems wherever necessary to prevent pellets from escaping plant boundaries
- Place screening in all storm drains
- Install baffles, skirts and booms in containment ditches or ponds

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[44] Document Display | NEPIS | US EPA; Plastics Industry Association (2016) Operation Clean Sweep Celebrates 25 Years, available at https://www.plasticsindustry.org/article/operation-clean-sweep-celebrates-25-years

[45] https://www.opcleansweep.eu/

- Finally, ensure that employees have ready access to: Brooms, dustpans, rakes, etc., Heavy-duty shop vacuums for inside use, Portable shop vacuums for outside use, Catch trays or traps, Wide-mouth sample collection jars or poly-bags, Tape for repairing bag or box damage, Scrap pellet containers, Procedures you expect them to undertake and checklists to assist in follow-through, Forklift clean-up kit.

Then, under 'Prevention, Containment & Clean-up Procedures', best practices are provided for each handling step, namely: Cleaning Empty Tank Railcars and Trucks; Top Loading; Sealing Loading Railcars/Trucks; Storing at Intermediate Sites; Valve Opening; Completing Unloading; Sampling; Sealing Valves; Sampling from unloading tubes; Sampling from top hatches; Selecting Packaging Materials; Bags: Filling and Handling; Bags: Emptying and Disposal; Octabins.

According to the industry, preventive measures taken separately have estimated pellet loss prevention efficiency ranging from 59% to 97%[46], while mitigation measures taken separately have estimated pellet loss prevention efficiency ranging from 81% to 95%. These measures must not be used alone but in unison to achieve a satisfactory reduction of losses to the environment.

While best practices measures are generally well understood, they have not been comprehensively implemented. As of April 2023, 2548 companies have committed to OCS[47]. This figure includes all PlasticsEurope's members (adherence to OCS is mandatory for the members of this association) but only a very small number of converters and transporters. Regarding converters, only 2% of all EuPC's members have committed to OCS (1,000 converters out of a total of close to 50,000). Regarding transporters, some 500 transport companies are OCS signatories. As no precise reporting has been made available within OCS, it is not possible to say whether those who have committed have also effectively or fully implemented the programme, with some evidence showing the opposite. Both acute and chronic pellet incidents have been reported to continue over the last years, including at sites that are OCS signatories[48].

Recognising the low take-up of OCS by the industry and the increasing rate of pellet losses, European plastic manufacturers (PlasticsEurope) and converters (EuPC) announced plans in 2019 to go beyond the OCS programme and develop a voluntary certification scheme building on OCS, including requirements, third-party, independent auditing, certification and some level of transparency (all aspects not foreseen under the current OCS programme). In January 2023, the new scheme was officially launched by its promoters based on the preparatory work carried out by a Supervisory Board gathering producers, converters, representatives of some Member States (Scotland, Germany and Spain), one NGO (Fauna & Flora International), some certification bodies (Aenor and Tuv-Nord) as well as one European Institution (the European Parliament). Representatives of the European Commission, the European Chemical Transport Association (ECTA) and Cefic took part in the discussions as observers.

According to the scheme owners, OCS CS is aimed at "controlling and documenting compliance of companies throughout the entire supply chain with requirements aiming for a minimisation of pellet losses across the entire plastic supply chain. It will also support the effective, harmonized and

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[46] Confidential data provided by EUPC from their documents used to setup the OCS certification scheme.le

[47] Idem

[48] Regarding chronic pellet losses in the Netherlands, Belgium and Spain, see https://www.plasticsoupfoundation.org/wp-content/uploads/2022/03/Westerschelde-plastic-nurdles-versie-definitief-21-11-2021-2.pdf; https://surfrider.eu/en/learn/news/ecaussinnes-belgium-surfrider-foundation-tackles-industrial-plastic-granules-1211028228325.html; https://goodkarmaprojects.org/2020/11/20/new-report-out-exposes-alarming-impacts-of-plastic-pellets-across-europe/?lang=en.

quantifiable implementation of the OCS programme". Companies will be invited to comply with requirements from the following categories:

- Commit to making zero loss of pellets, flakes, and powder a priority;
- Improve worksite set to prevent and address spills, meaning site risk assessments;
- Create and publish internal procedures to achieve zero pellet loss goals meaning documented procedures, including, for instance, description of roles and responsibilities, but also recording, investigation and follow-up of incidents and effectiveness of procedures, equipment and instructions in place;
- Provide employee training, including theory and practical hands-on exercises and accountability for spill prevention, containment, clean-up and disposal;
- Audit performance regularly, meaning internal audits;
- Comply with all applicable local and national regulations governing pellet containment; and
- Encourage partners to pursue the same objectives to be monitored, for instance, via the % of contracts containing an OCS clause.

Compliance will be verified at site level by third-party, independent auditors. Once successfully audited, companies will be certified compliant and will have the name of the company and the site location listed in a public register. The certification will be valid for 3 years after the date of the first audit, subject to an annual control audit. First audits were foreseen as of April 2023.

5.2 NGO activities

Several environmental non-governmental organisations (NGOs), such as Fidra, Fauna and Flora International (FFI), SOS Mal de Seine, are also working to reduce pellet losses. These organisations have implemented monitoring programs and engaged with authorities and the industry to promote good practices when handling pellets. Fidra has been working with the plastics industry since 2012 to raise awareness and collaborates with trade associations, decision-makers and regulators to identify solutions that will build upon Operation Clean Sweep® (OCS). FFI has engaged with the plastics industry and with regulators in the UK and across Europe to promote wider uptake and implementation of OCS since 2012 and has encouraged the introduction of annual compliance audits and open reporting that feed into yearly OCS membership renewal (rather than automatic membership for life) to enable all stakeholders to see which companies have fully implemented best management practices for preventing pellet loss at their sites. SOS Mal de Seine is in contact with the French Ministry of Environment and participates in raising awareness around plastic pellet losses. Several other NGOs are also actively involved in promoting awareness and regulatory action at the European level. Since 2018, NGO As You Sow has challenged seven of the largest pellets manufacturers to report any pellet spills happening in their facilities[49]. The companies agreed to do so; however, public reporting has not been done yet[50].

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[49] As You Sow, 'Plastic Pellet Pollution', 2021 (https://www.asyousow.org/our-work/waste/plastic-pellets).

[50] Evidence gathered by the NGOs include:
Dutch Ministry of Infrastructure and Water Management, 'Monitoring of pellets and mesoplastic fragments on Dutch beaches in 2021: a pilot study', 2022 (https://puc.overheid.nl/rijkswaterstaat/doc/PUC_721767_31/1/);
Rethink Plastic Alliance, Surfrider Foundation Europe, & Break Free from Plastic, 'Plastic Giants polluting through the backdoor', 2020 (https://rethinkplasticalliance.eu/wp-content/uploads/2020/12/bffp_rpa_pellets_polluting_through_the_backdoor.pdf);
Greenpeace, 'Inquinamento Silenzioso – Chi contamina le coste pugliesi con i granuli di plastica?' [Silent Pollution – Who is contaminating Puglia's coastline with plastic pellets?], 2022 (https://www.greenpeace.org/static/planet4-italy-stateless/2022/07/904ad868-inquinamento-silenzioso.pdf), It;

Table 44: Selected Voluntary initiatives (Industry and NGO)

Name	Details
Surfrider	Field actions on the presence of pellets on beaches, called "pellet hunt"
Rethink plastic alliance	Microplastics
Seas at Risk	Microplastics
Operation Clean Sweep (OCS)	Awareness raising, promoting best practices and providing guidance and tools to implement pellet loss prevention measures. https://www.opcleansweep.eu/. Since 2023, mandatory certification for members of EU trade association Plastics Europe.
SQAS	Alternative system to the OCS for transporters, the section on pellets is still under development (www.sqas.org)
RecyClass	Certification for recyclers, the section on pellets is still under development (www.recyclass.eu).

KIMO, 'Plastic pellets spill pollutes Danish, Norwegian, Swedish coastlines', 2020 (https://www.kimointernational.org/news/plastic-pellets-spill-pollutes-danish-norwegian-swedish-coastlines/);
Legambiente & Italian National Agency for New Technologies, Energy and Sustainable Economic Development, 'First preliminary study on microplastic within Italian lakes', 2016 (https://www.legambiente.it/sites/default/files/docs/microplastic_in_italian_lakes_legambiente_2016.pdf);
Italian National Agency for New Technologies, Energy and Sustainable Economic Development, 'Environment: ENEA in the field for the microplastics emergency in Italian lakes', 2022 (https://www.enea.it/en/news-enea/news/environment-enea-in-the-field-for-the-microplastics-emergency-in-italian-lakes);
SOS Mal de Seine, 'Granulés plastiques industriels sur le littoral français', 2011 (http://maldeseine.free.fr/documents%20granules/RAPPORT_version_WEB.htm);
Mani, T., et al., 'Repeated detection of polystyrene microbeads in the Lower Rhine River', Environmental Pollution, Vol. 245, 2019, pp. 634-641, Elsevier BV.

Annex 7:
Microplastics and pellets in the environment

The following section captures the current state of play of research regarding microplastics. It looks at the definition of microplastics, the impacts on health, the environment and climate, and the difficulties related to its monitoring. Most of these impacts are related to microplastics in general, and the impacts of pellets losses to the environment are largely similar. We would generally expect that the adverse impacts of pellets will be proportional to their part in the total microplastic emissions.

1 WHAT ARE MICROPLASTICS?

Plastics are materials prepared from (semi-)synthetic polymers such as polyethylene, polyvinylchloride (PVC), polyethylene terephthalate (PET), nylon, rayon and cellulose nitrate that are generally treated with chemical additives to transform them into plastic products.

Microplastics are plastic particles measuring less than 5 mm and include sub-micrometre particles called 'nanoplastics'.

While there is no legally binding definition of microplastics, there is a common understanding on their general characteristics:[51]

- synthetic materials with a high polymer content,
- solid particles,
- smaller than 5 mm, and
- not degradable.

The REACH restriction[52] for intentionally added microplastics, defines microplastics as "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) a length of 0.3µm ≤ x ≤ 15mm and length to diameter ratio of >3. " This definition excludes polymers with a solubility > 2 g/L. The size definition of microplastics was discussed at the first international research workshop on the occurrence, effects and fate of microplastic marine debris in 2008, hosted by NOAA.53 The participants adopted a pragmatic definition, suggesting an upper size limit of 5 mm. This was based on the premise that it would include a wide range of tiny particles that could readily be ingested by biota and such particles that might be expected to present a different kind of threat than larger plastic items such as entanglement. The minimum size of microplastics is most often defined as 1 µm as this can be verified by Raman microscopy, but due to methodological constraints of sampling or analysis limitations, different operational lower size limits, e.g., 10, 100, or 300 µm, are often used.

In Europe, approximately 80 % of all plastic raw materials produced are in the form of round to oval granules of approximately 2 mm to 5 mm in diameter.[54] A relevant part of the remaining 20% is even

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[51] Leslie, H.A., 'Review of microplastics in cosmetics: Scientific background on a potential source of plastic particulate marine litter to support decision-making', *V.U. Institute for Environmental Studies*, 2014.

[52] EUR-Lex - 32023R2055 - EN - EUR-Lex (europa.eu)

[53] Arthur, C., Baker, J. and Bamford, H. (eds), 'Proceedings of the International Research Workshop on the Occurrence, Effects, and Fate of Microplastics Marine Debris', NOAA Marine Debris Program, 2008 (https://marinedebris.noaa.gov/proceedings-international-research-workshop-microplastic-marine-debris).

[54] PlasticsEurope, 'PlasticsEurope Operation Clean Sweep® Report 2017', 2017 (https://www.opcleansweep.eu/application/files/8316/3456/6233/PlasticsEurope_OCS_progress_report-2017.pdf).

smaller than 2mm, such as powders, and a minor part can be slightly taller. It is common sense to tackle all these pellets together. This will equally avoid any action of the industry to make pellets slightly taller than 5mm in order to escape possible legislation. Figures from literature often refer to "pellets", irrespective of their dimension and shape.

1.1 Methodological challenges: lack of standardisation and reliable data

Although the number of publications on microplastics has increased rapidly in recent years, a standardised procedure for identifying/quantifying microplastics is still lacking, even though a first standard describing "Principles for the analysis of microplastics present in the environment" (ISO 24187:2023)[55] was recently released. Investigations are generally conducted using different methods, differing particle size ranges and expressed in different units that cannot be easily converted, making it challenging to compare results across studies resulting in largely incomparable data between studies. In a 2019 article, 40 bulk sampling and analysis methods for microplastics were studied and compared. It presents the general process for microplastic sampling and analysis in four steps: collection, density separation, digestion, and identification. It observed that each research team used one out of 2 to 5 different procedures depending on the article and the step (two for collection and up to five for identification). Hence, the reported abundance of microplastics and respective sources in the environment have high variability and may differ by several orders of magnitude, making harmonising sampling and analysis methods one of the biggest challenges when assessing the evolution of unintended release of microplastics.

As it is a transboundary issue, a bottom-up solution is not possible. A top-down approach assessment will involve a large number of assumptions, which could further add to the uncertainty. An approach could be to use case studies to illustrate specific scenarios of the evolution of (unintentionally released) microplastic load.

In the study, "Rethinking Microplastics as a Diverse Contaminant Suite"[56], the authors strongly advocate changing the thinking from one contaminant, "microplastic", to a diverse suite of contaminants, microplastics, as has been done for pesticides and flame retardants in the past.

1.2 Monitoring

Microplastics' main pathways into the environment are runoff waters, treated or untreated wastewater, direct input to water compartments (rivers, lakes, ocean), soil and the air. Their adverse impacts also depends on the microplastic particles' shape, size, on the polymer type and on the additives they contain, therefore gathering information on these microplastics' characteristics with regards to their appearance is crucial to better understand the production, occurrence, distribution and degradation of microplastics. One of the main problems encountered in tackling microplastics is the insufficient data available on their release and presence in the environment. This information and knowledge failure is due to the lack of standardised protocols and common data bases. To observe and analyse microplastics particles in the environment, harmonised measurement protocols must be established and followed. The MSFD Technical Group on Marine Litter is currently updating the MSFD Guidance on Monitoring Marine Litter to improve harmonised monitoring of marine litter

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[55] ISO 24187:2023

[56] Rochman, C.M., Brookson, C., Bikker, J., Djuric, N., Earn, A., Bucci, K., Athey, S., Huntington, A., McIlwraith, H., Munno, K., De Frond, H., Kolomijeca, A., Erdle, L., Grbic, J., Bayoumi, M., Borrelle, S.B., Wu, T., Santoro, S., Werbowski, L.M., Zhu, X., Giles, R.K., Hamilton, B.M., Thaysen, C., Kaura, A., Klasios, N., Ead, L., Kim, J., Sherlock, C., Ho, A. and Hung, C. (2019), Rethinking microplastics as a diverse contaminant suite. Environ Toxicol Chem, 38: 703-711. https://doi.org/10.1002/etc.4371

(including microplastics) and to ensure consistency and comparability of monitoring data for the MSFD. These protocols have to be laid down after considering the steps and aspects detailed below.

1.2.1 Sampling

The sampling of microplastics can take place through direct sampling from water using sieving or through the collection of sediments. The distribution of microplastics is largely influenced by geographical, meteorological, and temporal factors thus the sampling time, sampling place, the sample volume, replications and field blanks are crucial for a uniform classification. The lower the available sample volume is, the more important replication become to minimise sampling error. Regarding the sampling method, it is important to specify where the samples were taken.[57]

1.2.2 Extraction

Various extraction procedures are available based on density separation, filtration, digestion, etc. Recovery and precision can vary depending on the properties and amount of microplastics present, the sample matrix and the protocol used. The utilisation of blanks is important to detect and control contamination by particles during sampling and the analytical procedure.

1.2.3 Analysis

The most common types of analysis are microscopic techniques using Raman or FTIR spectoscropy and thermo-analytical techniques based on gas chromatography/mass spectroscopy of decomposition (pyrolysis) products. Prior to measurement, sample preparation is required depending on the sample and the measurement technique. The limit of an instrument's detection capacities must also be taken into account. Polymer libraries provide a means of identifying the polymers present in samples.

2 WHAT ARE THE IMPACTS OF MICROPLASTICS AND PELLETS?

Four types of adverse impacts can be observed from microplastics, such as pellets, finding their way into the environment: 1) on the environment; 2) on climate; 3) on human health; and 4) on the economy.

Some of these impacts are related to microplastics in general, including pellets, while others are specific to pellets. It is to be noted that pellets can also be in the form of powder, thus very small and thus airborne, as well as slightly bigger than 5 mm in diameter.

2.1 Impacts on the environment

The significant adverse impacts of microplastics on the environment were highlighted in a recent publication[58] that revealed that the 5th planetary boundary of novel entities had been exceeded. Chemicals at large, including plastics, have been identified as fulfilling the characteristics of a novel entity. The planetary boundaries (9 in total) were defined in a 2009 article as the "boundaries within

[57] J. C. Prata et al., Methods for sampling and detection of microplastics in water and sediment: A critical review, TrAC Trends in Analytical Chemistry, 2019, 110: 150-159.

[58] https://pubs.acs.org/doi/10.1021/acs.est.1c04158Persson, L., Carney Almroth, B., Collins, C. et al., 'Outside the safe operating space of the planetary boundary for novel entities', *Environmental Science and Technology,* Vol. 56, No 3, 2022, pp. 1510–1521, American Chemical Society.

which we expect that humanity can operate safely"[59].

The presence of microplastics in soil may have effects on soil physicochemical properties. It might also trigger alterations in physical soil properties including soil bulk density, water holding capacity, and soil structures and in the soil biota negatively impacting the growth of some plants[60].

Detrimental effects have also been observed on marine biodiversity[61,62]. Once in the aquatic environment, microplastics can impact marine biodiversity in a number of ways. An increasing number of studies report microplastic ingestion throughout the food chain[63,64]. International Pellet Watch, initiated in 2005 by Hideshige Takada[65] and The Great Nurdle Hunt[66], organised by UK charity FIDRA, both relied on pellet samples collected by citizens to demonstrate that pellet pollution is a global issue. Indeed, they are highly mobile and have been found thousands of kilometres from the nearest pellet production or conversion facility[67], including in important Natura 2000 areas[68]. They can carry a wide range of contaminants and microbes which can form a biofilm on their surface, thus promoting the invasion of alien species in the ocean.[69] When pellets are encrusted with tiny biotas or larvae, the risk of introducing invasive species is increased, putting local native species at risk[70].

Once released into the environment, pellets can be easily ingested by aquatic wildlife including marine fish, squid, and different seabirds.[71] While only a few studies have focused specifically on the physiological effects of pellets, numerous laboratory studies have shown how microplastics interact with aquatic organisms and animals. Many animal species ingest plastic and microplastic, mistaking it for food – from large mammals, birds and fish to tiny zooplanktons, affecting among others feeding behaviour, reproduction, and growth, and sometimes leading to death[72]. Microplastics can be taken up by to the organisms at the bottom of the food chain due to their size and ubiquitous distribution in the open seas and lowest levels of water bodies. Microplastics have been found inside the digestive tract of more than 100 different species[73].

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59 Rockström, J., Steffen, W., Noone, K. et al., 'Planetary boundaries: exploring the safe operating space for humanity', *Ecology and Society*, Vol. 14, No 2, Article 32.

60 Wang, W. et al., 'Environmental fate and impacts of microplastics in soil ecosystems: Progress and perspective', Science of the Total Environment, Vol. 708, 2020.

61 P. L. Corcoran, Degradation of Microplastics in the Environment, Handbook of Microplastics in the Environment, 2022, 531–542.

62 N. Kalogerakis et al., Microplastics Generation: Onset of Fragmentation of Polyethylene Films in Marine Environment Mesocosms, 2017, doi.org/10.3389/fmars.2017.00084

63 Cole, M., Lindeque, P., Halsband, C. and Galloway, T. S., 'Microplastics as contaminants in the marine environment: A review', *Marine Pollution Bulletin*, Vol. 62, 2011, pp. 2588-2597.

64 Koelmans, A. A. et al., Risk assessment of microplastic particles, *Nature Reviews Materials*, 7:138–152, 2022.

65 http://www.pelletwatch.org/index.html

66 https://www.nurdlehunt.org.uk

67 Corcoran P. L. et al., A comprehensive investigation of industrial plastic pellets on beaches across the Laurentian Great Lakes and the factors governing their distribution, Science of the Total Environment, 747:141227, 2020.

68 The unaccountability case of plastic pellet pollution - ScienceDirect

69 Khalid, N. et al., Linking effects of microplastics to ecological impacts in marine environments, *Chemosphere*, 264: 128541, 2021.

70 Corcoran P. L. et al., A comprehensive investigation of industrial plastic pellets on beaches across the Laurentian Great Lakes and the factors governing their distribution, *Science of the Total Environment*, 747:141227, 2020.

71 Corcoran P. L. et al., A comprehensive investigation of industrial plastic pellets on beaches across the Laurentian Great Lakes and the factors governing their distribution, *Science of the Total Environment*, 747:141227, 2020.

72 Group of Chief Scientific Advisors, 'Scientific opinion on the Environmental and Health risks of microplastics pollution', Aprile 2019.

73 Secretariat of the Convention on Biological Diversity, 'Impacts of marine debris on biodiversity: Current status and potential solutions', *CBD Technical Series*, No 67, 2012.

The Risk Assessment Committee of the European Chemicals Agency (ECHA) also stated[74] that ingestion in laboratory studies has been linked to a diverse range of sub-lethal endpoints, including survival, feeding, growth, reproduction, moulting, malformation, behaviour, photosynthesis, oxidative stress, enzyme activity, inflammation, gene expression and nutrient cycling. Typical harmful effects are inner and outer lesions and blockage of the gastrointestinal tract, leading to false satiation. Concerning micro- and nanoparticles, there are potentially three types of adverse effects associated with ingestion:

- Physical effects related to consumption are similar to those found for macro plastics (but for smaller organisms);
- Toxic responses from the release of hazardous substances derived from the additives in plastics or the toxic contaminants adsorbed on microplastics; and
- The contamination of new media (the environment or animals) by the microorganisms which develop on the surface of the plastic particles.

There is an emerging concern that microplastics can act as a carrier for microorganisms, including pathogenic species of bacteria, resulting in an increase in the occurrence of non-indigenous species.[75] GESAMP (2015)[76] suggests evaluating the potential significance of plastics and microplastics as a carrier for pathogenic microorganisms[77]. Although microplastics do not pose acute fatal effects on living organisms, they can cause chronic toxicity over the longer term. Due to their physical and chemical properties, microplastics can absorb and transport numerous organic contaminants such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAH), endocrine disrupting compounds (EDCs), various pharmaceuticals and heavy metals. Also, microplastics can contain a complex mixture of chemicals, which may subsequently be released into the environment and constitute new routes of exposure for organisms.

Specific impacts on the environment from pellets

Pellets have been found in areas including important Natura 2000 areas[78]. First of all, the persistence of a pellet in the aquatic environment may be measured over decades or more, depending on the polymer type, the types and amounts of additives, and the polymers' and additives' reactions to environmental processes (e.g. weathering, sunlight, wave action)[79,80].

Once in the environment, pellets are known to be eaten by a range of organisms and animals, and cause harm to biodiversity and habitats. In areas that are badly affected, pellets have been seen smothering sensitive habitats. Concerning biodiversity, as pellets are mainly constituted of either

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[74] ECHA Committee for Risk Assessment (RAC) Committee for Socio-economic Analysis (SEAC), Background Document to the Opinion on the Annex XV report proposing restrictions on intentionally added microplastics, (https://echa.europa.eu/documents/10162/2ddaab18-76d6-49a2-ec46-8350dabf5dc6).

[75] P.J. Landrigan et al., The Minderoo-Monaco Commission on Plastics and Human Health, *Annals of Global Health*, Vol. 89, no. 1, pp. 23.

[76] Sources, fate and effects of Microplastics in the marine environment: a global assessement

[77] Cole, M., Lindeque, P., Halsband, C. and Galloway, T. S., 'Microplastics as contaminants in the marine environment: A review', *Marine Pollution Bulletin*, Vol. 62, 2011, pp. 2588-2597.

[78] The unaccountability case of plastic pellet pollution - ScienceDirect

[79] P. L. Corcoran, Degradation of Microplastics in the Environment, Handbook of Microplastics in the Environment, 2022, 531–542.

[80] N. Kalogerakis et al., Microplastics Generation: Onset of Fragmentation of Polyethylene Films in Marine Environment Mesocosms, 2017, doi.org/10.3389/fmars.2017.00084

polyethylene or polypropylene, once in the aquatic environment[81], they float unless they become heavily biofouled (the gradual accumulation of organisms such as algae, bacteria, etc, on the plastic) and then sink and accumulate in sediment. According to Werner et al. (2016), harm is caused by pellets when they float or are in the water column, where they can be eaten by organisms and marine animals (e.g. seabirds, mammals, and fishes) either intentionally because they are mistaken for food or unintentionally when filter feeding animals take in seawater[82]. Several documented accounts describe pellet and other plastic ingestion by wildlife, most notably by seabirds and sea turtles[83,84,85]. Seabirds ingest pellets more frequently than any other animal, and approximately one-quarter of all seabird species are known to ingest pellets. Fulmars frequently ingest floating plastic debris, including pellets, as they capture prey from the sea surface[86].

Ingestion of pellets as any microplastic can cause physical harm such as internal injuries and impaired ability to breath, swallow, digest food properly, or immediate death[87]. In certain cases, plastic debris cannot pass through the digestive system, which can lead to malnutrition or starvation by creating a false feeling of fullness, known as pseudo- satiation[88].

Finally, it has been demonstrated in studies[89] as early as 2001 that pellets, unintentionally released from the plastic industry to the environment, contained measurable concentrations of hazardous substances used as additives. These hazardous substances can then enter the food chain, and be a potential risk for human health.

2.2 Climate impacts

When considering the possible impacts of microplastics (including pellets) on the climate, global trends suggest that microplastic emissions will continue to increase. Microplastics represent a non-climatic pressure on ecosystems as carbon and nutrient cycling processes in soil can be greatly

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81 The persistence of a pellet in the aquatic environment may be measured over decades or more, depending on the resin type, the types and amounts of additives, and the reactions of the resins and additives to environmental processes (e.g. weathering, sunlight, wave action). P. L. Corcoran, Degradation of Microplastics in the Environment, Handbook of Microplastics in the Environment, 2022, 531–542. N. Kalogerakis et al., Microplastics Generation: Onset of Fragmentation of Polyethylene Films in Marine Environment Mesocosms, 2017, doi.org/10.3389/fmars.2017.00084

82 Werner S; Budziak A; Van Franeker J; Galgani F; Hanke G; Maes T; Matiddi M; Nilsson P; Oosterbaan L; Priestland E; Thompson R; Veiga J; Vlachogianni T. Harm caused by Marine Litter. EUR 28317 EN. Luxembourg (Luxembourg): Publications Office of the European Union; 2016. JRC104308

83 Lacroix C. et Huvet A., 'Table ronde n°1 : Devenir et gestion dans les ports et les milieux littoraux – introduction scientifique : caractérisation de la pollution et risques associés' [Roundtable n°1 : Outlook and management in ports and coastal environmentas – scientific introduction : the characterisation of pollution and associated risks], Conférence Journée Plastiques et Environnement associés' [Conference : Day of plastics and associated environments], June 2019 (https://enviroplast2019.sciencesconf.org/data/TR1_1_PPT_journe_es_plastiques_et_environnement_Lacroix_Huvet.pdf).

84 Ryan, P. G., 'Seabirds indicate changes in the composition of plastic litter in the Atlantic and south-western Indian Oceans', *Marine Pollution Bulletin*, Vol. 56, no. 8, 2008, pp. 1406-1409.

85 Sheavly, S.B. and Register, K.M., 'Marine Debris & Plastics: Environmental Concerns, Sources, Impacts and Solutions', *Journal of Polymers and the Environment*, Vol. 15, 2007, pp. 301-305.

86 Plastic particles in fulmars | OSPAR Commission

87 Group of Chief Scientific Advisors, 'Scientific opinion on the Environmental and Health risks of microplastics pollution', Aprile 2019.

88 The Convention for the Protection of the Marine Environment of the North- East Atlantic (OSPAR) Commission, OSPAR Background document on pre-production plastic pellets, 2018.

89 Mato Y. et al., 'Plastic resin pellets as a transport medium for toxic chemicals in the marine environment', *Environmental Science & Technology*, Vol. 34, No. 2, 2001, pp. 318-324.

affected by the presence of microplastics and their further decomposition[90] (and might therefore lead to a decreased capacity for GHG absorption). In addition, plastics and microplastics are a source of GHG emissions, putting additional pressure on the climate. GHGs are emitted throughout the plastic life cycle, because all related activities (extraction, refining, manufacturing and end of life management) are carbon intensive. Conventional plastics (based on fossil fuels) produced in 2015 accounted for 3.8% of total global CO_2 emissions, and their share could reach 15% by 2050[91]. A more recent study estimates even higher CO_2 emissions from plastic production (1.96 Gt of CO_2e)[92].

Microplastics are widely found in aquatic environments.[93] Their presence may cause more greenhouse gas emissions as they can negatively affect multiple factors, such as phytoplankton photosynthesis, which contribute to carbon sequestration.[94] Microplastics are widely identified in aquatic environments.[95] The impact of marine plastics on ecosystem responsible for the gas exchange and circulation of marine CO2 may cause more greenhouse gas emissions. Marine microplastics can negatively affect phytoplankton photosynthesis and growth, zooplankton and their development and reproduction, marine biological pump andocean carbon stock. Phytoplankton and zooplankton are the most important producer and consumer of the ocean.[96]

Moreover, the climate change effects, e.g. more frequent heavy rainfall events, will exacerbate the problems linked with releases of those microplastics from urban runoff and stormwater overflows (SWO). Furthermore, the gradual degradation and fragmentation process of microplastics, when exposed to ambient solar radiation in ocean waters, may release methane, a potent greenhouse gas,[97] and ethylene into the atmosphere, depending on the type of microplastics, though the study also finds that this is likely to be an insignificant component of the global CH_4 budget.

2.3 Human health impacts

Despite more and more research being carried out to understand microplastics' impacts on human health, there is still no scientific consensus on these impacts. According to the Risk Assessment Committee of the European Chemical Agency (ECHA),[98] potential effects on terrestrial organisms in general, and on human health, have not been well studied but include infertility, genetic disruption, poisoning, reduced feeding and increased mortality in marine organisms and in humans if ingested in very large quantities. Inhalation of microplastics can provoke severe problems in the lung.

Humans are exposed to microplastics everywhere via food consumption and inhalation. The annual intake of microplastics by humans has been estimated to range from 70 000 to over 120 000 particles

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[90] Rilling M. C. et al., Microplastic effects on carbon cycling processes in soils, Plos Biology, 2021, https://doi.org/10.1371/journal.pbio.3001130

[91] IPCC Working Group III Report: Mitigation of Climate Change (2022) https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/

[92] Cabernard, L., Pfister, S., Oberschelp, C. et al. Growing environmental footprint of plastics driven by coal combustion. Nat Sustain 5, 139–148 (2022).

[93] Phytoplankton response to polystyrene microplastics: Perspective from an entire growth period - ScienceDirect

[94] Can microplastics pose a threat to ocean carbon sequestration? - ScienceDirect

[95] Phytoplankton response to polystyrene microplastics: Perspective from an entire growth period - ScienceDirect

[96] Can microplastics pose a threat to ocean carbon sequestration? - ScienceDirect

[97] Royer, S.-J. et al., 'Production of methane and ethylene from plastic in the environment', *PLoS ONE*, Vol. 13, No 8, 2018, Public Library of Science.

[98] European Chemicals Agency, Opinion of the Committee for Risk Assessment and Opinion of the Committee for Socio-Economic Analysis on an Annex XV dossier proposing restrictions on intentionally-added microplastics, ECHA/RAC/RES-O-0000006790-71-01/F and ECHA/SEAC/RES-O-0000006901-74-01/F, 2020 (https://echa.europa.eu/documents/10162/a513b793-dd84-d83a-9c06-e7a11580f366).

a year depending on age, gender, region, and consumption[99]. This includes an estimated 70 000 particles inhaled in air and 50 000 particles ingested in food and drink.

The consumption of seafood, containing microplastics, is one of the main concerns for humans[100]. There is evidence to suggest that additives such as dyes or plasticisers could cause toxicity, carcinogenicity and mutagenicity.[101,102] Pellets are likely to carry toxic chemicals as well on their surface since persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), dichloro-diphenyltrichloroethane (DDT), hexachlorocyclohexanes (HCHs), and polycyclic aromatic hydrocarbons (PAHs) can be easily adsorbed to their surface and then released over time. [103] The concentrations of these substances adsorbed onto plastic pellets are highly variable. The health impacts of POPs are not immediate but result rather from chronic, cumulative and long-term exposure.[104]Microplastics, including pellets would also pass up the food chain through plants which absorb synthetic contaminants from the soil[105]. Human exposure to microplastics through drinking water is believed to currently be low in Europe[106], but a systematic review of available evidence is lacking[107]. People that predominately drink bottled water may ingest an additional 90 000 particles of microplastic a year[108]. Work is ongoing to produce up-to-date knowledge on the occurrence and possible toxic effects of ingesting micro- and nanoplastics via food products and beverages to provide a basis for risk assessment.[109] CUSP, the European Research Cluster to Understand the Health Impacts of Micro- and Nanoplastics is also carrying out research in this area[110].

Although additional research is still required on exposure to airborne microplastics, their prevalence in urban zones is concerning: one study found microplastics in all urban air samples and identified 92% of them as fibrous.[111] Apart from inhaling fibres as fine dust in outdoors environments, humans

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[99] Kieran D. Cox, Garth A. Covernton, Hailey L. Davies, John F. Dower, Francis Juanes, and Sarah E. Dudas (2019). Human Consumption of Microplastics. Environmental Science & Technology 2019 53 (12), 7068-7074 DOI: 10.1021/acs.est.9b01517

[100] Cox, K. D. et al., 'Human consumption of microplastics', Environmental Science and Technology, Vol. 53, No 12, 2019, pp. 7068–7074.

[101] Gasperi, J., et al., Microplastics in Air: Are We Breathing It In?, *Current Opinion in Environmental Science & Health*, 1–5. 2018. https://doi.org/10.1016/J.COESH.2017.10.002

[102] Blackburn, K., Green, D., The potential effects of microplastics on human health: What is known and what is unknown, *Springer, Ambio*, 51:518–530, 2021.

[103] Corcoran P. L. et al., A comprehensive investigation of industrial plastic pellets on beaches across the Laurentian Great Lakes and the factors governing their distribution, *Science of the Total Environment*, 747:141227, 2020.

[104] Nadal, M. et al., Climate change and environmental concentrations of POPs: A review, *Environmental Research*, 143: 177-185, 2015.

[105] Sciencealert.com, 'Study shows how microplastics can easily clim the food chain. Should we be worried?', 2022 (https://www.sciencealert.com/study-shows-how-microplastics-can-easily-climb-the-food-chain-should-we-be-worried).

[106] WHO (2019) Microplastics in drinking-water. Geneva: World Health Organization; Licence: CC BY-NC-SA 3.0 IGO.

[107] EurEau, 'Microplastics and the water sector', 2019 (https://www.eureau.org/resources/briefing-notes/3940-briefing-note-on-microplastics-and-the-water-sector/file); Koelmans, A., Hazimah Mohamed Nor, N., Hermsen, E., Kooi, M. et al., 'Microplastics in freshwaters and drinking water: Critical review and assessment of data quality', *Water Research*, Vol. 155, 2019, pp. 410-422.

[108] Cox, K. D. et al., Ibid.

[109] Shopova et al., 'Risk assessment and toxicological research on micro- and nanoplastics after oral exposure via food products', EFSA Journal, 2020 https://doi.org/10.2903/j.efsa.2020.e181102

[110] CUSP cluster - The European Research Cluster to Understand the Health Impacts of Micro- and Nanoplastics (cusp-research.eu)

[111] Wright S.L. et al., 'Atmospheric microplastic deposition in an urban environment and an evaluation of transport', Environ Int, Vol. 136, 2020.

are also exposed to indoor airborne microplastic pollution.[112] When inhalation rates are high, accumulation of microplastics will occur in certain organs impacting their health. This process will cause chronic inflammation, which is known to be a leading cause of diseases such as cancer, heart disease, asthma, and diabetes. Both cellulosic and plastic microfibers were found in lung tissue taken from patients with different types of lung cancer. According to the same study, this may particularly affect people with a viral infection or children whose lungs are still developing. Also, children under the age of six inhale three times more microplastics than an average adult.

Several studies on the occupational exposure of textile workers show (as early as 1975[113]) that the inhalation of microplastic fibres from textiles can lead to pulmonary disease such as interstitial lung disease (linked to nylon flock exposure[114]). Chronic exposure to plastic microfibres in urban air, indoor[115] or outdoor[116], also raises concerns about the need for action reducing microplastic emissions in European cities.

A recent study[117] analysed 17 studies on the toxicity of microplastics to human cells establishing detrimental impacts (including cytotoxic), triggering immune responses, causing oxidative stress, and the shape of microplastics influencing these negative effects (irregularly shaped microplastics had more adverse effects than spherical ones). However, it also states that the "overall certainty of the body of evidence" is low due to the fact that researchers couldn't access the original data. High levels of exposure to microplastics are believed to induce inflammatory reactions and toxicity, possibly due to the additives used to produce the plastic.[118] In addition, microplastics could potentially act as vectors for pathogens and microbes[119].

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[112] Plastic Soup Foundation _ Do clothes make us sick, 2022. This study found that 30% of the dust captured in air conditioning filters from dormitories, offices, and living rooms were microplastic fibres, with polyester, rayon, and cellophane as the dominant polymers. Fibre fragments are released from clothes and indoor textiles through use, wear and tear, the washing of garments, and drying. Fibres cannot always be cleared, for example by coughing. The dimensions of the fibres also play a role in toxicity. Thinner fibres are inhalable as their elongated shape allows fibres to deeply penetrate into the lungs. Longer fibres are more persistent and toxic to lungs cells. Fibres < 0.3 µm wide and >10 µm long are most carcinogenic.

[113] Pimentel, J. C., Avila, R. and Lourenço, A. G., 'Respiratory disease caused by synthetic fibres: A new occupational disease', *Thorax*, Vol. 30, No 2, 1975, pp. 204–2019.

[114] Boag, A., Thomas V., Fraire, A., Kuhn, C. et al., 'The pathology of interstitial lung disease in nylon flock workers', *American Journal of Surgical Pathology*, Vol. 23, No 12, 1999, pp. 15–39.

[115] Dris, R., Gasperi, J., Mirande, C. et al., 'A first overview of textile fibres, including microplastics, in indoor and outdoor environments', *Environmental Pollution*, Vol. 221, 2017, pp. 453–458.

[116] Dris, R., Gasperi, J., Rochr, V. et al., 'Microplastic contamination in an urban area: A case study in Greater Paris', *Environmental Chemistry*, Vol. 12, No 5, 2015.

[117] Danopoulos, E., Twiddy, M., West, R. and Rotchell, J., 'A rapid review and meta-regression analyses of the toxicological impacts of microplastic exposure in human cells', *Journal of Hazardous Materials*, Vol. 427, No 6, 2022.

[118] Potential Health Impact of Environmentally Released Micro- and Nanoplastics in the Human Food Production Chain: Experiences from Nanotoxicology | Environmental Science & Technology (acs.org)

[119] Microplastics from textiles: towards a circular economy for textiles in Europe — European Environment Agency (europa.eu)

However, the precautionary principle should be applied since the presence of microplastics in human stool[120] demonstrate intestinal exposure. In addition, some studies seem to suggest that microplastics can be found in pregnant women's placenta,[121] and more recently, in human blood[122].

2.4 Economic impacts

In addition to the versatile effects on environment, climate and health, there are potentially negative impacts on the economy as well. Some of these impacts are related to microplastics in general, including pellets, others to pellets specifically.

The growing evidence/awareness of microplastics' presence in seafood, salt, honey, fruits, vegetables and drinking water could undermine consumer confidence and bear economic consequences.

There are potential negative economic impacts on activities such as commercial fishing and agriculture (e.g. reduced fishing due to impacts of microplastics on marine eco-systems and fauna, which eats it) as well as recreation and tourism (reduced attractiveness due to impacts of microplastics on beaches and vulnerable areas like national parks, rivers and lakes[123]).

Clean-up costs are often unknown and operations are usually the responsibility of local communities with a negative impact on their budgets. For example beach clean-ups are estimated to cost EUR1 000 000 per year for the city of Marseille (France)[124]. SOS Mal de Seine Association highlighted the lack of capacity of public authorities to deal with large- scale pollution of pellets on beaches (e.g. caused by lost containers). As a matter of fact, clean- up operations are complex to undertake because these particles are difficult to see due to their size and that vegetation may hide them. They should also be carried out within an hour of an incident to prevent widespread pollution by wind, rain, and/or tides. Monitoring costs of plastic pellet ingestion by species are also unknown. However, the costs of La Rochelle Aquarium's monitoring of microplastic ingestion by loggerhead sea turtles was a total of EUR50 000 over four years. Another pertinent example is the monitoring of microplastic ingestion by fulmars provided by ornithological groups, which costs EUR33 300 for one winter season.

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[120] Schwabl, P. et al., 'Detection of various microplastics in human stool', *Annals of Internal Medicine*, Vol. 171, No 7, 2019, pp. 453–457, American College of Physicians.

[121] Ragusa, A. et al., 'Plasticenta: First evidence of microplastics in human placenta', *Environment International*, Vol. 146, 2021, Elsevier BV. ; Dusza, H.M. et al, 'Uptake, Transport, and Toxicity of Pristine and Weathered Micro- and Nanoplastics in Human Placenta Cells', *Environmental Health Perspectives*, Vol; 130, No 9, 2022.

[122] Leslie, H. A. et al., 'Discovery and quantification of plastic particle pollution in human blood', *Environment International*, Vol. 163, 2022, Elsevier BV.

[123] Plastic Giants polluting through the backdoor; Silent Pollution – Who is contaminating Puglia's coastline with plastic pellets?; Plastic pellets spill pollutes Danish, Norwegian, Swedish coastlines; Microplastic pollution in the surface waters of Italian Subalpine Lakes; Granulés plastiques industriels sur le littoral français

[124] OSPAR Background document on pre-production Plastic Pellets, 2018

Annex 8:
Problem definition – pellet losses to the EU environment

1 PROBLEM DEFINITION

Current practices for handling pellets lead to losses at each stage in the supply chain, causing adverse environmental and potential human health impacts.

Plastic raw materials come in different forms, including pellets, flakes, powders and in liquid forms, all referred to collectively as "pre-production plastic pellets"[125]. In Europe, approximately 80 % of all plastic raw materials produced are in the form of round to oval granules of approximately 2 mm to 5 mm in diameter[126]. A relevant part of the remaining 20% is even smaller than 2mm, such as powders, and a minor part can be slightly bigger. It is common sense to tackle all these pellets together. This will also ensure pellets that might be slightly bigger will still be subject to possible legislation, thus avoiding possible attempts by industry to avoid relevant legislation by making pellets slightly bigger than 5mm. Figures from literature often refer to "pellets", irrespective of their dimension.

1.1 The pellet supply chain

Pellets can reach the environment through losses occurring at every stage of the supply chain: production (virgin or recycled), processing (compounding, masterbatch making, converting, etc.), logistic operations (transport, storage and tank cleaning), waste management, etc. Therefore, tackling pellet losses clearly requires a supply chain approach.

The pellet supply chain is complex. Virgin pellets are manufactured at large installations, and then stored in silos; they are mostly either filled directly into tankers, or packed for transport to conversion sites, where final plastic products are made. Losses can also occur at recycling facilities, where post-consumer plastic waste is recycled back into pellets in order to be reintroduced into the plastic manufacturing cycle[127].

Box 7: Companies handling pellets

Companies handling pellets are categorised as follows:

- producers who create virgin plastic pellets from oil, gas and other raw materials;
- recyclers who collect, sort, clean and process plastic waste into recycled plastic flakes or pellets;
- traders/brokers who purchase the plastic material and store it or otherwise handle it before selling it to converters or exporting;

[125] The Convention for the Protection of the Marine Environment of the North- East Atlantic (OSPAR) Commission, OSPAR Background document on pre-production plastic pellets, 2018. Technically, according to ISO 472:2013, a pellet is a "small mass of preformed moulding material, having relatively uniform dimensions in a given lot, used as feedstock in moulding and extrusion operations".

[126] PlasticsEurope, 'PlasticsEurope Operation Clean Sweep® Report 2017', 2017 (https://www.opcleansweep.eu/application/files/8316/3456/6233/PlasticsEurope_OCS_progress_report-2017.pdf).

[127] Hann, S., Sherrington, C., Jamieson, O., Hickmann, M., Kershaw, P., Bapasola, A., Cole, G. (2018). Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products, Eunomia.

- intermediary facilities that handle the plastic material between the producer and the processor, such as storage and repacking facilities;
- processors who transform the plastic pellets by either mixing them with other materials to alter their physical properties or by transforming them directly into manufactured goods (the former are called compounders and the latter converters);
- distributors who sell (a small portion of) the plastic pellets to sectors such as construction;
- logistic companies; and
- waste management companies.

Producers: in Europe, there are close to 100 large polymer-producing companies that are members of the trade association "Plastics Europe".[128] These companies produce some 54.8 million tonnes of virgin pellets per year and represent 90% of the total EU production. In 2021, circa 138,000 people worked for plastic manufacturers in the EU27. The number of individual enterprises was around 2300. In 2021, plastic manufacturers generated a turnover of EUR 117 billion.

Processors: the situation of the processors is significantly different: the trade association "European Plastic Converters" (EuPC) totals about 51 national and European industry associations, representing 90% of the total EU processing, equivalent to approximately 48 000 individual companies, out of which 66% are micro-companies (some 31 400 micro-enterprises handling an average tonnage below 100T and representing an average turnover of EUR 300 000 annually, equivalent to 4% of the total turnover of the industry)[129]. Converters employ 1.3 million people and have an annual turnover of EUR 269 billion[130].

Processors transform raw pellets by either mixing them with other materials to alter their physical properties (changing their melting point, colour, insulation properties, etc.) or by transforming them directly into manufactured goods. The former is called compounders and the latter converters. Compounders can either be part of a converter's system to alter their physical properties on the same site that they are manufacturing the finished product or independent members of the value chain supplying new pellets (thus adding a link to the value chain where loss is possible).

Transporters: the "European Chemical Transport Association" (ECTA) represents approximately 100 transport companies active in the transport of chemical products including pellets[131]. These ECTA members are the major Logistic Service Providers in this sector in Europe and most of them are not SMEs. They cover 30% of the total pellet transport in Europe. Beyond ECTA members, transporters are largely micro and small entreprises, ca. 13 000.

Transporters move plastic pellets from their manufacturing grounds to the facility they will be used in. Transport occurs by three main delivery mediums: Sea cargo ships; Road lorries; Railways; Air. Each distribution method uses different types of containers to store plastic pellets, ranging from small bags (20- 25 kg) to silo trucks (up to 35 t) and large maritime containers. Not all bags are sealed, airtight and puncture-resistant to prevent damage and tears.

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[128] Plastics Europe, 'Membership' (https://plasticseurope.org/about-us/membership/).
[129] European Plastic Converters (EuPC), 'Organisation' (https://www.plasticsconverters.eu/).
[130] Source Eurostat (20210 figures) for EU-27 (Statistics | Eurostat (europa.eu))
[131] European Chemical Transport Association, 'List of ECTA and ECTA RC* Members 2023' (https://www.ecta.com/organization/list-of-members/).

Other logistic operators: the "European Federation of Tank Cleaning Organizations" (EFTCO) declares 630 tank cleaning stations in Europe, out of which at least 440 deal with tanks containing pellets. Also, there would be around 850 warehouses in Europe storing pellets. These companies are largely micro and small enterprises. They provide intermediary services to the supply chain, aside from transporters. These intermediary points are important as they represent additional stages at which pellets are handled and can be lost.

Waste management companies: they collect waste pellets from processors to treat them. Producers, processors and intermediary facilities typically employ commercial waste management firms to handle their waste.

Recyclers: in 2021, there were some 730 plastic recycling companies in the EU[132]. They occupy more than 20 000 employees and create a turnover of EUR 8.5 billion annually. In 2021, they produced 7.6 million tonnes of recycled pellets, while the installed capacity is roughly of 11 million tonnes. 165 plastic recycling companies are members of the trade association "Plastics Recyclers Europe" (PRE) regrouping both industry associations and individual companies, mostly large companies. These companies represent 80% of the EU market installed capacity.

More information on the share of SMEs in the pellet supply chain is presented in Annex 12.

1.2 Pellet losses

While the pellets supply chain is mainly grouped into the above mentioned categories, there are several intermediate steps where pellet losses can occur, such as:

- Production
  - Granulation: cutting with a knife in the water nearby or in the pellet receptacles in the factory
  - Packaging (bagging or tanking)
  - Unloading by handling or pneumatic
  - Technical problems: pneumatic accidents with plug
  - Electrostatic phenomenon
- Compounding (similar steps as for production)
- Processing (conversion or transformation of pellets into products)
  - Unloading of pellets
  - Delivery in bags, octabins or tanks
  - Storage
  - Conversion
- Logistics
  - Storage in silos by pneumatic
  - Palletisation of containers = bags (big bags) or octabins
  - Bagging fractionation steps
  - Handling pallets of bags or octabins
  - Installation of pallets in unconfined storage parking lots
  - Loading of pallets on flatbed trailers or in (road) containers
  - Chronic losses during road or rail transport and accidental losses
  - Chronic losses shipping and accidental losses

[132] Plastics Recyclers Europe, 'Plastics Recycling Industry in Europe: Mapping of Installed Plastics Recycling Capacities 2021 Data', 2023 (https://www.residuosprofesional.com/wp-content/uploads/2023/03/Plastics-Recycling-Industry-in-Europe-2023.pdf).

    - Chronic losses during port handling and accidental losses

Other steps where pellet losses can occur are:

- Waste and cleaning steps
    - Operating waste
    - Recovery of empty containers for recycling
    - Tank washing
    - Cleaning of flatbed trailers
- Water used in different processes can also contain pellets
    - Granulation water
    - Cleaning water
    - Recycled water
    - Washing water
    - Retention water
    - others (stormwater, road washing and leaching)

The Commission of the regional convention for the protection of the Marine Environment of the North-East Atlantic (OSPAR)[133] distinguishes the following:

- Pellet **spill** as a "One-off escape of pellets from primary containment (not necessarily resulting in loss to the environment)";
- Pellet **loss** as a "One-off or prolonged escape of pellets to the environment".

Spills – if not contained – may end up as "losses" in the environment. A part of these pellets are recovered (in the wastewater treatment system for example), the other part is considered as lost or released into the environment.

Figure 7: Pellet losses in the environment

[133] OSPAR Commission, 'Guidelines in support of Recommendation 2021/06 on the reduction of plastic pellet loss into the marine environment', 2021 (https://www.ospar.org/documents?v=46269).

Pellet losses can be the result of:

1) chronic, ongoing pellet incidents during routine operations. This usually occurs as a result of lack of awareness and improper training, poor handling and housekeeping practices and due to the absence of pellet loss preventive and mitigating measures.

2) acute, one-off, pellet incidents. This usually occurs as a result of accidents during transport or major equipment failures in the absence of pellet loss preventive and mitigating measures.

1.2.1 Chronic pellet losses

Chronic pellet losses typically happen during both bulk and packed loading and unloading operations at special installations and during transport and logistic operations. The report from the plastics producers on Operation Clean Sweep[134] corroborates this presumption by adding process and mixing points as other pellet loss hotspots. The report states that: "*The majority of companies (97%) have analysed the sources of potential pellet spills at their facilities and identified that loading and unloading areas, process and mixing points are the three main locations where pellets losses occur more often at different sites"*.

The main reasons of these losses are the following[135]:

- In the **production process**, the most common causes of pellet losses are the incompletely sealed conveying systems, damaged or leaky packaging, rail hopper car and bulk truck cleaning operations, lack of a containment system, failure of the containment system during heavy rainfall, infrequent or inadequate housekeeping, unsealed or unsecured rail hopper car valves and the lack of employee awareness.

- During **transport**, pellet losses occur due to incompletely sealed bags or leaking bag valves, improper bag storage practices, lack of employee awareness, inadequate training of forklift operators, infrequent routine maintenance, improperly or inadequately sealed or secured rail hopper car valves, lack of a containment system or other control mechanisms, improper handling of pellet cargo at ship docks and aboard ship, overfilling of storage silos, displacement of the conveyor system ports and accidents of ships carrying pellets.

- In **processing facilities**, pellet losses can occur because of the lack of communication between industry management, inadequate employee awareness and training, inadequate facilities like lack of waste-, or storm-water containment systems in place, careless routine operations, inadequate housekeeping practices, easily damaged or leaky packaging and improper unloading and warehousing procedures.

There is evidence of point source input near plastic processing plants, where the abundance of plastic pellets or powders can be relatively high.[136] Chronic pellet incidents have been reported at production

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[134] Plastics Europe, 'Operation Clean Sweep® Progress Report 2019', 2020 (https://plasticseurope.org/knowledge-hub/operation-clean-sweep-progress-report-2019/).

[135] US Environmental Protection Agency, 'Plastic Pellets in the Aquatic Environment: Sources and Recommendations', 1992 (http://www.globalgarbage.org/13%20EPA%20Plastic%20Pellets.pdf).

[136] Norén, F. & Ekendahl, S., 'Microscopic Anthropogenic Particles in Swedish Waters: many more than believed', 2009, Schwerin, Germany: Helsinki Commission.

sites in the Netherlands[137], Belgium[138], Spain[139], the UK coastline, Scotland[140], Denmark[141] and Sweden[142]. Logistic platforms like ports are hotspots for pellet losses, and the ports of Rotterdam, Antwerp and Tarragona have been reported to be heavily polluted locations by several organisations active in the monitoring of pellet losses[143]. An important part of chronic pellet incidents happens also during the transport of pellets across land (e.g. road and rail), such as in Belgium[144], or during maritime transport[145].

1.2.2 Acute pellet losses

Acute pellet incidents have happened in industrial facilities in Italy[146] and during the transport of pellets across land, e.g. in France[147] and during maritime transport, e.g. in the Netherlands[148] or in Denmark[149]. Acute pellet incidents occurring in the form of containers lost at sea result in large quantities of pellets released directly into the marine environment[150]. Some big incidents with unknown origin have also to be mentioned such as the ones in Southampton, England[151] and in the Loire-Atlantique coastline of France[152] among several others in Europe and worldwide[153].

Box 8: Examples of major acute pellet incidents during maritime transport

2012: In Hong Kong, after being blown by Typhoon Vicente on 24 July 2012, some containers belonging to Chinese oil giant Sinopec which were carrying over 150 tonnes of plastic pellets, were blown into the sea, washing up on southern Hong Kong coasts, such as Shek O, Cheung Chau, Ma Wan and Lamma Island. The spill disrupted marine life and was credited with killing stocks of fish-on-fish farms[154].

2017: A nurdle spill of about two billion nurdles (49 tonnes) from a shipping container in Durban Harbour required extended clean-up efforts. These nurdles have also been spotted washing up on the shore in Western Australia[155].

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137 Westerschelde-plastic-nurdles-versie-definitief-21-11-2021-2.pdf (plasticsoupfoundation.org)
138 Ecaussinnes (Belgium): Surfrider Foundation tackles industial plastic granules
139 New report out exposes alarming impacts of plastic pellets across Europe - Good Karma Projects
140 Fife beach 'worst' for nurdle pollution - BBC News
141 Tackling sources of Marine Plastic Pollution through effective corporate engagement: a Danish Case Study
142 The unaccountability case of plastic pellet pollution - ScienceDirect
143 Plastic Giants polluting through the backdoor. New report out exposes alarming impacts of plastic pellets across Europe - Good Karma Projects
144 Ecaussinnes (Belgium): Surfrider Foundation tackles industial plastic granules
145 Sources, fate and effects of Microplastics in the marine environment: a global assessement
146 Nurdle pollution hotspot identified in Italy (nurdlehunt.org.uk)
147 Morbihan. Un camion perd sa marchandise, 28 tonnes de granulés en plastique sur la route (ouest-france.fr)
148 24 million plastic pellets from MSC Zoe on northern Dutch coastline – The Northern Times
149 Plastic pellets spill pollutes Danish, Norwegian, Swedish coastlines – KIMO (kimointernational.org)
150 In 2021, the container ship MV X-Press Pearl caught fire and sank losing approximately 1680 tonnes of plastic pellets in a single event (some 84 billion pellets). In Europe, in 2020, the MV Trans Carrier lost more than 10 tonnes of plastic pellets in the German Bight. Plastic pellets spill pollutes Danish, Norwegian, Swedish coastlines – KIMO (kimointernational.org) 24 million plastic pellets from MSC Zoe on northern Dutch coastline – The Northern Times
151 Plastic pollution at Chessel Bay nature reserve in Southampton | Daily Echo
152 Les plages de la côte Atlantique polluées par une marée de granulés plastiques, l'Etat porte plainte (lemonde.fr)
153 https://www.nurdlehunt.org.uk/nurdle-finds.html
154 Lyn, T.E., 'Sinopec pledges help to clear Hong Kong plastic spill', Reuters, 2012 (https://www.reuters.com/article/us-pollution-hongkong-sinopec-idUSBRE8780I920120809). https://www.reuters.com/article/us-pollution-hongkong-sinopec-idUSBRE8780I920120809
155 Two Oceans Aquarium, 'The Great Nurdle Disaster: What to do if you find nurdles', 2017 (https://www.aquarium.co.za/blog/entry/the-great-nurdle-disaster-what-to-do-if-you-find-nurdles). https://www.aquarium.co.za/blog/entry/the-great-nurdle-disaster-what-to-do-if-you-find-nurdles

2018: A semi-truck crash led to the release of bright blue-coloured nurdles into Pocono Creek and the waterways of the Lehigh Valley, Pennsylvania.

2020: On 23rd February 2020, the MV Trans Carrier lost more than 10 tonnes of plastic pellets in the German Bight when the cargo on board moved during a storm, damaging one of the containers, which broke open[156].

2020: During a thunderstorm on August 20th, a 12 m shipping container with 25 tonnes of nurdles fell off the CMA CGM Bianca ship into the Mississippi River in New Orleans. No official clean-up took place[157].

2021: On 2 June 2021, the cargo ship "X-Press Pearl" containing 1680 tonnes of plastics pellets[158] sank off the coast of Sri Lanka, spilling chemicals and microplastic nurdles and causing the worst environmental disaster in the country's history[159]. The actual quantity of pellets lost to the environment is unknown.

Existing monitoring programs in Europe show the presence of plastic pellets in the marine environment. In addition to those implemented in the framework of the Marine Strategy Framework Directive, which requires all Member States to monitor microplastic litter on beaches[160], there are programs like the Port of Antwerp's collaboration with PlasticsEurope[161]. In the area of the port of Antwerp, home to 10 pellets producers, in 2017, about 4 tonnes of plastics pellets were collected in the environment centred on the port area during a citizens' action, with most pellets found close to the production plants[162]. The Port of Antwerp has been running the Antwerp Zero Pellet Loss Platform since 2017 with the aim of improving the implementation of the OCS programme in the port of Antwerp. In 2022, an OVAM representative[163] confirmed that "there are still pellet losses around the Port of Antwerp".

Since the 1970s, plastic pellets have been observed in marine environments around the world, including at sites which are not close to petrochemical or polymer industries. These have been documented using different observation protocols developed by NGOs such as SOS Mal de Seine and Fidra. This demonstrates that while pellet losses can be concentrated in one geographical area, they are also extremely mobile and can be dispersed by surface water and sea currents, as well as through the air.

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[156] KIMO, 'Plastic pellets spill pollutes Danish, Norwegian, Swedish coastlines', 2020 (https://www.kimointernational.org/news/plastic-pellets-spill-pollutes-danish-norwegian-swedish-coastlines/).

[157] Nola.com, 'No cleanup planned as millions of plastic pellets wash up along Mississippi River and flow to the Gulf', 2020 (https://www.nola.com/news/environment/article_b4fba760-e18d-11ea-9b0b-b3a2123cf48b.html).

[158] United Nations Environment Programme, 'X-Press pearl maritime disaster Sri Lanka – Report of the UN Environmental Advisory Mission', 2021 (https://www.unep.org/resources/report/x-press-pearl-maritime-disaster-sri-lanka-report-un-environmental-advisory-mission).

[159] The Guardian, 'Sri Lanka faces disaster as burning ship spills chemicals on beaches', 2021 (https://www.theguardian.com/world/2021/may/31/sri-lanka-faces-disaster-burning-ship-spills-chemicals-beaches).

[160] In 2016, Spain started the MSFD subprogram on microplastics on beaches, and pellets were detected with an average concentration of 47.8 pellets/kg or 419.2 pellets/m2. Currently, the MSFD Technical Group on Litter is developing a protocol for monitoring pellets on beaches.

[161] Plastics Europe, 'Port of Antwerp Activity report 2021', 2021 (https://plasticseurope.org/knowledge-hub/port-of-antwerp-activity-report-2021/).

[162] Rethink Plastic Alliance, Surfrider Foundation Europe, & Break Free from Plastic, 'Plastic Giants polluting through the backdoor', 2020 (https://rethinkplasticalliance.eu/wp-content/uploads/2020/12/bffp_rpa_pellets_polluting_through_the_backdoor.pdf).

[163] Ovam, Personal communication, 2022.

1.3 Pellet pathways

Spilled pellets can reach the environment and become losses through several pathways.

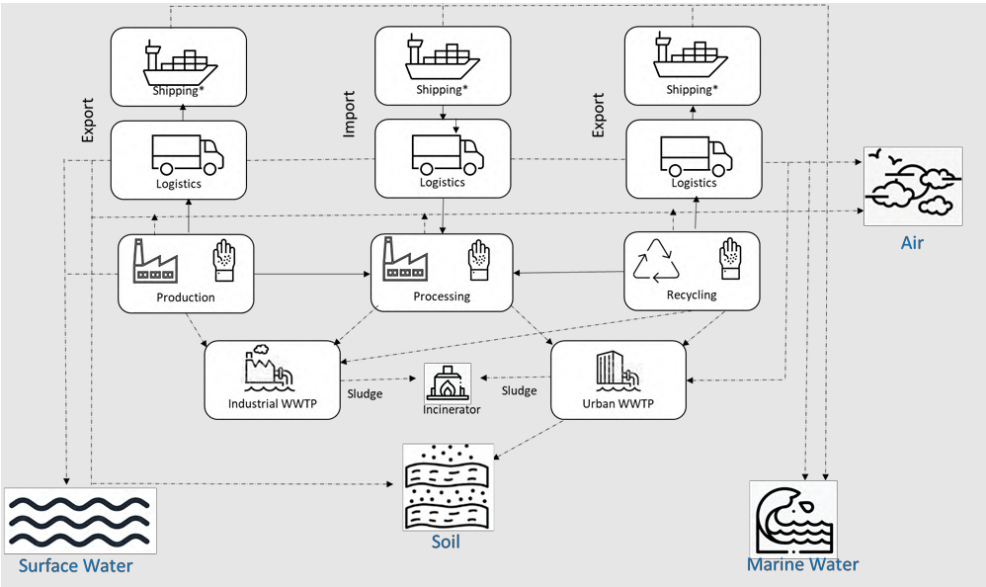

Figure 8: Pellet pathways (solid lines represent pellet movements and dotted lines are loss pathways)

The plastic pellet value chain is not airtight, and there are numerous opportunities for pellets to be lost into the environment. Pellets are released by the plastics industry at all stages of their life-cycle: during production, conversion, transport and storage (at every facility they are handled in). When pellets are spilled, they can reach the environment through two routes:

Direct releases into the environment:

- **Aquatic environment**: Pellets may be released directly into waterways, during handling operations, in particular at ports or during cargo transport at sea.
- **Land environment**: Pellets may be released at site or during transportation due to leaking packaging or during handling when transferring between different modes of transportation.
- **Air**: some pellets are in the form of powder and could be found in air when not properly contained.

Discharges in wastewater: via rainwater into storm-water drains, or wastewater treatment systems (WWT).

When pellets are spilled during logistic and shipping operations, they normally reach the environment directly and end up in water, land, and sometimes air.

Lost pellets may be carried by rainwater into storm-water drains. These transport the water into the urban wastewater treatment (WWT) plants, when connected, which is approximately 65% of the cases. The pellets may then be discharged into the aquatic environment through storm-water discharges or, where the sewage and storm sewers are combined, through WWT discharges. Normally, stormwater drains are designed to collect and carry rainwater, melted snow, and other precipitation from the land surface. Stormwater drains are typically separate from wastewater drains, which carry sewage and other household or industrial wastes to wastewater treatment plants. In some cases, depending on local regulations and infrastructure, stormwater and wastewater may be combined in a single drain. Some may discharge directly into nearby water bodies, while others may flow into retention ponds, infiltration basins, or other types of stormwater management systems. In

urban areas, stormwater may also be collected and treated before discharge to reduce the risk of flooding or water pollution.

When pellets are spilled inside installations where pellets are handled, dry or wet cleaning is possible. In the case of dry cleaning, pellets are collected and then go to waste management (mostly for incineration), except for recyclers who collect and put them back in the recycling process. Wet cleaning pushes pellets to drains. From there, spilled pellets typically reach industrial wastewater treatment in the case of production installations. Processing and recycling installations are either linked to industrial or urban wastewater treatment systems.

In industrial wastewater treatment facilities, pellets are mostly captured in sludge and incinerated. However the effluent may still contain some pellets (particularly, flakes and powders). In urban wastewater treatment facilities, pellets are also captured in sludge (between 95-99%, depending on the treatment efficiency). Depending on the sludge management, microplastics are either destroyed (through incineration, for example) or released into the environment if sludge is spread on agricultural lands (on average 50% of all sludge in the EU is applied in agriculture as fertilizer). These pellets may stay in the soil or ultimately reach the aquatic environment (runoff to surface water or through soil to groundwater). Pellets can also reach water via overflows, bypassing the wastewater facilities.

Therefore, the main pathways of pellets lost are water-related, i.e. urban, rain and storm water for losses occurring in terrestrial areas and marine water for losses at cargo handling installations at ports or occurring during cargo transport at sea.

1.4 Scale of the problem

While observable, these losses are not routinely measured, or indeed readily measurable at any specific step. There is no harmonised methodology for measuring pellet losses. Neither pellet loss measurements have been made at different steps of the supply chain, nor are any systemic monitoring and reporting data available within the Member States or the industry to calculate pellet losses. Hence, it is impossible to establish exact figures on pellet losses at each step because it depends on the installation size, actors involved, management practices, etc., and all these aspects are very heterogeneous in the EU.

Efforts to quantify the amount of pellets entering the environment typically apply a 'loss rate' as well as a number of handling steps to the total pellet volume handled. Robust empirical evidence to inform a 'loss rate' or a number of handling steps is scarce. However, the greater the number of steps at which pellets are handled, the greater the opportunities for loss.

The major handling steps occur at production plants (of both virgin and recycled pellets), processing installations and during logistic operations, i.e. all loading and unloading operations to transport pellets from one installation to another including warehouse installations, where pellets are stored and/or re-packed, and cleaning installations.

Several studies use the figures for pellet losses of 0.01%-0.04% (according to Sundt et al. (2014)[164]. However, this figure is an estimate from just one processor and is based on measurement in the effluent, so it does not measure losses at other steps of the supply chain, nor emissions happening otherwise, i.e. direct emissions to air, water and soil. Given the high uncertainty and potential double counting, rates in the range of 0.001% and 0.1% have been suggested by some studies such as Peano

[164] Norway (2014) Sources of microplastic pollution to the marine environment, Report for Norwegian Environment Agency.

et al. (2020)[165]. Compared to the total pellet volume, loss estimates in various publications show a wide variation (see table below), making it difficult to estimate the exact magnitude of the problem[166]. The reason for such a large variation is that the actors involved in the supply chain range from very small micro-enterprises to large companies and the level of awareness and measures in place to prevent pellet losses vary considerably. Similarly, the number of handling steps in a typical supply chain is influenced by the size of the operation, which is often driven by the demand for specific plastics products and also external factors (e.g. petrol prices, pandemic, economic crisis, energy price).

During the stakeholder meeting of 12 December 2022, stakeholders overall agreed with the approach but had diverging opinions on the loss rates (the industry considers them too high) and the number of handling steps (NGOs consider them too low[167]).

OSPAR[168] has further detailed the reasons leading to the lack of reliable information as follows:

- Most of the data were collected by interviews or questionnaires and not by measurements;
- The number of companies in the studies is relatively low;
- Different phases of the plastic cycle are involved (transport and production);
- Different companies may be involved (producers, transporters, storage companies and converters);
- The difference in the definition of pellet loss: some respondents seem to focus on the total pellet spill. In contrast, other respondents focus on the fraction of pellets that are washed into the drains or surface waters. An unknown fraction of the lost pellets will be collected and disposed of with solid waste; and
- Different study designs: For example, the German study estimated resource efficiency (production yield) by comparing the mass of the feedstock purchased and the mass of the final product sold, whereas, in other studies, the mass of pellet spills was estimated based on observations.

Due to the lack of data and awareness, it was difficult to provide exact numbers on pellet loss. This is well exemplified by the fact that all estimates in literature on pellet losses during the production phase are based on one single Norwegian plant.

To take into account these uncertainties, a range of loss rates is used to calculate the losses occurring at four major steps: production, processing, recycling and logistics. It is estimated that losses happen at a higher rate at processing and recycling installations because of relatively small installations and large number of handling steps (0.02%-0.06% of the total volume processed/recycled) than at production ones (0.01%-0.03% of the total volume produced), and at an even higher rate during transport and logistic operations (0.03%-0.12%) because of pellets normally entering the environment directly. These rates count for the major handling steps in production, processing,

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[165] Peano et al., 'Plastic Leak Project', 2020 (https://quantis.com/who-we-guide/our-impact/sustainability-initiatives/plastic-leak-project/).

[166] OSPAR, 'Assessment document of land-based inputs of microplastics in the marine environment', 2017 (https://www.ospar.org/documents?v=38018 Page 22).

[167] Seas at Risk provided a long list of different handling steps where pellet losses could occur, however without any figures on loss rates.

[168] OSPAR Commission, 'Assessment document of land-based inputs of microplastics in the marine environment', 2017 (https://www.ospar.org/documents?v=38018).

recycling and transport/logistic phases and do not take account of other handling steps occurring in other phases (e.g. distribution), for which no data is available. These figures are therefore at the same time uncertain due to the lack of a standardised methodology to measure pellet losses and scarce data, and conservative. As said, losses depend on the volume handled, type of facility, variability in pellet handling practices across the sector and Member states, etc. These figures will be improved once the reporting obligation under REACH (and possibly complemented with a harmonised methodology under this initiative) is in place.

Pellet loss calculations were made using these ranges of pellet loss ratios (lower and higher figures) for the four types of operations, namely virgin pellet production, recycling, pellet processing and logistics. These pellet loss ratios are applied to the volume of pellets handled during different steps of the pellet supply chain.

The table below presents a recap of the main evidence available to date.

Table 45: Summary of Literature on microplastic emissions due to pellets

Author and Year	Area of Study	Estimate of Pellet Loss	Basis of Estimate
OECD (2009)[169]	USA	The emission factor (EF) for dust emissions from transferring solid powders is estimated at 5 kg per tonne (0.5%)	This was the default emission factor as found in a previous USEPA (2006) model to estimate dust releases from transferring solid powders, using data from industries including paint and varnish formulation, plastic manufacturing, printing ink formulation, rubber manufacturing, and chemical manufacturing
Nova Institute (2015)[170]	Germany	0.1 – 1.0% of total plastics production 21000 to 210 000 tonnes/year for Germany	Estimates of resource efficiency comparing how much raw material is needed to make a tonne of manufactured product
Norway (2014)[171]	Norway	0.09% of total plastics production (0.05% from transport and 0.04% from processors) 450 tonnes/year for Norway	The transport estimate is based on the OECD (2009) emission factor for dust emissions from transferring solid powders and an assumption that 10% of this will not be contained by spill control measures. A Norwegian reprocessor provided the estimate of 0.04%.
Denmark (2015)[172]	Denmark	On average, 0.01% of raw material consumption at plastics facilities. Maximum 0.0013% of raw material	Estimates were provided by processors who have joined OCS in a survey undertaken by the Danish Plastics

[169] OECD, 'Emission Scenario Document On Adhesive Formulation', 2009 (https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2009)3&doclanguage=en)

[170] Essel, R. et al., Report for the German Federal Environment Agency 'Sources of microplastics relevant to marine protection in Germany', 2015 (https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_64_2015_sources_of_microplastics_relevant_to_marine_protection_1.pdf).

[171] Sundt, P. et al. Sources of microplastics-pollution to the marine environment, Norwegian Environment Agency Miljødirektoaret, 2014

[172] Lassen et al. Microplastics - Occurrence, effects and sources of releases to the environment in Denmark, The Danish Environmental Protection Agency, 2015.

		consumption for processors that have joined OCS. Total emissions = 3 to 56 tonnes/year for Denmark	Federation. The figures represent the loss to sewage from within the companies' area (incl. unloading from trucks that deliver raw materials). The authors adjust the potential for bias in providing this information by assuming the average facility will lose ten times as many pellets.
Boomerang Alliance (2015)[173]	Australia	1% of domestic production, relating to a medium scenario of nurdle loss in domestic production and transport. 10,000 tonnes/year for Australia	The source of this estimate is not given in the paper – not based on empirical evidence.
EC/Eunomia (2016)[174]	EU	0.04% losses of domestic production from production, of which 0 – 57% will be captured in wastewater treatment. 0.05% losses of domestic production from transport, of which 10 – 50% will be captured in some way before they reach the oceans. 24,000 to 48,450 tonnes/year for Europe. The data was reported as unreliable / unrepresentative in the report.	Both pellet loss figures are taken from the Mepex study. The wastewater capture is calculated from 63% of EU population being connected to tertiary wastewater treatment. In the best case 90% of microplastics are captured in these facilities and the worst case, no microplastics are captured. The capture of losses from transport is an assumption reflecting the likelihood that pellet spills that occur during transport – especially oceanic – will not be captured in a wastewater treatment system
Eunomia (2016)[175]	UK	0.001 – 0.01% loss at each stage (four stages studied – producers, processors, storage and transport, offsite waste management) 105 to 1054 tonnes/year for the UK	Loss rates based on Danish EPA (Denmark, 2015). The lower bound of this range assumed that every UK facility loses no more pellets than the Danish processors reported that they lost. The Danish EPA study assumes that the average facility loses ten times more than the best performing, but this provided the highest rate of pellet loss reviewed that could be used in the study. Instead of better data, and supported by personal communication with a Scottish processor, this estimate was therefore used for the worst-performing facility, i.e., the upper bound figure.
Sweden (2016)[176]	Sweden	Pellet loss is calculated at two points – a 0.04% emission factor is assumed from plastic pellet production, and a lower and upper estimate of 0.0005% - 0.01% loss rate is estimated from pellet handling at processors. The latter is estimated as net	The pellet loss from production figures is taken from the (Norway, 2014) study. The handling figure is based on (Denmark, 2015)

[173] Boomerang Alliance, Submission to Australian Senate inquiry 'The threat of marine plastic pollution in Australia', 2015 (https://assets.nationbuilder.com/boomerangalliance/pages/158/attachments/original/1445317763/Environment_Communications_marine_plastic_sub77.pdf?1445317763).

[174] Eunomia, 'Report to DG Environment on Study to support the development of measures to combat a range of marine litter sources', 2016.

[175] Eunomia, 'Report for Fidra on Study to Quantify Pellet Emissions in the UK', 2016.

[176] Magnusson et al. Swedish sources and pathways for microplastics to the marine environment, Swedish Environmental Protection Agency, 2016.

		emission figures (i.e. emissions to the environment). 310-533 tonnes/year for Sweden	
IUCN (2017)[177]	Global	Losses are computed at four stages: production of primary plastics, manufacturing of plastics, transport on land (for domestic uses of plastics products) and water (for interregional trade of plastics products), as well as plastic end-of-life. Optimistic (0.000003%) / central (0.00001) / pessimistic (0.0001%) of microplastics losses per stage	Loss rates are wrongly stated to be based on Fidra 2016. No other basis for the range of loss rates is provided. Fidra's assumption is that in this report there was a reporting error.
UN Environment (2018)[178]	Global	0,04% losses during production and processing. The average value, i.e. 0.005%, (estimate between 0.0005% and 0.01%.) was used for estimating losses during loading, reloading and transportation of the pellets. 30,000 tonnes/year global	The loss rates figures were taken from Norwegian polystyrene plant where a loss of 0.4 g/kg was reported (Norway, 2014). This value was used to estimate losses from the production and processing of pellets. The loss of pellets during transport and handling was calculated based on (Sweden, 2016) report.
Ryberg et al. (2019) [179]		0,04% losses during Production. Between 0,001% to 0,01% during processing. 0,0035% during handling and transportation. 20,000 tonnes/year global	The study uses four sources to estimate the losses (Norway, 2014), (Denmark, 2015) (Sweden, 2016) and Eunomia 2016[180] Production losses based on (Norway, 2014). Processing losses based on (Denmark, 2015) and Eunomia 2016 Handling and Transportation losses based on (Sweden, 2016) and Eunomia 2016

1.5 Chronic losses in reference year

High volumes of pellets are produced and handled every year, both globally and in Europe. There is a direct relationship between the amount of pellets produced and the amount released in the environment.

In Europe, in 2019, about 65.3 million tons of pellets (57.9 million tonnes of virgin, 6.5 million tonnes of recycled, and 0.9 million tonnes of bio-based) were produced in the EU. In the same year, 12.7 million tonnes of pellets were imported to Europe to be converted into final plastic products at a converting site in the EU, while 14.9 million tonnes of pellets were exported.

[177] International Union for Conservation of Nature, 'Primary Microplastics in the Oceans: A Global Evaluation of Sources', 2017 (https://portals.iucn.org/library/sites/library/files/documents/2017-002-En.pdf).
[178] Ryberg et al. Mapping of global plastics value chain and plastic losses to the environment, UN Environment, 2018.
[179] Ryberg et al. Global environmental losses of plastics across their value chains, Resources, conservation and recycling, 2019 https://doi.org/10.1016/j.resconrec.2019.104459
[180] Eunomia, 'Report for Fidra on Study to Quantify Pellet Emissions in the UK', 2016.

This impact assessment has found that the amount of pellets lost to the environment in the EU in 2019 can be estimated to be between 52 140 tonnes and 184 290 tonnes (see the table below for the the value chain)**, equivalent to 0.08% to 0.28% of total pellet volumes in the EU.**

Table 46: Pellets lost (tonnes per year) per sector and per size of the companies

	Micro	Small	Medium	Large	Total
Production	0	0	0	7222 – 21 665	7222 – 21 665
Waste management, including recycling	0	0	0	1448 – 4345	1448 – 4345
Conversion	611 – 1834	2445 – 7334	5583 – 16 748	6961 – 20 884	15 600 – 46 800
Logistics	2378 – 9513	4529 – 18 116	7109 – 28 436	13 854 – 55 414	27 870 – 111 480
Total	2990 – 11 347	6974 – 25 450	12 692 – 45 185	29 485 – 102 308	52 140 – 184 290

The calculations are explained in Annex 9, on the baseline.

Figure 9 shows the global distribution of pellets losses, as well as the importance of these losses.

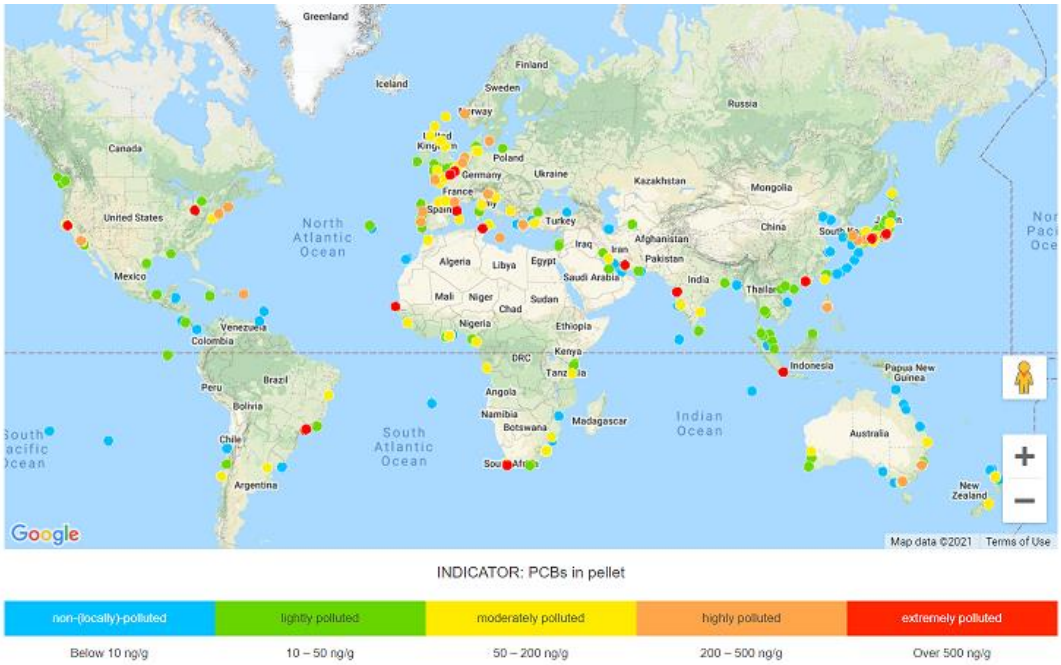

Figure 9: Scale of pellet losses at global level[181]

[181] International Pellet Watch, 'Where can we find the plastic resin pellets?' (http://pelletwatch.org/where#:~:text=Plastic%20resin%20pellets%20are%20distributed,trash%2C%20wood%2C%20shell).).

2 ADVERSE IMPACTS

Four types of adverse impacts can be observed from pellets finding their way into the environment: 1) on the environment itself; 2) on climate; 3) on human health; 4) and on the economy.

These impacts are described in Annex 7.

3 PROBLEM DRIVERS

There are several market and regulatory failures.

3.1 Market failures

1) **Prices do not reflect negative externalities**: The activities of economic operators do not integrate the negative externalities caused by pellets finding their way into the environment, leading to a suboptimal market outcome. On one side, due to their small size, pellets are easy to spill; on the other side, it is relatively costly to prevent spills or to clean up after spills as good handling practices require measures to be taken, such as training of staff. The cost of lost pellets, incurred by economic operators involved in the production, use and transport of pellets, is not sufficiently high to motivate a change in behaviour. In addition, once spilled, pellets are considered contaminated and therefore become waste[182]. There are no incentives for economic operators to integrate the negative externalities caused by pellets finding their way into the environment.
2) **Imperfect information**: Economic operators do not have sufficient information to be fully aware of the pellets which are unintentionally lost from their operations (and of consequential impacts). This applies notably to the smaller companies present in the pellet supply chain, mostly on the conversion side. As no systematic monitoring and reporting systems are in place, they are not aware of quantities released, and because there is no or insufficient awareness raising about the impacts, they are not aware of the negative externalities. Furthermore, as information on available preventive and mitigating measures by responsible companies is not sufficiently promoted throughout the supply chain, they are not aware of possible actions to be taken. Under these circumstances, it is difficult for economic operators to make sustainable choices when investing in new equipment, determining their internal procedures and choosing partners along the supply chain. A lack of specific support for the smallest companies present in the supply chain, especially on the conversion side, also explains a suboptimal market outcome.

As such, economic operators do not sufficiently integrate concerns about pellet losses in their operations and no sufficient information about quantities, impacts, actions etc., is routinely sought or promoted.

3.2 Regulatory failures

Existing EU legislation does not address pellets sufficiently: The absence of specific requirements to implement best handling practices is arguably the most significant of the problem drivers. While existing EU regulatory frameworks could be relevant (governing marine litter, water, industrial emissions, waste, packaging, chemicals and transport activities), they do not specifically address the issue of pellet losses and their responsible handling to prevent and reduce losses to the environment.

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[182] Hann, S., Sherrington, C., Jamieson, O., Hickmann, M., Kershaw, P., Bapasola, A., Cole, G. (2018). Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products, Eunomia.

At the national level, the very large majority of facilities involved in the conversion of pellets or in logistic operations related to pellets are too small to attract attention and receive routine visits from environmental regulators as to for instance implementation of waste legislation.

Pellets are very partially covered by the REACH restriction on microplastics intentionally added to products[183]. The restriction proposal does not prevent the placing on the market of pellets but does foresee lighter measures for so-called 'derogated' uses, meaning uses of microplastics at industrial sites, including plastic pellet sites, where releases can be prevented through risk management measures. These lighter measures are namely an 'instructions for use and disposal' requirement along the supply chain, and a 'reporting' requirement, as outlined in detail in Annex 6. All together, the reported information on all 'derogated' uses would help identify high releases and prioritise them for further regulatory risk management. However, as they apply to all 'derogated' uses, these lighter measures are generally defined and not specific to each single 'derogated' use. Also, they do not help as such to effectively reduce pellet losses or prevent them (e.g. they are not a requirement on their handling), and the reporting requirement is not based on a methodology to measure pellet losses (it was left to the industry to develop a methodology).

The Marine Strategy Framework Directive addresses the monitoring and assessment of the impacts of microlitter, including microplastics, in coastal and marine environments in a way that they can be linked to sources[184]. Currently, a guidance document is under development in view of a harmonized method to monitor the presence of plastic pellets along EU coastlines. However, this work does not include specific requirements concerning the prevention or reduction of pellet losses at source.

The revised Urban Waste Water Treatment Directive (UWWTD)[185] proposes to measure microplastics in the inlets and outlets of the urban WWT plants (including in the sludge) for agglomerations. The measures proposed in the UWWTD are only end-of-pipe solutions and no specific requirements concerning the prevention or reduction of pellet losses at the source are foreseen.

The Sewage Sludge Directive (SSD)[186] does not address microplastics. During its evaluation, the concept of source control i.e. targeting substances such as microplastics and micropollutants at source, was widely supported by stakeholders in order to improve circularity in the wastewater treatment sector. Indeed, for the sludge and/or water is to be reused, stakeholders highlighted that there is a need for tracking and preventing pollution at source.

The recast of the Drinking Water Directive (DWD), the update of the Groundwater Directive (GWD) and the Environmental Quality Standards Directive (EQSD) all include provisions related to microplastics monitoring at the end-of-life stage only.

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[183] Commission Regulation (EU) …/… amending Annex XVII to Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards synthetic polymer microparticles.

[184] EUR-Lex - 32017D0848 - EN - EUR-Lex (europa.eu) "…micro-litter shall be monitored in the surface layer of the water column and in the seabed sediment and may additionally be monitored on the coastline. Micro-litter shall be monitored in a manner that can be related to point-sources for inputs (such as harbours, marinas, waste-water treatment plants, storm-water effluents), where feasible."

[185] Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01991L0271-20140101).

[186] Council Directive of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture (86/278/EEC) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01986L0278-20220101).

The Industrial Emissions Directive (IED)[187] aims to prevent and control pollution arising from industrial activities in large industrial installations, and is only partially suited to address pellet losses as a form of pollution occurring along the entire supply chain. While activities like the production of polymeric materials, such as pellets, on an industrial scale fall under the scope of the IED, other activities like the conversion, transport or storage of pellets, usually operated by small and medium enterprises, are not covered. In addition, the BAT Reference Document (BREF) for the production of polymers was adopted in 2007 and does not address the specific issue of pellet losses.

Waste legislation such as the Waste Framework Directive (WFD)[188] and Packaging and Packaging Waste Directive[189] does not specifically address the pellet loss issue as they do not regulate emissions during the production of products or packaging. The WFD imposes Member States a generic obligation to take waste preventive measures addressing the industrial generation of waste as pellets can be. The Commission could adopt guidelines to assist Member States in preparing their programmes and preventive measures based on the WFD. Nevertheless, the implementation of these guidelines by Member States is voluntary thus not ensuring the harmonised implementation of preventive measures throughout the EU and the level playing field among economic operators.

4 OBJECTIVE

4.1 General objectives

The general objective of this initiative is to contribute to the reduction of microplastic-related pollution by preventing and reducing pellet losses to the environment that are due to current handling pellet practices at all stages of the supply chain within the EU, thus reducing the adverse environmental, economic and (potential) human health consequences of pellet pollution..

4.2 Specific objectives

Accordingly, the above general objective translates into three specific objectives:

- To reduce and prevent pellet losses in an economically proportionate manner to a level consistent with the Commission's 2030 target of a 30% reduction in both intentional and unintentional microplastic releases (compared to 2016 levels);
- To improve information on the magnitude of pellet losses throughout the pellet supply chain, in particular the accuracy of loss estimates, and to raise awareness among relevant actors; and
- To ensure the appropriate mitigation of impacts on SMEs involved in the pellet supply chain.

[187] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast) (annexe 6 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02010L0075-20110106).

[188] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705).

[189] European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01994L0062-20180704).

Annex 9:
Baseline

To develop the baseline for pellet losses to the environment, the following methodology was used due to a lack of pre-existing harmonised methodology, along with significant knowledge gaps in data and reporting.

1 THE PELLET SUPPLY CHAIN

In the pellet supply chain, pellet losses can occur at different steps of production, processing, and logistical activities. It is important to distinguish between the three types of chains detailed below to consider which activities are relevant. However, the magnitude of pellet losses will depend on the number of intermediate steps and on pellet handling practices at different facilities.

- For **pellets produced and processed in the EU**, pellet losses could occur during all three activities.
- For **pellets produced in the EU and exported**, pellet losses could occur at the pellet production facilities and during the logistics for export.
- For **pellets imported into the EU and processed in the EU**, there could be losses during import logistics and losses during processing.

The pellets supply chain is mainly grouped into three main categories: **production, processing and logistics**. Each step contains several steps where pellets losses can occur (see Annex 8). There is however hardly any info on the pellet spills and losses at each step. Therefore a different method needs to be used to estimate pellet losses to the environment.

For production, one also needs to distinguish between virgin pellet production and pellets produced through plastic recycling (pre-consumer and post-consumer), as recycling plants also include small facilities and have therefore higher risks of pellet losses.

The data sources and assumptions used to estimate the total quantity of pellets production are the following:

- 2019 is taken as the baseline year, as 2020 is an outlier because of COVID, and we are seeing positive growth trends again from 2021;
- For virgin pellets, the projections are made from 2019 figures[190]; a growth rate of 0.9% per year is assumed till 2030[191];
- The source for recycled pellets production data (2019-2021) is Plastic Recyclers Europe; a growth rate of 5.6% per year is assumed[192];

[190] Plastics Europe changed the calculation method in 2021, excluding adhesives, paints and coatings, thus not used to be coherent with previous year estimates and also with import/export figures

[191] Plastics Europe and SystemIQ

[192] K 2022 - Trend Report Europe https://www.k-online.com/en/Media_News/Press/Technical_article/K_2022_-_Trend_Report_Europe

- The source for bio-based pellets production data (2019-2021) is Plastics Europe; for a growth rate CAGR of 14% for 2022-2027[193], and the same trend is assumed to continue till 2030;
- Pellets imports and exports figures for virgin pellets are from Eurostat; a growth rate of 0.9% is assumed till 2030.

Using these assumptions, the total pellet production is expected to reach about 79 million tonnes in 2030. If we take into account imports and exports, the net volume of pellets used in the EU would be around 76 million tonnes in 2030. The total figures estimated here are within 1% range compared to the estimates made by the recent OECD scenario[194] that used a modelling approach (see Figure 10).

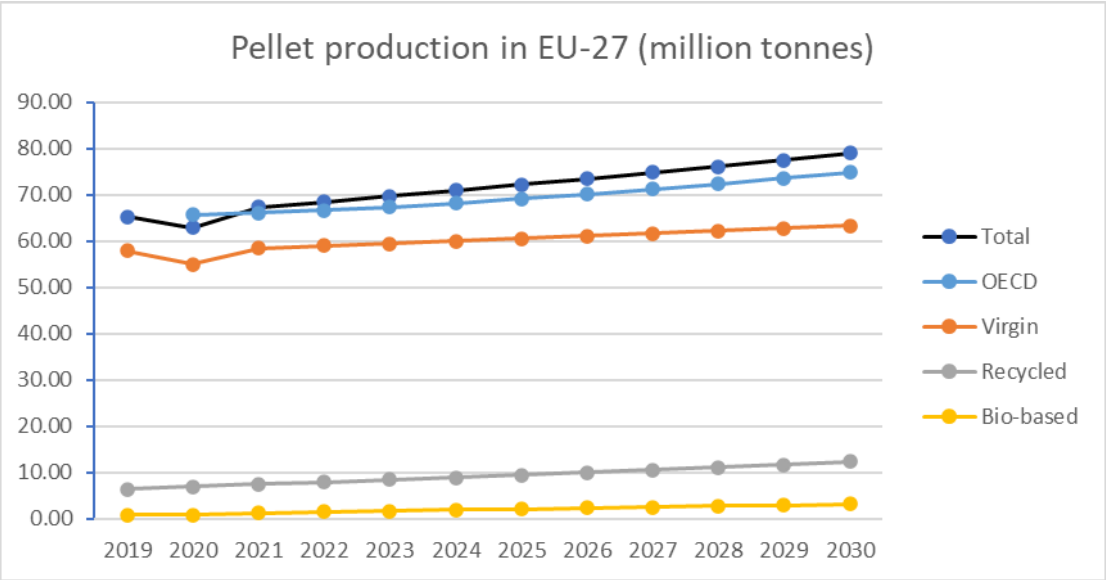

Figure 10: Pellet production volumes in EU-27 and projections until 2030

2 How will pellet losses evolve in 2030?

To define the projected development of total pellet losses in 2030, consideration was given to the following: 1) Existing and forthcoming EU legislation; 2) National and international initiatives; 3) Industry initiatives. These pieces of legislation and initiatives are presented below.

2.1 Existing and forthcoming EU legislation

The existing and forthcoming EU legislation with relevance for pellet losses is described in detail in Annex 6. This legislation includes the REACH restriction on unintentionally added microplastics, the Marine Strategy Framework Directive, several pieces of water-related legislation, the Industrial Emissions Directive and the Waste Framework Directive. Globally this legislation is not explicitly considered in the baseline as (1) the analysis was done at the same time and it was not clear which measures would be proposed, or more importantly (2) the measures applying or under consideration

[193] Nova Institute (2023) Bio-based Building Blocks and Polymers Global Capacities, Production and Trends 2022–2027 https://renewable-carbon.eu/publications/product/bio-based-building-blocks-and-polymers-global-capacities-production-and-trends-2022-2027-short-version-pdf/

[194] OECD (2022) Global Plastics Outlook: Policy Scenarios to 2060. https://www.oecd.org/publications/global-plastics-outlook-aa1edf33-en.htm

are limited in scope and impact, or generic (mainly reporting, monitoring or provisions for larger plants only).

2.2 National and international initiatives

A few Member States have already started to introduce measures to tackle pellet losses. These measures are summarised in Table 47 and presented in detail in Annex 6.

Table 47: Member State actions targeting pellet losses

Country	Actions
Austria	• Law adopted addressing "filterable substances" to which pellets belong
Belgium (Flanders)	• Introducing environmental permit system / Best Available Techniques • Examining an environmental management system with possible certification
Denmark	• Monitoring • Waiting for OCS certification scheme implementation and Commission's proposal
France	• Law adopted providing minimum obligations to prevent pellet losses for all actors in the supply chain along with mandatory external auditing
The Netherlands	• Monitoring • Waiting for OCS certification scheme implementation
Spain	• Promoting OCS certification scheme implementation
Sweden	• Revising current guidelines to make them more comprehensive and include more actors across the supply chain

France is the only Member State to have adopted legislation specifically targeting pellet losses. This legislation covers businesses making and handling pellets in quantities higher than 5 tonnes including logistic platforms but not transporters. The threshold has been reduced from what initially proposed i.e. 10 tonnes following public consultation. Businesses are subject to equipment and procedural obligations to prevent the loss and leakage of pellets, and are required to be regularly audited by independent and accredited certification bodies[195]. Obligations remain of a relatively generic nature. For instance, a business must identify areas where pellets are more likely to spill, check that the packaging used is designed to minimise the risk of spills and train and raise awareness among staff. As a unique transparency measure, the company must make the summary of the auditing report available on its website. The Decree entered into force on January 1, 2022 for new sites, while for existing sites, it will enter into force in 2023, at the same time as equipment obligations.

In 2021, the British Standards Institution published the Publicly Available Specification PAS 510:2021[196], for use by organisations of any size across the pellet handling supply chain. It builds on

[195] Décret no 2021-461 du 16 avril 2021 relatif à la prévention des pertes de granulés de plastiques industriels dans l'environnement [Decree n. 2021-461 of 16 April 2021 related to the prevention of the leakage of industrial plastic pellets into the environment], Journal official "Lois et Décrets" no. 0092 du 18 avril 2021 [JORF] [Official journal "Laws and Decrees" no. 0092 of 18 April 2021], 18 April 2021, Fr.

[196] BSI Knowledge, 'Plastic pellets, flakes and powders. Handling and management throughout the supply chain to prevent their leakage to the environment. Specification - PAS 510:2021101', 2021 (https://knowledge.bsigroup.com/products/plastic-pellets-flakes-and-powders-handling-and-management-throughout-the-supply-chain-to-prevent-their-leakage-to-the-environment-specification?version=standard).

the industry-led Operation Clean Sweep® (OCS) programme (see Annex 6) by creating a standardised and consistent approach to risk management and containment of pellets[197]. The PAS might be considered for further development as a British standard or constitute part of the UK input into the development of a European or International standard on pellets.

In 2021, the parties to the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) adopted the non-binding Recommendation 2021/06[198] to reduce the loss of plastic pellets in the marine environment by promoting the timely development and implementation of effective and consistent pellet loss prevention standards and certification schemes for the entire plastic supply chain. The Recommendation was accompanied by supporting guidelines which set out essential requirements for standards and certification schemes. The first full implementation report is due in January 2025, with an interim report due in 2024. A preliminary interim report was informally shared by OSPAR in February and the actions reported by the Member States that are parties to the OSPAR Convention are presented in the above Table 47.

In the International Maritime Organization (IMO), a Correspondence Group on Marine Plastic Litter from Ships looked at measures that could be relevant in reducing the environmental risk associated with the maritime transport of plastic pellets. While three primary measures including packaging were identified as particularly relevant to reduce the environmental risks associated with the maritime transport of plastic pellets (and a voluntary circular to this effect was drafted), the Group was not in a position to conclude on the most appropriate instrument for mandatory measures[199]. The Group noted that experience gained from the implementation of voluntary measures could be useful in the further consideration of the most appropriate instrument for mandatory measures.

A similar international initiative is ongoing on containers lost at sea, and discussions are held on the possibility of making the information on containers lost at sea available publicly (to date, such information is reported only to insurance companies). If retained, this measure would allow for a better understanding of the scale and magnitude of pellets lost at sea and would facilitate liability identification and compensation arrangements in line with the polluter pays principle.

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[197] The PAS provides requirements in the following areas: a) Organizational responsibilities; b) Leadership and commitment; c) Competence, training and awareness; d) Risk assessment of pellet loss to the environment; e) Operational controls, i.e. prevention, containment and clean-up, procurement and suppliers; f) Internal and external communication; g) Performance evaluation, i.e. monitoring and documentation, auditing and verification of conformity; h) Improvement, i.e. internal and external non-conformity and corrective action, and continual improvement.

[198] www.ospar.org/convention/strategy

[199] The three primary measures identified as relevant are: Packaging provisions for plastic pellets carried at sea; Provisions for notifying the carrier so that containers containing plastic pellets can be identified; Stowage provisions for freight containers containing plastic pellets. Among the options for mandatory measures, the Group considered the three following options/instruments: Assignment of an individual UN Number (class 9) for plastic pellets transported at sea in freight containers (UN Number); Amendment to Appendix I of MARPOL Annex III that would recognize plastic pellets as a "harmful substance" (Harmful substance); A new chapter to MARPOL Annex III that would prescribe requirements for the transport of plastic pellets in freight containers without classifying the cargo as a harmful substance/dangerous goods.

2.3 Industry initiatives

Since 2015, the European plastic manufacturing industry has progressively adopted the Operation Clean Sweep® (OCS) programme[200] as a voluntary pledge to work towards zero plastic pellet losses. This programme is presented in detail in Annex 6.

While best practices are generally well understood, they have not been comprehensively implemented. As of April 2023, 2548 companies have committed to OCS[201]. This figure includes all PlasticsEurope's members (these are producers; adherence to OCS is mandatory for the members of this association). Only 2% of EuPC's members (converters) have committed to OCS (around 1 000 converters out of 48 000); and only some 500 transport companies. As no precise reporting has been made available within OCS, it is not possible to say whether those who have committed have also effectively or fully implemented the programme, with evidence showing the opposite. Both acute and chronic pellet incidents have been reported to continue over the last years, including at sites that are OCS signatories[202].

The recent launch of the OCS Certification Scheme (OCS CS) aims to address these issues. Recognising the low uptake of OCS by the industry, in 2019, European plastic manufacturers (PlasticsEurope) and converters (EuPC) announced plans to develop a voluntary certification scheme building on OCS and including requirements, third-party, independent auditing, certification and some level of transparency (all aspects not foreseen under the current OCS programme). In January 2023, the new scheme was officially launched by its promoters. It is presented in detail in Annex 6.

While going in the right direction, the new scheme constitutes only a partial attempt by the industry to adopt a genuine supply chain approach and pursue the zero pellet pollution objective effectively. First of all, while the requirements are in principle applicable to all companies handling pellets, and all companies can get audited and certified, when fully in place, the new scheme will be required only for producers (adherence to the existing OCS programme is already mandatory for the members of PlasticsEurope since 2019[203]). Not all producers are members of PlasticsEurope. Thus, the new scheme will not be binding for key players in the pellet supply chain, such as converters, transporters, warehousing operators and recyclers.

EuPC, representing converters, found it difficult to make adherence to the new scheme mandatory for their members (to date, adherence of converters to the existing OCS programme is very low). As explained in Annex 8, members of EuPC are European and national associations representing close to 50,000 individual companies, out of which 66% are micro-companies. It is estimated that the certification process is relatively short for producers, (PlasticsEurope expect all their members to be certified by the end of 2024, some producers reporting however a longer period before certifying all their sites), while the process is set to be much longer for converters.

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200 www.opcleansweep.eu

201 www.opcleansweep.eu

202 Regarding chronic pellet losses in the Netherlands, Belgium and Spain, see https://www.plasticsoupfoundation.org/wp-content/uploads/2022/03/Westerschelde-plastic-nurdles-versie-definitief-21-11-2021-2.pdf; https://surfrider.eu/en/learn/news/ecaussinnes-belgium-surfrider-foundation-tackles-industrial-plastic-granules-1211028228325.html; https://goodkarmaprojects.org/2020/11/20/new-report-out-exposes-alarming-impacts-of-plastic-pellets-across-europe/?lang=en.

203 OCS becomes an intrinsic part of PlasticsEurope's DNA - Operation Clean SweepOperation Clean Sweep (opcleansweep.eu)

Transporters, warehousing operators and clean tankers are observers of the new OCS certification scheme and will be assessed (not certified) under the chemical industry's Safety and Quality Assessment for Sustainability (SQAS) system, which has contained requirements to tackle pellet losses starting since March 2023[204]. Full alignment between the new OCS certification scheme and the SQAS system is still pending. In particular, there are no plans currently to force OCS-certified companies to work exclusively with SQAS-assessed transport companies. To date, there are approximately 3000 transport companies which are SQAS-assessed and even more transport companies which are non SQAS-assessed. According to the sector, SQAS-assessed transport companies cover 80% of the total pellet transport of virgin pellet producers in Europe. Clean tankers are mostly SQAS assessed, while among warehousing operators only a part is SQAS assessed.

To test the new scheme, nine pilot audits covering producers, converters and transporters were held in 2021 in five countries: Belgium, Netherlands, Portugal, Spain and France. The bodies that conducted these audits were well-known bodies like Aenor, Bureau Veritas, SGS, etc. All audited companies failed to pass. The strongest point observed by auditors was a good involvement of management, while the weakest one was related to the objective of encouraging partners to pursue the same objectives.

At the end of 2021, FFI decided to resign from the Supervisory Board of the new OCS certification scheme arguing that it did not fully align with the guidelines of the OSPAR Recommendation 2021/06, and citing issues with the governance of the scheme, the level of transparency, the lack of a formal standard from a recognised standardisation body, the fact that the whole supply chain is not captured adequately, and the lack of timelines for compliance. FFI called instead for the introduction of effective legislation applicable to all pellet handling companies and based on a supply chain approach to eliminate this source of pollution fully[205].

Recyclers are neither promoters nor observers of the new scheme and have their own certification scheme in place (RecyClass), which has a section on pellet losses requiring the implementation of a procedure to prevent leakage within the premises and surrounding of the recycling plant, and ensure the training of staff. To go a step further, recyclers are conducting a study on potential areas in the recycling process where microplastics could be generated and released, and on preventive measures. The recommendations of this study will be used to complete the RecyClass certification scheme's pellet loss/microplastics requirements.

2.4 The baseline

All in all, the above national and international initiatives are expected to contribute to very limited reduction in pellet losses by 2030. France is the only country to have adopted specific national legislation to prevent pellet losses via legal obligations. The relevant provisions are relatively generic and do not cover transporters. However, the baseline considers an estimated reduction from it. The

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[204] A first addition to the SQAS assessment questionnaire was made in January 2022. The current version of the questionnaire is available here https://www.sqas.org/downloads/ts2022/SQAS%202022%20TS%20Questionnaire%20and%20Guidelines%20Rev%202%20(English).docx

[205] FFI call for the introduction of effective legislation that will require all pellet (flake and powder) handling companies across the whole supply chain to provide independent verification that pellet loss prevention measures have been implemented, maintained and monitored for effectiveness towards the goal of zero pellet loss to the environment, prior to materials being placed on the market. They also call for tighter restrictions on the packaging and labelling of pellets being prepared for transport to reduce the risk of loss and improve communication. Finally, EU legislation should complement international maritime legislation for pellets currently being considered by IMO to reduce the risk of catastrophic pellet pollution at sea.

other national initiatives are non-legislative and limited in scope (e.g. research and monitoring activities). Both the BSI PAS and the OSPAR Recommendation provide for a non-binding comprehensive set of measures to be taken and are reference documents in the field. However, in both cases, it is up to the companies or parties to implement such measures, and it was not possible, at the moment of the impact assessment, to evaluate their precise implementation. The IMO work on pellets focuses on one aspect only i.e. shipping of pellets, and has resulted so far in voluntary measures only, with very limited effects up to date.

Once fully in place, the new industry-led OCS certification scheme is expected to contribute to some reduction in pellet losses by 2030. It is difficult to assess the take-up of the new scheme by the industry, and therefore its effectiveness. This counts equally for similar schemes by the recyclers or logistics companies (RecyClass and SQAS).

For the baseline, it has been assumed that by 2030:

1. 90% of the total virgin pellet volume produced (by the members of PlasticsEurope) and 5% for the non-PlasticsEurope members, will be certified compliant against OCS new rules and will be effectively implementing such rules with a success rate ranging from 60% to 80%;
2. 20% of the total recycled pellet volume will be certified compliant against RecyClass pellet provisions and will be effectively implementing the new provisions with a success rate ranging from 40% to 60%;
3. 30% of the total volume processed will be certified compliant against OCS new rules and will be effectively implementing such rules with a success rate ranging from 40% to 60%;
4. 40% of the total volume handled by logistics companies will be SQAS assessed and will be effectively implementing such a scheme with a success rate ranging from 40% to 60%; and
5. The French legislation will cover about 85% of the French pellet volume (about 10% of the EU volume), leading to a 60-80% pellet loss reduction in 2030.

Based on the pellet loss calculations taking into account industry efforts (OCS new rules, RecyClass and SQAS) and Member State legislation (France), **in 2030, there will still be pellet losses in the range of <u>42 050 – 170 266 tonnes per year</u>**.

Table 48: Emissions in 2030 (in tonnes) considering the impact of ongoing/upcoming initiatives

	Low emission scenario	**High emission scenario**
Without considering ongoing initiatives	62 178	219 355
OCS reduction potential:		
• Producers	4 130 - 5 507	12 390 - 16 521
• Recyclers	197 - 296	592 – 889
• Processors	2 005 - 3 007	6 015 - 9 022
• Logistics	4 726 - 7 089	18 905 - 28 357
French legislation	3 171 - 4 228	11 187 - 14 916
Pellet losses in 2030 in the baseline scenario	**42 050 - 47 948**	**149 651 - 170 266**

Annex 10:
Policy options to reduce pellet losses

1 METHODOLOGY TO IDENTIFY MEASURES

Measures, i.e. specific technological and behavioural standards/changes affecting pellet losses, were identified from collected evidence (literature review) and stakeholder consultation (OPC, targeted interviews and workshops, targeted SME survey).

Overall, 173 ideas were identified during desk research and in the stakeholder workshops conducted in November 2021 and December 2022. After eliminating the duplicates, the long list of measures was as follows:

- Development of measurement standards for pellets;
- Voluntary Commitment to industry-led OCS certification scheme;
- Reduction target: devise a reduction target for pellet losses considering the current situation;
- Development of a universal information leaflet and labelling for packaging of plastic pellets for their transport;
- Training obligations (with regular updates) for all actors in the plastic pellet value chain;
- Ensure that all containers used for transport and storage are environmentally sealed, airtight and puncture resistant to prevent damage and tears;
- Classify pellets as harmful in the International Maritime Law (MARPOL Annexes III and V and inclusion of pellets in the International Maritime Dangerous Goods (IMDG) Code as hazardous or dangerous substances). Slots below deck or in more protected areas would be used to reduce the risk of container loss at sea;
- Mandatory reporting system for containers lost at sea in international waters. (Not just to insurance companies);
- Address/sanction big pellet losses under the EU Environmental Crime Directive;
- Support for SMEs, including financial incentives;
- Extended producer responsibility system for pellets / Set up an environmental damage remediation fund, financed by industry;
- Obligation for all supply chain players to prevent pellet losses through measures embedded in EU law;
- All installations, producing, converting, handling, transporting etc., can only operate having an environmental permit issued by a competent authority, by using the EU Industrial Emissions Directive;
- Independent verification of best practices using well-designed standards and certification schemes as promoted by the Commission of the regional convention for the protection of the

Marine Environment of the North-East Atlantic (OSPAR)[206];

- Prohibition on discharges (zero tolerance threshold similar to Formosa Plastic Consent Decree).

2 SCREENING OF MEASURES

The identified measures were screened using the criteria defined in the Better Regulation Tool #16.

From the outset, the option of developing standardised methods to measure pellet losses was retained (Option 1).

Voluntary commitments like the one under the industry-driven OCS and OCS certification scheme were considered as suitable options to address the identified problem driver 'Market failure (prices do not reflect negative externalities)'. In particular, the new industry-led OCS certification scheme was first retained as an option, then, discarded as the new scheme has in the meantime been launched by its promoters. Therefore, this impact assessment considers such commitment as part of the baseline.

The option of developing voluntary verification of best practices using well-designed standards and certification schemes is ongoing under the work of the Commission of the regional convention for the protection of the Marine Environment of the North-East Atlantic (OSPAR) and in the framework of the above mentioned industry efforts. Therefore, this impact assessment considers such development as part of the baseline. Also, certification is an essential part of Option 2.

Information/awareness raising on the handling of pellets throughout the pellet supply chain, and the development of a universal information leaflet and labelling for packaging of plastic pellets for their transport, were considered as suitable options to address the identified problem driver 'Market failure in the shape of imperfect information'. However, this impact assessment considers that this would be better taken up by the mandatory requirements in Option 2.

Training obligations (with regular updates) for all actors in the pellet supply chain were also considered as a suitable option, however, again, this impact assessment considers that this would be better taken up by the mandatory requirements in Option 2. Indeed, training is an essential part of this option.

The possibility of using the Industrial Emissions Directive to address pellet losses at relevant installations was discarded on the ground of effectiveness, efficiency and relevance. The IED is not suited to address pellet losses as a form of pollution occurring along the entire supply chain. While activities like the production of polymeric materials on an industrial scale fall under the scope of the IED, other activities like the conversion, transport or storage of pellets, usually operated by small and medium enterprises, are not covered. The permits are primarily designed for large installations with multiple environmental issues. Moreover, the BAT Reference Document (BREF) for the production of polymers was adopted in 2007 and does not address the specific issue of pellet losses.

[206] https://www.ospar.org/convention/text

The possibility of using the Environmental Crime Directive[207] to sanction all pellet losses was discarded on the ground of the limited scope of this legal instrument due to its nature (criminal law) and therefore not adequate to address all types of unintentional losses.

Supporting SMEs, including via financial incentives, is integrated in option 2 as a way to mitigate the regulatory burden on SMEs.

The possibility of setting extended producer responsibility schemes and environmental damage remediation funds, financed by industry, were discarded on the ground of technical feasibility and relevance. EPR targets a product, while for pellets, we have different types of "producers", those who manufacture the pellets, those who transform them into a product etc. Also, EPR aims to tackle the end-of-life, i.e. when the product becomes waste, while for pellets, it is a diffused pollution issue along the entire supply chain.

Classifying pellets as a "harmful substance" in the International Maritime Law was seen by some stakeholders as a positive measure to reduce the environmental risk associated with the maritime transport of pellets. However, an initiative on this precise issue is currently ongoing in the International Maritime Organization with the support of the European Union. At the same time, the Ship Source Pollution Directive is under revision, and one of the options could be to extend the scope of this Directive to MARPOL Annex III, where pellets could be classified as "harmful substance". Therefore, while addressing the maritime transport of pellets by means of more stringent packaging or stowing provisions may help reduce pellet losses at sea, this impact assessment considers such initiatives as part of the baseline. The same applies to developing a mandatory reporting system for containers lost at sea in international waters (initiative ongoing). On these acute pellet incidents, while losses of pellets coming from containers lost at sea are very visible and impactful on the shores affected, these losses are estimated not to represent the biggest losses in quantities.

The table below summarises the measures that have been screened out from the evaluation as well as the reasons for their exclusion.

Table 49: Discarded measures

Problem Area	Measure Title	Reason for screening out
Market failure/ Information/knowledge failure	Support for SMEs, including financial incentives	This measure is integrated in option 2 as a way to mitigate the regulatory burden on SMEs.
Market failure / Information failure	Development of a universal information leaflet and labelling for packaging of plastic pellets for their transport	The information on good practices exists, but is not well enough implemented. However, this impact assessment considers that this would be better taken up by the mandatory requirements in option 2.
Market failure / Information failure	Training obligations (with regular updates) for all actors from the plastic pellet value chain	Such obligations would help, but this impact assessment considers that this would be better taken up by the mandatory requirements in option 2.

[207] Directive 2008/99/EC of the European Parliament and of the Council of 19 November 2008 on the protection of the environment through criminal law.

Market/Regulatory failure	Extended producer responsibility (EPR) / Set up an environmental damage remediation fund, financed by industry	This measure is discarded on the ground of technical feasibility and relevance. EPR targets a product, while for pellets, we have different types of "producers", those who manufacture the pellets, those who transform them into a product etc. Also, EPR aims to tackle the end-of-life, i.e. when the product becomes waste, while for pellets, it is a diffused pollution issue along the entire supply chain.
Regulatory Failure	Independent verification of best practices using well-designed standards and certification schemes as promoted by OSPAR.	The verification of the best practices could be ensured by the industry-led OCS CS; this impact assessment considers this as a part of the baseline.
Regulatory failure	Prohibition on discharges (zero tolerance threshold similar to Formosa Plastic Consent Decree)	This relates to intentional illegal discharges. This is not a relevant measure, as pellet loss is an "unintentional" release.
Regulatory failure	All installations, producing, converting, handling, transporting etc., can only operate having an environmental permit issued by a competent authority.	This measure is discarded on the grounds of effectiveness, efficiency and relevance. The production phase of polymers is already covered by the Industrial Emissions Directive (IED) but the concerned BREF was adopted in 2007 and does not address the specific issue of pellet losses. In addition, The IED is not suited to address pellet losses as a form of pollution occurring along the entire supply chain.
Regulatory failure	Sanction big pellet losses under the EU Environmental Crime Directive	This measure is discarded on the ground of legal feasibility. While it may be relevant to sanction big losses of plastic pellets (causing serious pollution and environmental impacts), currently, there are no legal obligations in place or deriving from EU law regarding plastic pellets. Therefore it is not possible to identify any breach of legislation. The sanction for duty-holders on the ground would become possible once such obligations are in place.
Regulatory failure	Classifying pellets as a "harmful substance" in the International Maritime Law	An initiative on this precise issue is currently already ongoing in the International Maritime Organization with the support of the European Union.
Regulatory failure	Developing a mandatory reporting system for containers lost at sea in international waters	Ongoing initiative with the support of the European Union.f

3 FINAL LIST OF MEASURES / OPTIONS

Four options for action were identified.

Option 1: Mandatory standardised methodology to measure pellet losses

Under this option, the Commission initiates the development of a standardised method to measure pellet losses from the range of relevant pellet-related industrial activities (i.e. production, conversion,

recycling, transport and other logistic operations), to be used for the reporting on estimates of quantities released on an annual basis, as obliged under the REACH restriction. The new standard will improve the quality of the reporting on the quantities released (one methodology for all instead of several, different ones) improving the information on the magnitude of pellet losses throughout the pellet supply chain, while also raising awareness among relevant actors as they can measure pellet spills and losses and assess their evolution over time.

Currently, there is no standardised methodology to measure pellet losses. It is expected that under REACH, there will be a reporting requirement on estimates of quantities released on an annual basis for pellet manufacturers and downstream users[208], but not a methodology. This option would be developed via the European Standards Organisation (CEN), which typically takes 3-4 years to complete. The umbrella association of European converters (EuPC) is developing for the OCS certification scheme signatories a methodology for measuring such losses, named the Bow-tie model, and this work can serve as the basis of the harmonised methodology. This model focuses on a risk analysis to identify, at first, the most probable sources of pellets leakages that should be solved in priority. Once the risk areas have been defined, the model proposes several ways to quantify the losses based on the available information (e.g. amount of pellets sent to waste) or on amounts of pellets collected in existing prevention (trays, buckets etc.) and mitigation (vacuum cleaners, filters, etc.) barriers.

This option addresses the problem drivers of market (imperfect information) and regulatory failures.

Option 2: Mandatory requirements to prevent and reduce pellet losses in a new EU law

Under this option, mandatory requirements are defined and imposed on the entire pellet supply chain thus maximising the opportunities of preventing and reducing pellet losses. The requirements to comply with at the site level are based on those already identified by stakeholders in the framework of the BSI PAS and OSPAR recommendation and the industry-led OCS certification scheme. Firms will need to provide evidence of the following:

1. The creation and publication of internal procedures such as defining organisational responsibilities, a pellet loss prevention policy with pellet loss prevention objectives, a regular risk mapping exercise and corresponding risk management assessment at site level;
2. Competence, training and awareness of staff to prevent, contain and clean up spills including maintaining a record of spills;
3. Operational controls including preventive, mitigating and clean up measures and equipment;
4. Communication of implemented policies, measures and objectives both within the organisation and externally, as well as of improvement as reaction to non-conformity.

[208] In REACH, 'downstream users' are defined as "any natural or legal person established within the Community, other than the manufacturer or the importer, who uses a substance, either on its own or in a mixture, in the course of his industrial or professional activities. A distributor or a consumer is not a downstream user. A re-importer exempted pursuant to Article 2(7)(c) shall be regarded as a downstream user". Concretely, pellet converters, recyclers as well as storing operators who own the pellets would be considered as downstream users under REACH. Transporters are not all downstream users but emissions during transport would also need to be reported by the relevant downstream user. Instead, would not be covered by the reporting obligation: importers, distributors, storing operators who store the pellets for third parties, retailers and consumers. A transitional period of 24 months is set for the entry into force of the reporting requirement.

A risk mapping exercise needs to be performed to identify the leakage potential of all necessary, handling steps in all high-risk areas and pathways to the external environment. According to industry, special attention should be given to the following areas where there is a high likelihood of loss to the environment: nearby sewers and drains that do not have any pellet collection facilities or that are not connected to the facility's WWTP; in areas with high traffic (e.g. near gates); in areas close to the fence line; nearby gravelled or non-paved areas; in areas where pellets being spilled or lost may be picked up by the wind or water (rain and storm water) and transported outside[209]. Once this is done, there needs to be a risk management assessment performed to determine where actions are required for equipment, best practice handling, mitigation and remediation.

Knowing that the first step should be to avoid all unnecessary handling of pellets, preventive barriers include "Avoidance of Unnecessary Handling" (as the possibility of minimising the number of transfer points in the supply chain is the starting point for reducing spill opportunities) and "Best Practice Handling". The latter can take the form of collection and retention trays. Mitigation and clean-up measures can take the form of filters, vacuum systems to remove accumulated pellets, and tools for immediate cleaning (shovel, broom, brush, vacuum cleaner).

This is also the option of mandatory external auditing and certification. To demonstrate compliance with the defined mandatory requirements, all pellet handling companies including logistic platforms and transporters must be externally audited and certified at the site level by independent certifying bodies selected among accredited organisms, in order to operate. This implementation approach is consistent with the non-binding OSPAR Recommendation, adopted by OSPAR contracting parties including the EU and 11 Member States, which promotes certification schemes for the entire supply chain. It is also fully in line with the polluter pays principle as the cost of the audits would be borne by the industry itself, and it allows for a harmonised implementation across the EU as a whole, ensuring a level playing field among operators. Certification obligations will be imposed in a phased manner. Once externally audited, companies must notify the public authority about the outcome of the external audit. In the case of non-compliance, they are also responsible for imposing corrective measures and, where relevant, penalties.

This option does not include reduction targets and it is assumed that over a period of time the certification process will deliver results. Once the measure under Option 1 is in place, the reduction targets could possibly be defined. The measure under Option 1 would enable measuring its possible success rate.

There will be a 5 tonnes/year threshold for the requirements (as done in the existing French legislation[210] - this limit was decided as a consequence of a public consultation in France). It avoids requiring costly investments with very limited environmental benefits in terms of pellet loss reduction.

This option addresses the problem drivers of market and regulatory failures.

Option 3: Improved packaging for pellet logistics

This option aims to ensure that all bags and containers used for pellet logistics (transport, storage etc.) are environmentally sealed, airtight and puncture-resistant to prevent damage and tears, which

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[209] SQAS

[210] Décret no 2021-461 du 16 avril 2021 relatif à la prévention des pertes de granulés de plastiques industriels dans l'environnement [Decree n. 2021-461 of 16 April 2021 related to the prevention of the leakage of industrial plastic pellets into the environment], Journal official "Lois et Décrets" no. 0092 du 18 avril 2021 [JORF] [Official journal "Laws and Decrees" no. 0092 of 18 April 2021], 18 April 2021, Fr.

could lead to pellet losses. The option imposes the use of specific types of bags and containers for pellet handling, transport and storage. It can be set up as an independent legislation or can be implemented as part of the legal proposal in Option 2.

This option addresses the problem drivers of market and regulatory failures.

Option 4: EU target to reduce pellet losses

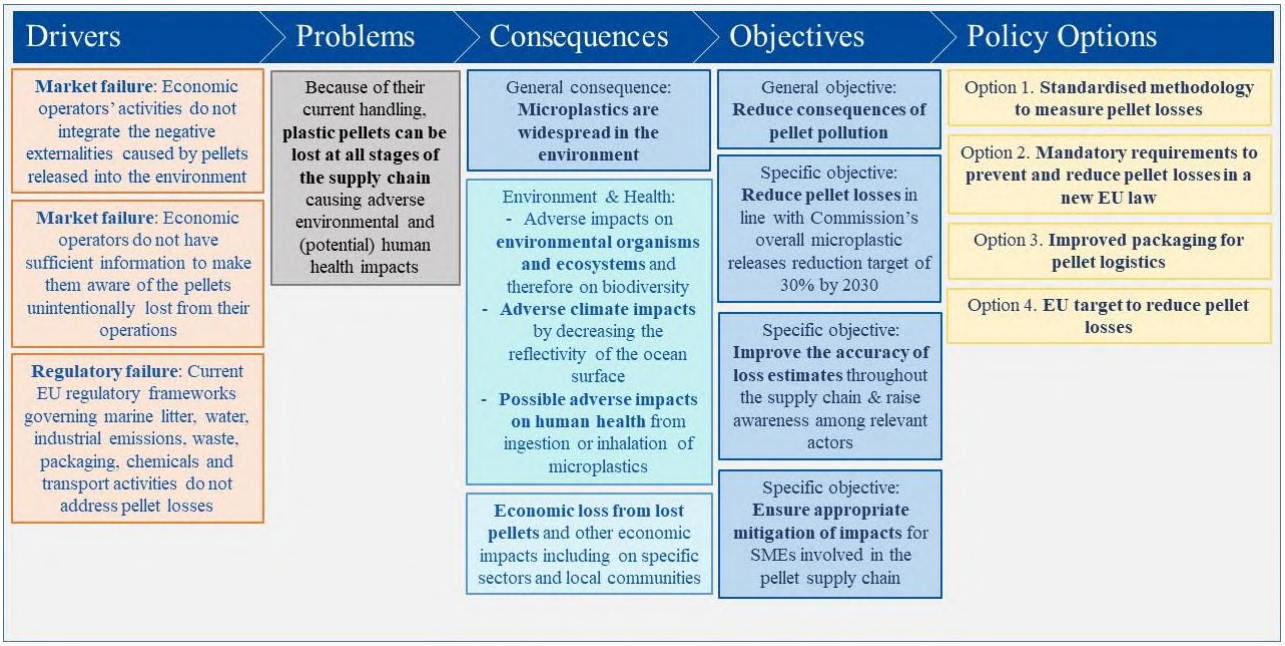
This option is to establish an EU reduction target in line with the Commission's overall microplastic releases reduction target of 30% by 2030. Each Member State must introduce the necessary transposing legislation and measures to ensure delivery, including compliance assurance and reporting by economic operators to track progress against the target. Periodic reporting by competent national authorities to the Commission would also be necessary to ensure delivery and appropriate remedial action in case of shortfall in reducing pellet losses.

This needs an established harmonised measuring methodology or standard (Option 1) first. Without it, it would be challenging to establish a baseline and measure the achievement/non-achievement of the established target.

4 THE INTERVENTION LOGIC

The diagram below sets out the underlying reasoning of this impact assessment by illustrating the logical connection between the problem, its drivers the specific objectives and the policy options which are assessed in Annex 11.

Figure 11: The intervention logic



Annex 11:
Impacts of Policy options to reduce pellet losses

1 IDENTIFICATION AND SCREENING OF IMPACTS

The first step in assessing the impacts of a policy option is to identify the significant ones, both direct and indirect. The following table sets out the impacts that were considered as significant in this impact assessment.

Table 50: Impact categories and indicators with degree of significance (+, ++, +++)

Broad impact category	**Indicator**	**Significance**
Environmental impacts		
Quality of natural resources	Change in quality of ecosystems and biodiversity: reducing pellet losses improves ecosystems and biodiversity	+++
Efficient use of raw materials	Change in the efficient use of raw materials: reducing pellet losses reduces the amount of pellets that become waste (and need to be recycled)	+
International environmental impacts	Change in quality of ecosystems and biodiversity outside the EU due to transboundary nature of pellet pollution: reducing pellet losses improves ecosystems and biodiversity globally	+
Climate change	Reducing pellet losses has positive effects on plankton and therefore on climate change	+
Economic impacts		
Society & economy at large	Change costs to society when taking action to reduce pellet losses, including clean up and monitoring costs, reduced ecosystem services from activities like commercial fishing and agriculture, tourism and recreation in areas affected by losses	++
Businesses including SMEs	Change in benefits to businesses when taking action to reduce pellet losses, including reduced waste (and reduced value loss for pellets that are lost) and other economic benefits Change in costs (adjustment and administrative costs) to businesses when taking action to reduce pellet losses, including costs for SMEs present in the supply chain	++ +++
Internal market and competition	Change in costs due to improper functioning of the internal market due to internal market fragmentation	+
End users	Change (increase) in prices of final plastic products to end users as a negative knock-on effect of change in costs to businesses	+
EU competitiveness	The additional costs are likely to have minor negative impact the competitiveness of EU pellet producers as their competitors outside the EU will not be affected	+
Innovation / Technological development / digital economy	The innovation and research impact category covers the impacts on technological development related to the sectors concerned	+
Social Impacts		
Public health & safety	Effects of measures on public health because of risks to food chain; effects of measures on safety at work (pellets spilled on the floor)	+

Sensitive populations	Effects of measures on sensitive populations in areas affected by pellet losses (ports, beaches, protected areas, etc.)	+
Employment	Effects of measures on employment (additional job opportunities in the plastic sector)	+
Administrative burden		
Public authorities	Change in costs to public authorities in the Member States and to the European Commission	++

Then, the significant impacts have been examined by indicating whether they are likely to be positive or negative and which stakeholder groups they are most likely to impact. Colour coding is used to summarise the impacts referring to the direction (positive or negative) and size (small or large). Note that for several indicators no extensive quantification has been possible, due to the lack of available data. In these cases, the assessment is based on expert judgement provided via the underpinning support study.

Table 51: Coding used to present likely impacts

Score	Description
+++	Very significant direct positive impact or benefit
++	Significant direct positive impact or benefit
+	Small direct positive impact or benefit
(+)	Indirect positive impact or benefit
+/-	Both direct positive and negative impacts, and balance depends on how implemented
0	No impact or only very indirect impacts
(-)	Indirect negative impact or cost
-	Small direct negative impact or cost
--	Significant direct negative impact or cost
---	Very significant direct negative impact or cost
High	High Benefits significantly outweigh costs of measure
Medium	Medium Benefits on balance outweigh costs of measure
Low	Low Benefits close to or even below costs of measure
Uncertain	Potential high benefits, but significant questions as to whether the measure can deliver outcome

The outcome of this step is the final list of likely impacts.

Table 52: Screening of impacts

Impact	Impacts	Stakeholder groups impacted	Justification for inclusion / exclusion
Environmental impacts			
Quality of natural resources	+++	Reduced pellet losses lead to better quality of natural resources (improved eco-systems and biodiversity)	The objective is to reduce pellet losses and related adverse impacts on the environment, so this is a key impact category
Efficient use of raw materials	+	Reduced pellet losses lead to fewer pellets becoming waste	Less pellet losses leads directly to the more efficient use of pellets
International environmental impacts	++	Reduced pellet losses lead to improved ecosystems and biodiversity globally	Pellet pollution is trans-boundary (it affects both cross-border river basins and seas) and global pellet pollution is an important key impact category

Climate change	+	No specific group is impacted	Reducing pellet loss will lead to less GHG emissions, for example, during all steps of the plastic value chain, but as well due to indirect effects on plankton growth.
Economic impacts			
Society & economy at large	+	Reduced pellet losses lead to less costs on society (e.g. clean up costs) and economy at large (sectors such as commercial fishing and agriculture, recreation and tourism)	The objective is to reduce pellet losses for environmental, societal and economic reasons
Businesses including SMEs	--	Industrial operators bear the costs of taking action to reduce pellet losses. However, reduced pellet losses lead to less value loss when pellets are lost for those owning them, and to other economic benefits for operators in general including SMEs (e.g. modernised equipment, improved reputation and level playing field among operators)	The objective is to reduce pellet losses in an economically proportionate manner, so this is a key impact category. Certain costs could be unbearable for some of the SMEs present in the pellet supply chain thus the need for mitigating measures
Internal market and competition	+	A few Member States are starting to take action to reduce pellet losses	If action is taken at EU level, the functioning of the internal market can be improved (same obligations on every operator, level playing field among them)
End users	-	Measures could negatively affect consumers through price increases.	Measures could negatively affect consumers through price increases.
Third countries and international relations	-	There could be limited effects on countries outside of the EU with both direct and indirect impacts	There could be limited effects on countries outside of the EU with both direct and indirect impacts.
Innovation / technological development / digital economy	?	Research and innovation institutes and industry	Development of a common monitoring methodology and innovative measures to prevent and reduce pellet losses
Social impacts			
Public health & safety	+	Reduced pellet losses lead to improved public health (less polluted food chain) and safety at work (less pellets spilled on the floor)	The objective is to reduce pellet losses and related adverse impacts on public health, so this is a key impact category
Affected populations	+	Reduced pellet losses lead to less negative effects on populations in affected areas	Reducing negative effects on affected populations, e.g. working in tourism, agriculture, fisheries, incl. less clean-up costs and health impacts
Employment	+	Reduced pellet losses lead to more job opportunities in the plastic sector	Estimation of job opportunities
Administrative burden			
Administrative burden on businesses	--	Industrial operators bear the costs of taking action to reduce pellet losses including administrative costs	The objective is to reduce pellet losses in an economically proportionate manner, so this is a key impact category

Public authorities: MS	-	Member State public authorities (at local, regional and/or national levels) depending on pellet responsibilities (activities of data collection, verification, correction and enforcement)	The objective is to reduce pellet losses in an economically proportionate manner, so this is a key impact category
Public authorities: European Commission	-	European Commission depending on pellet responsibilities	The objective is to reduce pellet losses in an economically proportionate manner, so this is a key impact category

The economic impacts are primarily related to the economic costs of implementing the measures, and the environmental impacts are primarily related to the environmental benefits associated with the reductions in pellet losses.

Whilst it is not feasible to quantify or value changes in environmental impacts, reductions in pellet losses will reduce the negative environmental impacts compared to the baseline. In most cases, the reductions will affect emissions to all environmental compartments. Hence, the environmental impacts will be more or less proportional to the reduced losses. There will also be associated changes in GHG emissions, as microplastics releases, including pellets, affect plankton and therefore the absorption of GHG. Similarly, the social impacts, which include possible negative human health effects, are also likely to be affected proportionally to the reduction in pellet losses. It means that all measures have more or less the same types of environmental and social impacts, and only the magnitude differs.

The approach to the assessment of cost impacts draws on evidence identified during the literature review and stakeholder consultations. In many cases, the costs are affected by multiple factors, so the cost estimates presented are generally order of magnitude estimates. Similarly, many factors influence the assessment of the reduction potential and its likely fulfilments, so the assessment provides an order of magnitude of the options.

All calculations are made in relation to the baseline for 2030.

2 OPTION 1: MANDATORY STANDARDISED METHODOLOGY TO MEASURE PELLET LOSSES

This option proposes a standardised measurement methodology to be used for the reporting on estimates of quantities released on an annual basis, as obliged under REACH. This option would also be beneficial for all the other options as it would allow them to tackle the information failure problem driver and enable their effective implementation.

Environmental impacts

Under this option, there are **no direct reductions of pellet losses, but a standardized methodology to measure such losses will enable relevant actors to tackle them, thus reducing pellet losses to the environment**. The common standard will improve the quality of the reporting on the quantities released (one methodology for all instead of several, different ones) improving the information on the magnitude of pellet losses throughout the pellet supply chain, while also raising awareness among relevant actors as they can measure pellet spills and losses and assess their evolution over time. It is already a necessary step to measure any reduction measure's success rate.

This option will benefit all other options as the magnitude of pellet losses is a critical knowledge gap.

Social impacts

No significant social impacts are expected.

Economic impacts

This option will entail **both costs and savings**. The cost of developing (and testing) the methodology will be one-off and will depend on the time required to develop the methodology. The European Standards Organisation (CEN) typically takes 3-4 years to complete the process, and has mostly members from the industry. It could be seen if the industry bears this cost entirely or if the Commission can support such development through a dedicated study (e.g. the one being conducted for tyre abrasion). The advantage of the latter approach is more likely if the standard has to be taken up in legislation.

When developing the common standard, CEN will take into account the methodology that is being developed under the OCS certification scheme.

Therefore, the cost of this measure will be related to developing a draft method and calibrating it through the data collected by initial monitoring. It will be important to conduct such monitoring along the whole supply chain, viz., from pellets production, conversion and recycling, along with transport and logistic operations between different supply chain steps. Modelling approaches could also be used to validate different scenarios, e.g. the difference between virgin vs recycled pellet products, small production facilities vs larger ones, etc.

Table 53: Assumptions used for calculating the costs of Option 1

Description	Data	Unit	Source
Number of people working full time necessary to elaborate the standard between 12 and 36 months[211]	7.25	persons	ISO website
Mean cost of labour in EU of one expert working full-time	39.5	EUR/hour	Eurostat
Number of hours per week in a full-time job (48 working weeks/year)	40.6	hours/week	Eurostat
Number of companies conducting tests for testing the standard	30	Number	Assumption
Number of experts necessary per company to conduct the tests	1	person	Assumption
Number of hours necessary per company to conduct the tests	24	hours	Assumption

This assessment has estimated the cost of developing the common standard to be between EUR 558 087 (12 months development) and EUR 1 674 263 (36 months development). The testing cost at one facility will cost about EUR 700-1500 per test, depending on the installation size. Assuming that about 1 000 installations will test the standard during the development phase, the testing will cost between EUR 700 000 and 1 500 000. The total would be between EUR 1 258 000 and 3 174 000 (rounded figures). As the common standard would be based on developments under the OSC certifications scheme, it is estimated that the lower end of the cost estimation is more likely.

Once the standard is operational, it will need to be implemented in the value chain. The application frequency and sample size of measuring pellet losses will need to be decided and could depend on company size. The costs for a company will vary depending on the number of installations of the

[211] The ISO sub-committee 14 of the technical committee ISO/TC 61 on the environmental aspects of plastics is comprised of 29 members (the national standardisation organisations).standardization organisation). We assume that each member contributes 0.25 FTE to work on the committee.

company and their size. Furthermore, with time, the application of the standard methodology could be automatised, and costs brought down.

The implementation costs to be incurred by the industry to use the common standard, once this is developed and tested, are already considered under the REACH restriction (as part of the reporting costs) and do not need to be taken into account here. These costs will consist of the costs for the companies to set up specific reporting systems and for the public authority to set up verification and evaluation systems[212]. There is however no concrete information available at this moment on how the reporting obligation under REACH would look like in practise (mainly as it has been voted only recently). Once this information is available, this standardised measurement methodology will need to be coherent with specific requirements.

At the same time, imposing a standardised methodology to measure pellet losses has the potential to save costs on different levels:

- The plastic industry is developing a methodology, however, it is not clear how much such a method would be accepted by the whole value chain. Some partners in the value chain could develop their own methodology. Some Member States might also develop a methodology on their own. Under Option 1, there is only one cost for developing the methodology, and not several.
- More importantly, businesses will have to apply only one methodology in the different parts of the supply chain and in different countries.
- The verification and evaluation of the reporting by the public authority will be simplified.

While it is difficult to do an exact cost-benefit assessment, the cost savings would be higher than the development costs for the standard. These cost savings are fully in line with the Communication COM(2021) 219 final on joining forces to make better laws.

Stakeholder views: Stakeholders generally agree on this option. In the targeted SMEs consultation conducted early 2023, a standardised methodology to measure pellet spills and losses was mentioned by 51% of respondents as a support measure that could best help them to take action to reduce pellet losses. The testing cost of one facility would be about EUR 700 per test, which means a proportionally greater cost for small compared to large companies. However, these costs are already covered under the REACH restriction.

Summary: This is the basis for setting up the framework to measure pellet losses and thus fundamental for monitoring pellet losses and their evolution in the future. It will facilitate and improve the quality of the reporting under REACH, while also raising awareness among relevant actors as they can measure pellet spills and losses and assess their evolution over time. While an exact cost-benefit assessment could not be made, the cost savings are expected to be higher than the development costs of the standard.

Table 54: Summary of impacts of Option 1

Economic impacts	Environmental impacts	Social impacts

[212] For the Committee for Socio-economic Analysis (SEAC), established under REACH, the total costs of reporting could be substantial as the number of companies affected is likely to be large. SEAC considers that there are different options to reduce such costs, e.g. by excluding certain actors (small or micro-sized companies) from the requirement or by setting a threshold for microplastics volumes used or released to be reported. However, SEAC did not draw a firm conclusion on how these different options would compromise the value of information obtained and hence the benefits of reporting in terms of facilitating better risk management.

Cost savings	No environmental impacts but will contribute to better monitoring of losses in other options	No relevant impacts are expected

3 OPTION 2: MANDATORY REQUIREMENTS TO PREVENT AND REDUCE PELLET LOSSES IN A NEW EU LAW

In this option, imposing mandatory requirements and certification for all pellet handling companies is the EU's responsibility. Industry bears the costs of the external auditing and certification. Public authorities in Member States are responsible, in the case of non-compliance, for imposing corrective measures and, where relevant, penalties.

As it is a mandatory approach covering the full value chain with explicit requirements, a certification scheme and a check in case of non-compliance, we estimate that the sector will have a high degree of compliance (95% of the total virgin pellet volume handled) and will be effectively implementing such rules with a success rate ranging from 80 to 95% (meaning that pellet losses would reduce with these percentages).

Economic impacts

In this option, industry costs were calculated based on data input from a survey conducted by the industry. As the data was based on Belgium's experience and on a survey answered mainly by enterprises located in Western Europe, a correction factor was used to apply these costs at the EU level (EU average wage is 29 EUR/h, Belgium average wage is 41 EUR/h). The correction factor was applied to all costs, not only for personnel costs as price levels differ across EU Member States and therefore it would better describe actual additional costs of the measure.

What would be the costs of this option for the sector?

There is little direct information available regarding the costs to companies of taking measures to adhere with best practice handling. Discussions with stakeholders in the course of this IA suggest that the costs of implementing Option 2 could be limited as the plastics industry is already moving towards measures and a system of external auditing and certification based on OCS. Some transporters and other firms in the logistics chain already implement similar measures as best practice from a health and safety standpoint. However, some costs could still be significant for some companies, in particular those that have not introduced any measure to counter pellet losses.

Direct compliance costs for the sector

This option requires that all supply chain actors comply. The cost of this option varies significantly according to the type of actor (producer, converter, transporter, storage, and recycler) in question, and to the size of the installation or company. For example, micro and small companies (which constitute meaning 89% of all converters, but only 20% of turnover) would be significantly affected by the costs incurred by the upgrade of their facilities, the introduction of procedures including internal and external audit and the training of their personnel. There is also a significant number of transport companies needing certification, thus increasing the measure's costs.

a) Producers and Converters

According to estimates from the converting industry, the cost of setting up this option is calculated as described in the table below. The costs of 100t, 1kt, 10kt and >50kt/year presented above represent on average the costs for a micro, small, medium and large converting enterprise. The costs for the micro-enterprises were extrapolated from the three other categories. Large plant costs are also applied

to the plastic producers (including virgin and recycled plastics, plastic export and import) as they are generally large companies. This is consistent with the figure of the plastic production (about 1 FTE per 500 kt handled)[213].

Table 55: Potential costs incurred by plastic converters

Type of cost – Type of enterprise	**Plant capacity 100 t /year Micro**		**Plant capacity 1 kt/year Small**		**Plant capacity 10 kt /year Medium**		**Plant capacity > 50 kt /year Large**	
	Resource	**EUR/ year**	**Resource**	**EUR/ year**	**Resource**	**EUR/ year**	**Resource**	**EUR/ year**
Personnel: dedicated resource	5 persondays/ year @ 303 EUR/day	1 514	20 persondays/ year @ 303 EUR/day	6 055	60 persondays/ year @ 303 EUR/day	18 164	120 persondays/ year @ 303 EUR/day	36 328
Personnel: training of staff	2.5 x ½ persondays/ year = 1.25 persondays @ 303 EUR/day	363	10 x ½ training/year = 5 persondays @ 303 EUR/day	1 514	30 x ½ training/year =15 persondays @ 303 EUR/day	4 541	70 x ½ training/year = 35 man/days @ 303 EUR/day	10 596
Personnel: internal audit	1 personday/year @ 303 EUR/day	303	5 persondays/ year @ 303 EUR/day	1 514	5 persondays/ year @ 303 EUR/day	1 514	5 persondays/ year @ 303 EUR/day	1 514
Cleaning equipment(vacuum cleaners, brooms, shovels)	EUR 4 000 amortised over 6 years	472	EUR 4 000 amortised over 6 years	472	EUR 12 000 amortised over 6 years	1 415	EUR 12 000 amortised over 6 years	1 415
Panels, signage	EUR 3 750 amortised over 6 years	442	EUR 7 500 amortised over 6 years	884	EUR 7 500 amortised over 6 years	884	EUR 7 500 amortised over 6 years	884
Collection and retention trays, containment systems	EUR 5 000 amortised over 6 years	590	EUR 10 000 amortised over 6 years	1 179	EUR 30 000 amortised over 6 years	3 537	EUR 30 000 amortised over 6 years	3 537
Miscellaneous external services (sewer map etc.)	EUR 5 000 amortised over 6 years	590	EUR 10 000 amortised over 6 years	1 179	EUR 10 000 amortised over 6 years	1 179	EUR 10 000 amortised over 6 years	1 179
Cost of auditing (external)		707		1 061		1 061		1 061
Automated transport system								17 683
Sewage treatment systems/ improvement of sewage/ construction	EUR 50 000 amortised over 10 years	3 537	EUR 100 000 amortised over 10 years	7 073	EUR 150 000 amortised over 10 years	10 610	EUR 300 000 amortised over 10 years	21 220
Maintenance cost		354		707		2 829		17 683

[213] Personal communication from a main plastic producer

Type of cost – Type of enterprise	Plant capacity 100 t /year Micro		Plant capacity 1 kt/year Small		Plant capacity 10 kt /year Medium		Plant capacity > 50 kt /year Large	
	Resource	EUR/ year	Resource	EUR/ year	Resource	EUR/ year	Resource	EUR/ year
Cost/year (EUR)	**8 870**		**21 638**		**45 733**		**113 098**	
Cost/tonne (EUR/t)	**88.70**		**21.64**		**4.57**		**2.26**	

The total cost for producers and converters was then calculated based on the volume (tons) of pellets handled by enterprise type.

In the plastic converters industry, there are ca 48 000 enterprises. The breakdown of converters according to the size of the plant in 2019 (in 2021, the shares are similar) has been calculated with Eurostat data and is as follows:

- Micro - 4% of the pellet volume processed
- Small - 16% of the pellet volume processed
- Medium - 36% of the pellet volume processed
- Large - 44% of the pellet volume processed

Although micro-enterprises represent 66% of the enterprises in the processing sector, their overall turnover accounts for less than 4% of the sector. Both Plastics Europe and PRE have confirmed that their members are not SMEs. However, recyclers are generally small installations, even if they belong to a large company.

b) Logistics

Costs for the logistics operators were not available. There are three main parts in logistics:

- Transport,
- Storage or warehouses,
- Cleaning stations.

The cost for these were calculated at enterprise level, based on the basic assumption that the measures needed to be taken by a firm are largely similar and will mostly depend on the size of the firm. As an important part of the cost are related to personnel, it was assumed that a firm with the same number of persons would occur the same cost structure, and this for the main classes: micro-, small, medium and large enterprises. For the storage providers, the same cost as for converters were taken. For the transport providers, there are no costs related to equipment and investments, only to personnel, external auditing and miscellaneous (see the table below).

Table 56: Potential costs incurred by the transport providers per type of enterprise

Type of cost	Micro	Small	Medium	Large
	EUR/ year	EUR/year	EUR/ year	EUR/ year
Personnel: dedicated resource	1 514	6 055	18 164	36 328
Personnel: training of staff	363	1 514	4 541	10 596

Personnel: internal audit	303	1 514	1 514	1 514
Cost of auditing (external)	707	1 061	1 061	1 061
Total	**2 887**	**10 143**	**25 280**	**49 498**

The total costs for transport was calculated based on the number of firms working in the sector. The sector structure of the transport sector (all types of goods - rail, road, water and inland water), according to the number of persons working in the enterprise is as follows [214]:

- Micro - 81% of the transport providers
- Small - 16% of the transport providers
- Medium - 2.6% of the transport providers
- Large - 0.4% of the transport providers

It was assumed that not all micro enterprises in the transport sector will be subject to additional costs under this option for the following reasons:

- There will be a 5 tonnes/year threshold for the requirements, so not all micro enterprises will be concerned.

- After setting up new rules for the pellets transport, it is expected that certain enterprises will no longer transport pellets, especially among micro enterprises, so the costs will not occur. This is even more the case as in transport the size of the micro enterprises seem smaller than in converting (e.g. a one truck company).

- Eurostat data estimates the data on micro-enterprises with "low reliability".

Therefore we assume that only 50% of the micro enterprises will be concerned with the higher costs under this option.

Based on the transport sector input, about 50 large companies are dealing with pellets, all members of the European Chemical Transport Association (ECTA). Starting from this figure, the assumptions above, and assuming that the transport of pellets follows the same division of enterprises as the total transport, the number of enterprises per size could be calculated, and therefore the costs for the transport sector.

Based on these calculations, it results that about 4-5% of the transport companies are working with pellets. We assume that a similar part and enterprises structure for the storage providers or warehouses (NACE H 52.1) who are dealing with pellets.

There will be no additional costs for tank cleaning stations as the ones, who are dealing with pellets, are already complying with SQAS which has similar requirements. The profile of these tank cleaning stations is the following:

[214] Eurostat 2021: Nomenclature of Economic Activities (NACE) codes were included – H 49.2 - Freight rail transport, H 49.4 - Freight transport by road and removal services and H 50.4 - Inland freight water transport. Data for H 50.2. Sea and coastal freight water transport was not available by Eurostat. For inland water transport, the same structure as for rail transport was assumed.

Table 57: Enterprise structure of cleaning stations (enterprises)

Number of employees	Number	% over Total
Less than 10	300	68
10-50	125	28
More than 50	15	4
Total	**440**	**100**

It is still possible that additional external auditing would be needed. An audit costs around EUR 707 for a micro-enterprise, and EUR 1061 for small and medium enterprises. In that case, the cost would be:

440 warehouses x (68% x 707 EUR + 32% x 1061 EUR) = 224 587 EUR

Based on the above, we estimate that, ca 13 000 transport providers, 850 storage or warehouse providers and 440 cleaning stations are dealing with pellets and will be affected by the requirements.

Note: The analysis is done using a rough estimate of the costs per tonne. However, to deal with pellet losses, both investments (fixed costs) and variable costs will depend on the progress made by companies in the meantime through their voluntary commitments. The upfront investment costs will be relatively more important for SMEs, especially for micro-enterprises than for other enterprises. Micro-enterprises could therefore merit receiving special attention.

Costs taken up in the base line

As the industry has already started implementing some of the proposed measures through their voluntary programs, such as OCS CS and RecyClass, some of these costs will already be incurred in the business-as-usual scenario, i.e. under the baseline. We use the following volume assumptions for the costs incurred under the baseline:

- about 70% (referring to the efficiency rate of loss reduction) of the 90% of the total virgin pellet volume produced (by the members of Plastics Europe) and 5% for the non-Plastics Europe members;
- about 50% (referring to the efficiency rate of loss reduction) of the 20% of the total recycled pellet volume produced;
- 50% (referring to the efficiency rate of loss reduction) of the 30% of the total volume processed; and
- 30% (referring to the efficiency rate of loss reduction) of the 40% of the total volume handled by logistics companies (transport – storage).

These values are based on the ones used to estimate the baseline. Where, in the baseline, a lower and higher boundary were proposed, the average value was taken here.

Stakeholder views: When consulted in the framework of the open public consultation (Annex 2), stakeholders agreed that there is improper handling of pellets. The umbrella association of European converters, EuPC, pointed to limited resources as a barrier to implementing voluntary measures under the industry-driven OCS programme. More recently, the umbrella association of European manufacturers, PlasticsEurope, agreed the most effective approach to tackling pellet losses is mandatory external auditing and certification building on OCS and applied to all actors throughout

the supply chain. Producers therefore considered a legislative proposal requiring certification of an OCS-like pellet loss prevention management system would be very quickly implementable throughout the whole supply chain because it would benefit from the existing industry initiative and would reinforce it.

A second consultation targeting all SMEs handling pellets was conducted from January to February 2023 in all EU languages (Annex 12). Based on the 330 replies received, it emerged that for a majority of respondents, only a lighter version of requirements could be imposed on such companies. Specifically, they reported that the requirement on the training of staff should be made mandatory in the same way for all companies, but the obligation of being externally audited and certified should not be imposed at all on SMEs. The survey also indicated that the direct economic impacts of this option would be too high to be sustainable for micro and small companies, as well as companies with capacities below 1000t. Among the various best handling practices, the mandatory use of specific equipment and of specific packaging (i.e. airtight, puncture-resistant and environmentally sealed) was identified as the most expensive measure. Generally, the cost per tonne of the measures to be implemented would become insignificant for companies with capacities above 5000t. Finally, financial support and standardised methodology to measure pellet losses were identified as the support that would best help respondents.

In light of the above, three sub-options have been considered and assessed in the form of lighter requirements for the micro, small and medium companies present in the pellet supply chain (see table below). A derogation for companies making and handling pellets in quantities lower than 5 tonnes will also apply in all scenarios. Such an approach will avoid requiring costly investments which would only deliver very limited environmental benefits in terms of pellet loss reduction.

These lighter requirements are also justified following the principle of proportionality and the need to match the nature and intensity of a given measure to the identified problem.

Sub-options "Lighter requirements for micro-, small- and medium-enterprises"

From the calculation above, it is clear that the relative cost for an SME are higher than for large companies. It was therefore estimated that lighter requirements would be needed to alleviate a part of these costs. This is also consistent with the replies and request received through the stakeholder consultations.

The lighter requirements assume that:

- There will be no requirement for a sewage treatment system and maintenance;
- Certification requirements will be reduced to 5 years for micro-enterprise and 3 years for small ones; and
- A reduction of 10% reduction of personnel costs.

With these reduced requirements, we assume that the pellet loss will be 35% higher for converter and 20 % for logistics (for transport, there is no sewage treatment system, thus neither related requirements) from these companies than under the main scenario. This assumption means that the other requirements are still the most important ones to reduce pellet losses, but that there is already a significant increase in pellet loss.

Table 58: Costs for lighter requirements for micro, small and medium sized companies for typical plant capacities

Type of cost **Type of enterprise**	**Plant capacity 100 t /year** **Micro**		**Plant capacity 1 kt/year** **Small**		**Plant capacity 10 kt /year** **Medium**	
	Resource	**EUR/year**	**Resource**	**EUR/year**	**Resource**	**EUR/year**
Personnel: dedicated resource	10% lower than main option	1 362	10% lower than main option	5 449	10% lower than main option	16 384
Personnel: training of staff		327		1 362		4 087
Personnel: internal audit		272		1 362		1 362
Cleaning equipment (vacuum cleaners, brooms, shovels)	Same as main option	472	Same as main option	472	Same as main option	1 415
Panels, signage		442		884		884
Collection and retention trays, containment systems		590		1 179		3 537
Miscellaneous external services (sewer map etc.)		590		1 179		1 179
Cost of auditing (external) (normally every year)	Every 5 years	141	Every 3 years	354	Every 3 years	1 061
Sewage treatment systems/ improvement of sewage/ construction	No sewage treatment		No sewage treatment		No sewage treatment	
Maintenance cost	No maintenance cost		No maintenance cost		No maintenance cost	
Cost/year (EUR)		**4 196**		**12 242**		**29 872**
Cost/tonne (EUR/t)		**41.96**		**12.24**		**2.99**

As with the main option 2, the equivalence for the logistics sector is made.

The cost of implementing Option 2 would be 742 and the sub-options 2a, 2b, and 2c would be 615, 516 and 479 million EUR/year respectively.

The cost-effectiveness of the options range from **2672 EUR/tonne avoided** per year to **26 342 EUR/tonne avoided** per year, depending on the sub-option and the lower/higher estimation of losses.

The cost of measures under option 2 and its sub-options vary between sectors (see table below).

Table 59: The cost of measures under option 2 and sub-options 2a, 2b and 2c for the value chain (M EUR/year) (without taking the savings into account)

	Option 2	Option 2a	Option 2b	Option 2c
Plastic converters	616.36	497.70	402.29	365.51
Plastic producers, including recyclers	65.92	65.92	65.92	65.92
Transport providers	51.32	45.42	42.99	42.41
Storage providers	8.12	5.88	5.13	4.68
Total	***741.72***	***614.92***	***516.32***	***478.51***

Table 59 shows the costs for the different parts of the value chain. However, this does not yet take into account the benefits of the pellets saved, which are quite important, see the following table, which is only done for option 2b.

Table 60: Summary of impacts in 2030 of Sub-option 2b per part of the supply chain

	Plastic converters	Plastic producers, incl. recyclers	Transport & storage	Total
Cost of the measure (M€/y)	402.3	65.9	48.1	516.3
Savings from pellet losses (M€/y)	10.1 - 40.7	2.4 – 16.2	16.1 – 91.3	28.6 – 148.3
Net cost to business (M€/y)	375.7 – 491.2*			

* It is not possible to calculate the net cost for each part of the supply chain as it is not clear who benefits exactly from reduced pellet losses. This depends on who owns the pellets and can valorise the savings from less pellets lost. This is not known for the pellets in transport and storage.

The additional costs are likely to negatively impact the competitiveness of the EU pellet producers as their competitors outside the EU will not be affected. According to EuPC the turnover of the plastics sector in the EU27 in 2021 was EUR 405 billion[215]. Therefore, this additional estimated cost of option 2b would represent about 0.13% of the EU plastics sector turnover and would only have a very minor impact on the competitiveness.

What would be the cost for the public authorities?

The costs arising will depend on the manner it is implemented in Member States. The focus is on administrative costs, i.e. procedures to follow, monitoring, delays, complaint-handling mechanism, access to justice, etc. Further costs can be related to competent authorities for the setting up of the system, i.e. one-off costs at the beginning as well as some costs for the maintenance of the system and compliance promotion, such as awareness raising, information to stakeholders, training of officials, developing and providing of guidance and capacity building of public authority officials and enforcement actions. However, it may not be necessary to set up a new system in Member States as some of these mechanisms already exist through other legislation, such as IED, Environmental Liability Directive, Environmental Crime Directive, UWWTD, and synergies could be achieved by integrating some of the costs for public authorities related to pellet losses. These costs vary

215 https://www.plasticsconverters.eu

significantly across Member States depending on the current situation on implementing environmental legislation.

Further to that, it could be envisaged that the public authorities in the Member States would be required to hold a public register of certified companies to ensure full transparency and traceability of the supply chain, including to ensure compliance with the requirements. This registry could done through an existing system to lower the costs. This would imply separate minor reporting costs (EUR 188 000 per year) for the economic operators (notifying the public authority about the outcome of the external auditing, as the reporting on the pellet losses to ECHA already will be required), and processing costs for the public authorities in the Member States. Also, there might be minor additional costs related to reporting obligations to the Commission to ensure compliance with the regulation as the Commission could assemble such system. However, this would be a minor task for Member States as they would have necessary data in the registry.

About 50 person days in average would be needed to set up the system for receiving the notification from the companies, about 20 days each year for compiling and quality assurance and appropriate follow-up measures (e.g. enforcement) for each Member State. Using average Eurostat wages (EUR 29/hour), we can estimate the processing costs, including data collection, verification, correction, and enforcement to be EUR 313 000 (total annualised one-off administrative costs of EUR 36 700, discounted at 3% over 10 years) for the first year and EUR 125 000 per year for the whole EU. These cost will vary across Member States as it would be higher for larger ones and lower for smaller ones.

What would be the benefits for the sector?

For businesses owning the pellets, this option could reduce the estimated economic loss of EUR 42 – 170 million coming from about 42 050 – 170 266 tonnes per year tonnes of pellets lost in 2030 (1000 EUR/t, mainly coming from less pellets lost by logistics, but also by producers and converters as described in Table 48 in Annex 9). (Prices of plastics are fluctuating and depend on the exact polymer type and the stage of processing).

Benefits for SMEs from implementing the BSI PAS (a system with similar requirement in the UK to reduce pellet losses) were reported to be:

- modernised equipment thanks to grants they secured;
- less legacy pellet pollution, which had previously been extensive around the sites;
- reduced waste (and lower waste management costs);
- improved staff awareness and training;
- reduced fire risk because proper and regular site assessments revealed build-up of dust in areas previously unchecked;
- involvement of suppliers/customers – all site visitors are required to read and accept rules relating to proper pellet management; and
- Improved reputation.

What would the benefits of this option be for the economy at large and society?

Under this option, reducing pellet losses may have positive knock-on economic impacts on sectors such as tourism. In some coastal areas (such as in the vicinity of Antwerp and Tarragona ports[216]), pellets can be found in significant quantities including in protected areas[217]. Their removal would reinforce the attractivity of these areas for tourism purposes.

Similarly, the reduction of pellet losses into the environment may have positive knock-on economic impacts on commercial fishing and agriculture, in areas where these activities are particularly affected by the releases with significant harm to ecosystems and biodiversity. In particular, there will be fewer pellets lost into the marine environment and, thus, fewer perturbations to all marine organisms, including economically important organisms such as oyster and seabass[218]. Considering that the ecosystem services provided by the Ocean are estimated to be worth over USD 24 trillion, the regulation of microplastics and the protection of marine ecosystems and habitats seems to be of significant importance[219]. Similarly, there would be fewer pellets lost in the installations' wastewater and in the sludge resulting from their treatment. Consequently, there will be less pellets lost to the soil after sludge application on agricultural land.

Benefits also include avoided costs to society. Cleaning up pellet pollution and remediation measures can cause harm to ecosystems as it is almost impossible to specifically remove them without affecting the environment they are spilled into[220]. They are also challenging to local communities in terms of technological, human and financial resources. For example, it was estimated that beach clean-ups cost the city of Marseille (France) an average of EUR 1 000 000 per year[221]. KIMO Netherlands reported that the clean-up costs of the 2019 pellet spill of the MSC Zoe in the Wadden Sea would be approximately EUR 100 000 annually[222]. These are obviously only examples. Even if there are no figures available, the sum of the clean-up costs for the whole EU shore should be much higher.

By applying the costs of the clean-up operations of the 2017 MSC Susanna loss in Durban, South Africa, (where 35.8 tonnes of pellets were collected over the period of the operation) to an EU context, each tonne of pellets on average costs EUR 1.21 to EUR 1.82 million to collect.

Environmental impacts

As this option requires that all actors of the supply chain comply with mandatory requirements and certification (with the only exception of companies making and handling pellets in quantities lower than 5 tonnes), the main expected environmental impact from this option is a **significant reduction of pellet losses** that are likely to be harmful to ecosystems and biodiversity and may affect human health.

The overall reduction is expected to be **between 27 128 tonnes/year (low emission scenario) and 148 879 tonnes/year (high emission scenario)**, representing a 65% and 87% reduction overall, respectively (compared to the baseline). It will also save annually 106 – 583 of GHG emissions in kilotonnes of CO2 equivalent [223].

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[216] https://surfrider.eu/wp-content/uploads/2020/11/report-pellet-pollution-2020.pdf

[217] The unaccountability case of plastic pellet pollution - ScienceDirect

[218] Zhu, X. et al. (2020) 'Bioaccumulation of microplastics and its in vivo interactions with trace metals in edible oysters', Marine Pollution Bulletin, 154, 111079. doi: https://doi.org/10.1016/j.marpolbul.2020.111079 83 Barboza, L.G.A et al. (2018) 'Microplastics cause neurotoxicity, oxidative damage and energy-related changes and interact with the bioaccumulation of mercury in the European seabass, Dicentrarchus labrax (Linnaeus, 1758)', Aquatic Toxicology, 195, pp. 49-57. doi: https://doi.org/10.1016/j.aquatox.2017.12.008.

[219] WWF Report 2015; Reviving the ocean economy

[220] UN Environment; Marine Litter - Socioeconomic Study, 2015

[221] OSPAR Background document on pre-production Plastic Pellets 2018

[222] Fishing for Litter fleet cleans up after MSC Zoe but who pays the costs? – KIMO (kimointernational.org)

[223] Calculation is based on the report "Plastic leakage and greenhouse gas emissions are increasing - OECD"

When providing for lighter requirements for the **smallest or micro-enterprises**, the reduction of pellet losses ranges from **26 730 tonnes/year to 147 227 tonnes/year** (105 – 576 ktCO_2e). With lighter requirements for the micro and **small enterprises**, the reduction of pellet losses ranges from **25 142 tonnes/year to 140 621 tonnes/year** (98 – 551 ktCO_2e). **Similarly,** with lighter requirements for micro-, small and **medium-enterprises**, the reduction of pellet losses ranges from **21 569 tonnes/year to 125 757 tonnes/year** (84 – 492 ktCO_2e).

Social impacts

This measure will require additional staff to prevent pellet losses and for training. Applying the same assumptions made on the share of the volume between small, medium and large factories, implementing the measure would need from 3772 to 4103 FTE personnel.

Since this option may increase the cost of plastic raw materials, the general public may be impacted by an increase in the cost of plastic goods. Since plastic is used everywhere, any increase in its cost will be felt in society. However, the cost increase is likely to be limited as the cost of the measure is small compared to the turnover of the sector. For large companies, in particular, it is possible that the manufacturer would absorb such a slight increase in its production costs and that consumers would be unaffected.

Summary: The introduction of mandatory requirements and certification would result in significant reductions of pellet losses. The more losses are avoided, the greater the positive impacts are for the environment and for economic activities like commercial fishing, agriculture, tourism and recreation. the costs incurred by the sector under Option 2 and its sub-options (without micro/without micro and small companies/ without micro, small and medium companies) may increase the cost of plastic goods produced and/or converted in the EU. There would be a cost for public administrations as they would be in charge of monitoring its implementation, but this would be via a unique instrument i.e. a public register of certified companies.

This option has less risks as to the probability of reaching the objectives and massively reduces the number of free riders. The system is set up in a way to limit public costs as it involves third party auditing and certification. The possibility of a public register of certified companies at national level would further increase the transparency and traceability of the supply chain, with limited processing costs for the public authorities in the Member States.

Costs for business are expected to be higher in the beginning as some investments need to be done and go down afterwards. There will also be a learning curve reducing costs later on.

Table 61: Summary of impacts in 2030 of Option 2 and its sub-options 2a-2c

	Option 2	**Option 2a: Lighter requirements for micro-enterprises**	**Option 2b: Lighter requirements for micro-and small enterprises**	**Option 2c: Lighter requirements for micro-, small and medium-enterprises**
Environmental impacts (i.e. reduced pellet losses) (tonnes)	27 128 – 148 879	26 730 – 147 227	25 142 – 140 621	21 569 – 125 757
Environmental impact (GHG	106 210 – 582 890	104 655 – 576 424	98 437 – 550 560	84 446 – 492 366

	Option 2	Option 2a: Lighter requirements for micro-enterprises	Option 2b: Lighter requirements for micro-and small enterprises	Option 2c: Lighter requirements for micro-, small and medium-enterprises
emission savings) (tonnes of CO_2 eq)				
Economic impacts				
Cost of the measure (M EUR/year)	742	615	516	479
Savings from the pellet losses (M EUR/year)	27 - 149	27 - 147	25 – 141	22 - 126
Net cost to businesses (M EUR/year)	593 - 715	468 - 588	376 - 491	353 - 457
Cost-effectiveness (EUR/tonne/year)	3 982 – 26 342	3 177 – 22 005	2 672 – 19 536	2 805 – 21 186
Savings from GHG emission (MEUR/y)^	11 – 58	10 – 58	10 – 55	8 – 49
Other economic impacts	**Public Administrations**: increased costs for data collection (i.e. public register) and overall monitoring of the implementation, intervention in case of non-compliance (i.e. enforcement of the sanctions) **Citizens**: limited increase of the cost of plastics goods **Tourism and recreation:** increased attractivity through the reduction of pellets in coastal areas and other vulnerable areas **Fisheries:** fewer pellets released in water and improved ecosystem services due to fewer pellets absorbed by marine organisms and animals in areas affected **Agriculture:** fewer pellets released on soils and improved ecosystem services due to fewer pellets affecting soil properties in areas affected			
Other environmental impacts	**Society**: fewer costs related to clean up and remediation activities by local communities in affected areas			
Social impacts (jobs in FTE)	4103	4004	3858	3772

Note: 1 tonne of CO^2 estimated value is 100 EUR€/t. Therefore, it can add 8 – 58 M EUR€/year in savings.

* Net cost: cost – savings. In every option there are 2 scenarios of the projection of the pellet losses. Therefore, higher pellet loss reduction refers to lower costs and vice versa.

4 OPTION 3: IMPROVED PACKAGING FOR LOGISTIC OF PELLETS

This option targets in particular the logistics sector operators to prevent losses from transport, intermediate storage and handling during these operations. The option imposes the use of specific types of bags and containers for pellet handling, transport and storage and, where relevant, product

design measures. It can be set up as an independent piece of legislation or can be implemented as part of the legal proposal in Option 2.

What would be the costs of this option?

Current packaging materials used to transport pellets are:

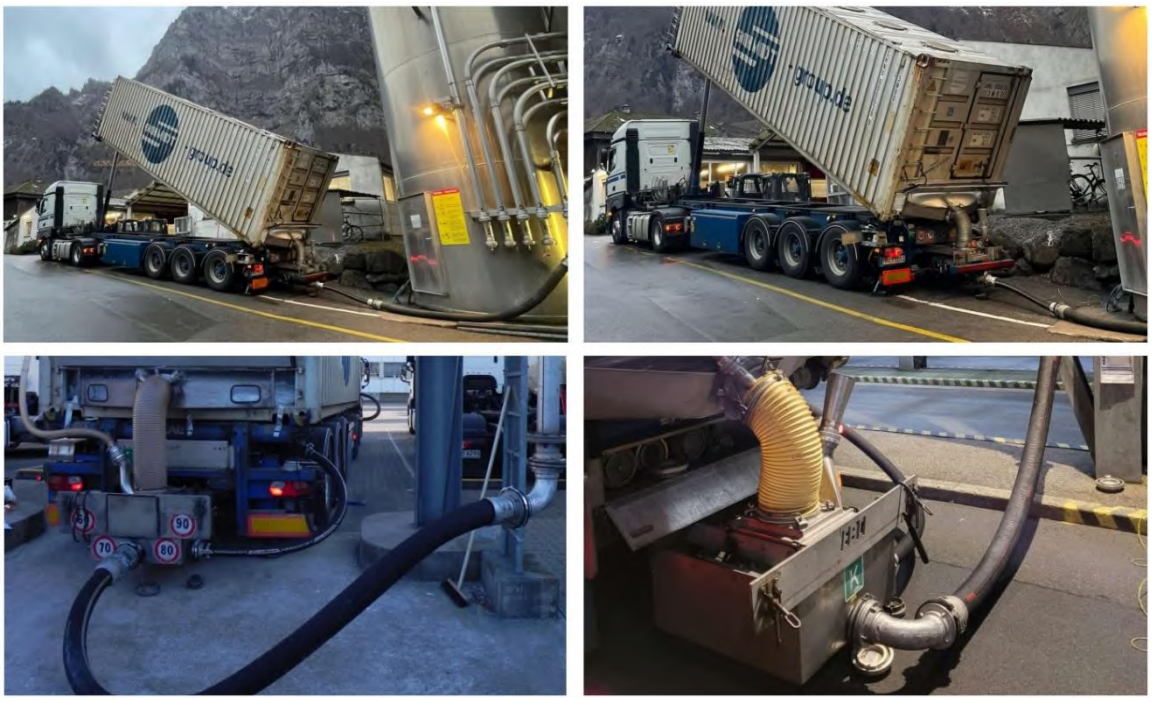
- plastic bags (containing up to 25kg of pellets) stacked on pallets with a total weight of up to 1.5 tonnes;
- octabins (cardboard containers containing between 0.5 and 1.3 tonnes of pellets);
- big bags, containing from 0.5 to 1 tonne of pellets;
- containers, containing up to 25 tonnes of pellets; and
- silo trucks, containing up to 35 tonnes of pellets.

These different packaging materials do not present the same pellet loss risks, with plastic bags holding the most risk for pellet losses and silo trucks the least. As shown in the figures below, silo trucks have airtight suction mechanisms and the loading and unloading of these trucks leave little room for pellet spills, but if they are spilled, then they are collected for disposal.

Figure 12: Loading pellets into a silo truck

Source: Schmidt-heilbronn Company

Figure 13: Unloading pellets from a silo truck



Source: Schmidt-heilbronn Company

The costs of imposing specific packaging and accompanying measures could be potentially high, especially for producers, who may have to change their production lines since plastic bags are automatically filled on-site through their own manufacturing chain. Similarly, logistics operators will have to adapt their transport and storage approaches depending on the type of packaging.

Plastic bags are the packaging materials which would be targeted first because of their poor resistance to tears during operations. In its background document on pre-production plastic pellets[224], OSPAR mentions that plastic bags and octabins could be replaced with reusable rigid HDPE barrels or with intermediate bulk containers (IBC). IBC Containers' pricing ranges from EUR 165 up to 4500 [225] while HDPE barrels are cheaper and cost between EUR 13 to 40[226] depending on their specifications e.g. size, material, and type of opening. Replacing existing machinery and processes might also generate extra costs. Another approach could be to use thicker plastic bags which are more resistant to tears.

[224] OSPAR Commission, Background document on pre-production plastic pellets, 2018, https://www.ospar.org/documents?v=39764. Accessed 12 Apr 2022.

[225] www.ibctanks.com/chemical

[226] www.hasdrums.com.sg

Figure 14: Returnable rigid HDPE barrels

Figure 15: Intermediate bulk containers (IBC)

The IMO Correspondence Group on Marine Plastic Litter from Ships that is looking at how to reduce the environmental risk associated with the maritime transport of plastic pellets considered packaging provisions for plastic pellets carried at sea as primary measures to take forward for further assessment.

However, they acknowledge the high cost of this measure to the industry because production facilities are already fitted with bagging lines to package pellets. The bags have several advantages over the rigid containers and the IBC because they enable flexibility in the size of shipments and prevent dust contamination. Bags are also more suitable to fill up means of transport, and therefore increase freight loads. This reduces the number of freights so GHG emissions and transport costs would be lower when using bags.

Data is lacking on:

- the volume of pellet losses due to packaging in general and specific packaging types, and the share of these losses in the overall pellet loss estimates;
- the market shares of the different types of packaging used for pellet transport; and
- the cost difference between actual packaging and improved packaging.

What would be the benefits of this option?

This option could potentially significantly reduce pellet losses during transport and intermediate storage, as well as handling during these operations. Also, with increased efficiency in their processes, the sector would gain from the investments. However, no quantification could be made to estimate the losses due to torn plastic bags or octabins.

Economic impacts

Due to important data gaps, it was not possible to quantify the direct investment and compliance costs for the sector deriving from this option.

The cost of this option would probably be high, relative to turnover, but so could the gains in terms of pellet loss prevention. However, the cost per tonne of pellet losses avoided is expected to be higher than with Option 2 because it will force the industry to overhaul their production lines to effectively remove the bagging lines and replace for instance plastic bags with returnable rigid HDPE barrels or

with intermediate bulk containers IBC. Imposing thicker more resistant plastic bags could lower such costs. However, as all these solutions mainly represent an investment cost, smaller enterprises would be affected more than bigger ones respective to their size.

Environmental impacts

This option would yield positive environmental impacts by reducing pellet losses to the environment; however, it can also increase CO2 emissions. Indeed, rigid HDPE barrels and IBC do not offer the same flexibility as plastic bags. When not entirely filled up with material, they increase storage volume for a given quantity of material, increasing the CO2 emissions incurred by transport. If thicker bags would be chosen, there would only be a minor increase of GHG emissions (As thicker bags are used, there is an increase in the amount of plastics used for the bags. This is expected to be minor compared to the GHG emissions from transport).

Social impacts

There are no social impacts foreseen for this option. However, moving towards more automated solutions like silo trucks could reduce the number of jobs (more workforce is needed for manual loading and unloading of pellet containers/bags).

Stakeholder views: While there is no precise information available on the proportion of pellet losses that can be attributed to poor quality packaging, NGOs often emphasise its relevance. Industry seems less convinced, especially in light of the expected high costs of improved packaging. The umbrella association of European manufacturers, PlasticsEurope, considers that more robust packaging of plastic pellets or prohibiting certain types of packaging does not address the root cause of the problem, and is not an effective alternative for excluding the transport sector or any other sector in the plastic supply chain from mandatory provisions.

In the second consultation conducted early 2023 targeting all SMEs handling pellets (Annex 12), respondents consistently reported the potential high costs of changing the packaging structure. In particular, it emerged that while two-thirds of respondents consider the use of specific packaging effective to reduce pellet losses, only 54% do it always or often (and a third never does it or has no opinion). Views on whether this should become a mandatory requirement are mixed: 33% in favour, 20% in favour if lighter requirements for SMEs, and 27% against, while the use of specific packaging is estimated as the most costly measure both in terms of person/days and euros/tonne/year. Financial support was identified as the form of support that would best help respondents, along with a standardised methodology to measure pellet losses.

Summary: The use of more resistant packaging materials and spill-proof packaging options would reduce pellet losses throughout the supply chain. However, the impacts differ according to the type of improved packaging chosen. While switching out plastic bags for barrels would likely present a greater reduction in losses, it would also increase the GHG emissions and costs of transport, in addition to require greater investment costs (as infrastructure will need to be replaced). Opting for thicker more resistant plastic bags would avoid these investment costs and allow for greater volumes to be transported per unit of transport. This option could be incorporated into a more comprehensive set of requirements, such as those laid out in option 2. There was not enough data to be able to calculate the precise costs, but it was estimated that the cost effectiveness of this option would be lower than for option 2.

5 OPTION 4: EU TARGET TO REDUCE PELLET LOSSES

An emission reduction target for pellet losses will be set under this option. The target can be ambitious as the plastic production and conversion industry responsible for the OCS certification scheme believes that a 95% reduction of losses in their facilities is achievable. While this seems

correct if all firms would implement, it is not clear if this would be realistic, and if this 95% target is achievable for the whole sector.

This option can only be implemented if a measurement standard for pellets losses is developed (Option 1). It would also be useful to gain more knowledge before its implementation, which can be done through the REACH reporting requirement. A new piece of legislation could be used to create and enforce a pellet loss reduction target, but it could also be integrated into Option 2.

The target could be set either for the whole plastics industry, or at sector level allowing the supply chain to optimise processes to achieve the target. In the latter case, there could be differentiated targets depending on the place in the value chain.

An emission target mechanism could be set up to define and enforce the target by:

- Setting a maximum volume of pellets which can be lost either per unit of pellet produced/converted/transported in mg/kg or setting a maximum quantity of pellets which can be lost to the environment; or
- Setting a maximum percentage of the production volume that can be lost, enforced by measuring the content of catchment devices (e.g. filters) part of the plants' containment systems and sampling on the plant's premises and vicinity.

A more sector-oriented approach would require a kind of clearinghouse which would report the pellet losses every year, as well as close cooperation and engagement from all actors throughout the supply chain, which is not the case today. (For instance producers and processors are discussing together the implementation of the OCS certification scheme, but recyclers and logistics operators are still external to the process. Also, they all have different strategies, ambitions, and means to tackle pellet losses).

Whatever the approach, the thresholds will need to be refined after additional data is gathered from, for example, the REACH reporting requirements. Building on the results of this first monitoring exercise, it will be possible to define an achievable threshold for pellet losses.

Enforcement will be the main difficulty in this option; indeed, sampling protocols for pellet losses are in development, and there are currently no standards to do so.

This is a medium to long-term option, which should be in phase with the time necessary to identify the relevant threshold. Indeed, the REACH restriction on intentionally added microplastics was adopted on 25 September 2023.[227] In this restriction, the reporting on estimates of quantities released is proposed, but there are some limitations, as identified by Rethink Plastic Alliance[228] in their position paper:

- The ECHA restriction does not require the industry to report the tonnages handled, yet, this would help define a spill rate, which would be useful in defining a possible threshold;
- The ECHA restriction does not provide minimum requirements for the reporting on estimates of quantities released, but having this information would be essential to provide comparable data; and
- The entry into force of the reporting requirement takes a long time. In view of voluntary

[227] Commission Regulation (EU) …/… amending Annex XVII to Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards synthetic polymer microparticles.

[228] Rethink Plastic alliance, PLASTIC PELLETS UNDER REACH: Strengthening requirements to enable effective supply chain legislation, Position Paper, March 2021, https://rethinkplasticalliance.eu/wp-content/uploads/2021/04/plastic_pellets_under_reach.pdf Accessed 14 April, 2022.

initiatives, which will include reporting, that the plastic pellet supply chain is putting in place, the Restriction now includes a 24-month transitional period for the reporting requirement.

The ECHA reporting requirement could be used to define a threshold for pellet emissions to the environment; however, it may need some improvements depending on the decisions to come regarding the comments made to the proposal. It will also need some more years before the data becomes available.

Once the threshold is defined, it could be possible to include it in legislation.

What would be the costs?

The cost of setting the emissions reduction targets would depend on the measurement standard developed to measure pellet losses accurately. Once developed, the standard would need to be applied over 12 to 36 months to generate a statistically strong database with and without implementing prevention, mitigation and clean-up measures. The target could be defined as the result of this observation phase.

The implementation of the targets are expected to generate the same or similar costs as the requirements under option 2. Similarly, lighter requirements would be needed for for SMEs, especially for micro and/or smaller firms to mitigate concerns raised by SMEs (e.g. lack of staff/time, lack of information on risks and solutions and lack of financial resources – see Annex 12). The follow-up costs might be higher than under Option 1 as a more stringent system would need to be set up.

What would be the costs for the public authorities?

The costs of applying the emission reduction targets through legislation would be similar as those under Option 2.

What would be the benefits?

Pellet losses would be similar as in Option 2. As discussed earlier, this will only be achieved in the medium to long term as it requires adopting a methodological standard for the quantification of pellet losses, as well as its testing in various sites of different sizes over a significant period (minimum of 12 months). This option, independently from Option 2, only looks at the objective, and not at the means to achieve it. The measurement and follow up of such spills and losses will not be feasible without having the methodology (Option 1).

Therefore this measure is not favoured in the short term.

Economic impacts

The economic impacts of this option will be on the pellets value chain. The cost to adapt procedures and sites would be comparable to Option 2 as similar prevention, mitigation and clean-up measures would be implemented. However, accurate monitoring following the measurement standard developed under Option 1 would be needed to ensure that the emissions targets are respected (not included in Option 2 which focuses on requirements and certification). Also, the public authorities in Member States will bear additional costs for compliance and enforcement.

Environmental impacts

Environmental impacts will depend on the already avoided losses through measures such as Option 2 or Option 3, but also on the ambition level set. As compliance checks and verification is estimated to be more difficult, they are expected to be slightly lower than in option 2.

Social impacts

The main social impact is additional job creation mainly for the industry, and some for the competent authorities, again relatively similar to option 2.

Stakeholder views: This option was not discussed by the stakeholders in detail. It was however mentioned that setting up a performance monitoring system, essential for such as system, would be costly.

Summary: Defining an EU emission reduction target for pellet losses, once a mandatory standardised methodology has been developed, tested and applied, can significantly reduce pellet losses as it requires preventive, mitigation and clean-up measures to be taken. However, this option, in contrast with Option 2, only looks at the objective, and not at the means to achieve it. Implementation and enforcement by the Member States seem more challenging than in Option 2. As this option requires a performance monitoring system first, its implementation would take time. Therefore this option is not favoured in the short term.

6 SUMMARY OF THE IMPACTS

The table below illustrates the economic costs of implementing the measures and the environmental benefits of reducing pellet losses for the four options assessed. Other impacts (costs and benefits) are also presented.

Table 62: Summary of impacts for the four options

	Impacts				Assessment and considerations	Benefit - cost
	Env	Eco	Soc	Cost		
Option 1	(+)	(+)	0	(+)	A mandatory standardised methodology benefits all other options, implying (development and testing) costs for the sector. It will result in cost savings as only one method needs to be developed and applied, also leading to lower verification costs.	**High**
Option 2	+++	+	+	---	Mandatory requirements and certification have the highest reduction in pellet losses, with the highest direct compliance costs for the sector.	**Medium**
2a	+++	+	+	--	The reduction of pellet losses is still very high, but costs are lower than under Option 2 thanks to lighter requirements for micro-enterprises.	**Medium**
2b	+++	+	+	-	The reduction of pellet losses is still very high, and costs are lower than under Option 2a thanks to lighter requirements for micro- and small enterprises.	**High**
2c	++	+	+	-	The reduction of pellet losses is lower than under the other sub-options, and costs are only slightly lower than under Option 2b due to lighter requirements for micro-, small, and medium-enterprises.	**Medium**
Option 3	+	-	0	--	Improved packaging reduces pellet losses throughout the supply chain (not quantified), but generates more GHG emissions (subject to the packaging type), while entailing potentially quite high investment costs for the sector.	**Medium - Low**
Option 4	++	+	+	---	An EU emission target has potentially a high reduction of pellet losses, as operators have to adopt preventive, mitigation and clean-up measures, but the enforcement might be challenging. Its costs are comparable than those of Option 2. As it depends on Option 1, it can only be implemented afterwards, leading to a delay in implementation time.	**Low**

Annex 12:
Impacts on SMEs

1 IDENTIFICATION OF AFFECTED BUSINESSES

This initiative focuses on the unintentional release of microplastics from plastic pellets. Among pellet producers, the exact number of SMEs is not known because, in Eurostat, the statistics per enterprise size are aggregated in a broader category including basic chemicals, fertilisers, plastics and synthetic rubber[229]. In this broader category, SMEs account for 24% of the total turnover. As to pellet converters, according to Eurostat[230], there are 47 710 companies manufacturing plastic products, out of which 31 400 are micro-enterprises (66%), 15 410 are small companies and medium-sized companies (32%), and 900 are large companies (2%). In terms of turnover, the micro-enterprises represent about 4%, while small companies and medium-sized companies account for 52%, and the large ones for 44%[231]. In addition, for the transport and storage sector in the number of companies (based on Eurostat 2021 data, see calculation in annex 11): 0.4% large are large enterprises, 3% medium, 16% small and 81% micro.

Regarding plastic producers, large enterprises represent 76%, while medium-sized enterprises 22% and small enterprises 2% (note: Plastics Europe estimates that there are only large firms). Among the 730 plastic recycler companies in Europe, half of them are SMEs, and there are several micro-enterprises.

2 GENERAL CONSULTATION OF SMES

The Commission first consulted SMEs through its open public consultation covering six sources, including pellets. The consultation period started on 22 February 2022 and ended on 17 May 2022, lasting 12 weeks. Among the respondents from businesses (about 67% of the 411 respondents) to the open public consultation, 85 were micro, 54 small and 36 were medium-sized enterprises. The closed-ended questions didn't have questions specific to SMEs, and they did not respond to the open-ended questions.

In addition, five virtual stakeholder meetings were organised, where sectoral business organisations (Plastics Europe, EuPC, and PRE) participated actively. During the meeting dedicated to the identification of potential measures on pellets, the following possibilities were suggested by the business organisations:

- Voluntary implementation of EuCertPlast to prevent pellet loss by recyclers;
- Voluntary commitment to OCS certification scheme by Plastics Europe and EuPC;
- Compounding, masterbatch and converting industry's voluntary commitment to minimise pellet losses;
- Use existing waste legislation, where appropriate, to require that pellet handling sites have adequate measures to prevent plastic pellets from being released to the environment;

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[229] NACE code [C201]: Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms

[230] [C222] Manufacture of plastics products (not sure if it covers only convertors or other plastic product manfacturers)

[231] EuPC

- Development of universal information leaflet and labelling for packaging of plastic pellets;
- Development of best practice guidelines; and
- Awareness raising and training of the personnel.

Stakeholders consistently highlighted the need for financial support for SMEs. During bilateral discussions with umbrella organisation EuPC, limited resources were indicated as a barrier to implementing the voluntary OCS certification.

3 TARGETED SME CONSULTATION

3.1 Summary of the results

A second consultation targeting SMEs that are handling plastic pellets (producers, converters, recyclers and transporters/logistics) took place via the Enterprise Europe Network from 26 January to 23 February 2023 in all EU languages. Based on the 330 replies received by 23 February 2023, the following analysis was made:

- The survey included the following list of nine individual pellet management measures:
    1) Get expert advice
    2) Undertake external audit/certification
    3) Monitor and report annual quantities
    4) Use airtight, puncture resistant packaging
    5) Have specific equipment
    6) Train staff
    7) Establish rules and procedures
    8) Have specific protocols
    9) Identify the risky locations and processes
- Respondents were asked to indicate whether they implemented these measures in their company, whether they deemed these measures effective to reduce pellet losses, and whether they would be in favour of making these measures mandatory. For seven measures, **a majority was in favour of making them mandatory under the condition that requirements are lighter for smaller companies** (Figure 18). This was however not the case for: (1) the training of staff (more than 50% are in favour of making this mandatory in any case); and (2) external auditing (49% are against making it mandatory in any case).
- Respondents were also asked to estimate the costs of the nine pellet management measures, as well as total combined costs of reducing pellet spills and losses. The analysis of these estimated costs shows **a significant burden for micro and small companies**, **as well as companies with capacities below 1 000 t** (see Table 63). Important note: as shown in Table 65 and Table 66, there is some correlation between the company size and the tonnage capacities, however, there is no perfect correlation; some micro and small companies indicate plastics processing capacities above 1 000 or even 5 000 tonnes per year while some mid-sized or large companies indicate capacities below this threshold. Among the nine pellet management measures, the use of specific equipment and of specific packaging[232] are identified as the most costly.
- **A large majority (86%)** of respondents indicated that **plastic pellet management is dealt with as an important or priority matter** in their company (Figure 16: Behavioural profile of

[232] i.e. airtight, puncture resistant and /or environmentally sealed packaging to transport and store pellets

respondents on plastic pellet management). Six pellet management measures[233] out of nine can be considered consensual (i.e. more than two-thirds of respondents do them "always" or "often", consider them effective and could accept some mandatory requirement – see Figure 16, Figure 17 and Figure 18). However, **there is no such consensus on the measures related to monitoring**[234] **and external auditing**[235] (as well as expert advice[236]) (see Figure 16, Figure 17 and Figure 18). This is coherent, as 67% of respondents do not quantify the spills and losses in their company (only 30% do so – see Figure 19) and only 22% of respondents have some mandatory environmental auditing scheme in place (while 38% have a voluntary one and 30% don't have any auditing – see Figure 21).

- **The specific case of equipment**[237]: over two-thirds of respondents indicated having specific equipment to reduce pellet losses in their company ("always" or "often") and consider this measure to be effective, but views are mixed on whether this measure should become mandatory (28% of respondents consider it should remain voluntary, 27% think it should be mandatory and 33% mandatory with lighter requirements for SMEs). This is coherent as this is a measure which respondents estimated as costly. Besides 25% of respondents mention a "lack of financial resources to buy equipment" as a barrier preventing their company from taking action to reduce pellets losses, and 52% mention "**financial support** (e.g. to invest in specific equipment)" as the measure that could help them the most (Figure 19 and Figure 20).

  The specific case of packaging[238]: while two-thirds of respondents consider the use of specific packaging effective to reduce pellets losses, only 54% do it always or often (and a third never does it or has no opinion). Views on whether this should be mandatory are mixed(33% in favour, 20% in favour if lighter requirements for SMEs, and 27% against), while the use of specific packaging is estimated as **the most costly measure** both in person/days and euros/t/year (Table 64).
- Barriers preventing respondents from taking pellet management measures fall into three main categories (Figure 19): **lack of staff/time** (55% of respondents), **lack of information** on risks and solutions (50%) and **lack of financial resources** (48%). Financial support comes first as a support measure that could best help respondents (Figure 20), followed by measures to improve information (standardised method to assess spills and losses, courses and material, workshops) and assist respondents (external expertise).
- **60% of the respondents have some external environmental auditing scheme in place** (voluntary or mandatory), and out of these, 61% think this would probably make it easier or cheaper for them to implement an audit on pellets. In other words, 37% of respondents (61% of 60%) can reasonably expect a limited cost of a new audit on pellets (Figure 21 and Figure 22).
- 71% of respondents know Operation Clean Sweep (OCS) and implement it or intend to do so, and 9% have another similar programme (the most mentioned being the IK voluntary programme 'Zero Pellet Loss' in Germany). This means **80% of respondents take or intend to take action to reduce pellet losses**. However, among these 80%, 24% of respondents, who currently

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233 i.e. measures related to procedures and protocols, and staff training

234 "Monitor and report annual quantities of spills and losses, including spillage incidents"

235 "Undertake external audit/ certification / inspection on spills and losses"

236 "Get expert advice on the risks and good practices for our company". This measure is not considered to be made mandatory.

237 Equipment to reduce pellet spills and losses (e.g. dust remover, vacuum cleaners, protective barriers etc.)

238 Airtight, puncture resistant and /or environmentally sealed packaging to transport and store pellets, e.g. thicker plastic bags, rigid plastic packaging or well-sealed octabins.

implement OCS, do not indicate their intention to continue implementing OCS Europe in the future (Figure 25).

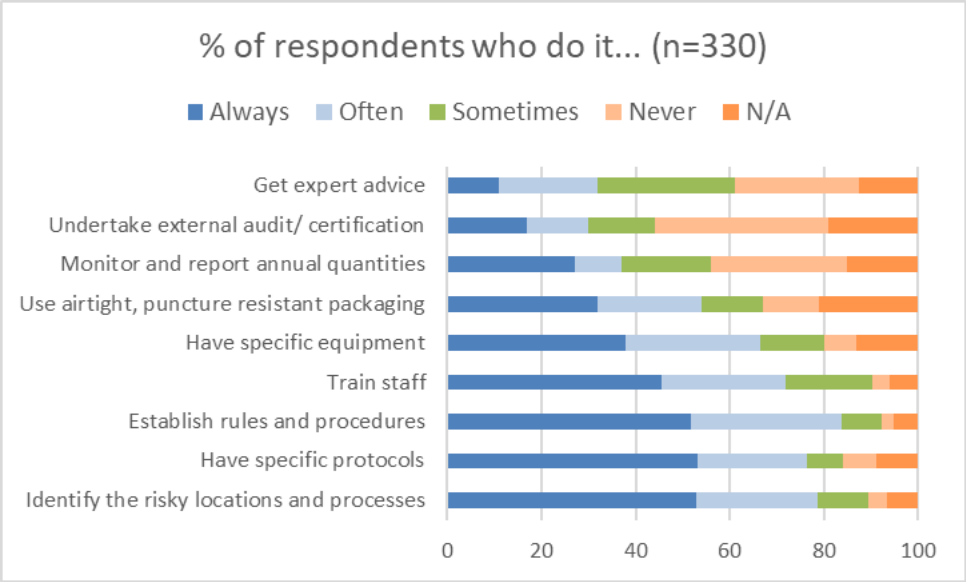

Figure 16: Behavioural profile of respondents on plastic pellet management

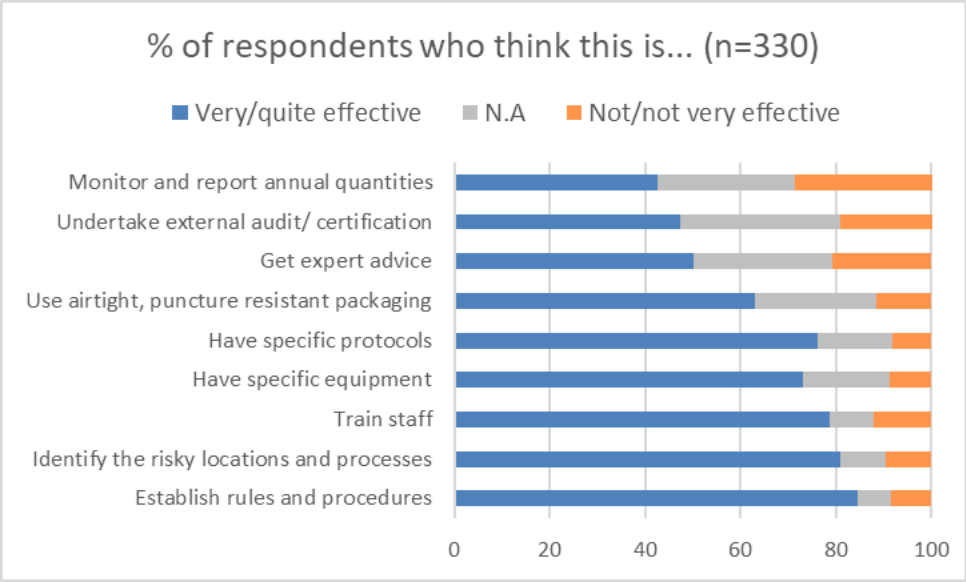

Figure 17: General opinion of respondents on the efficiency of plastic pellet management measures

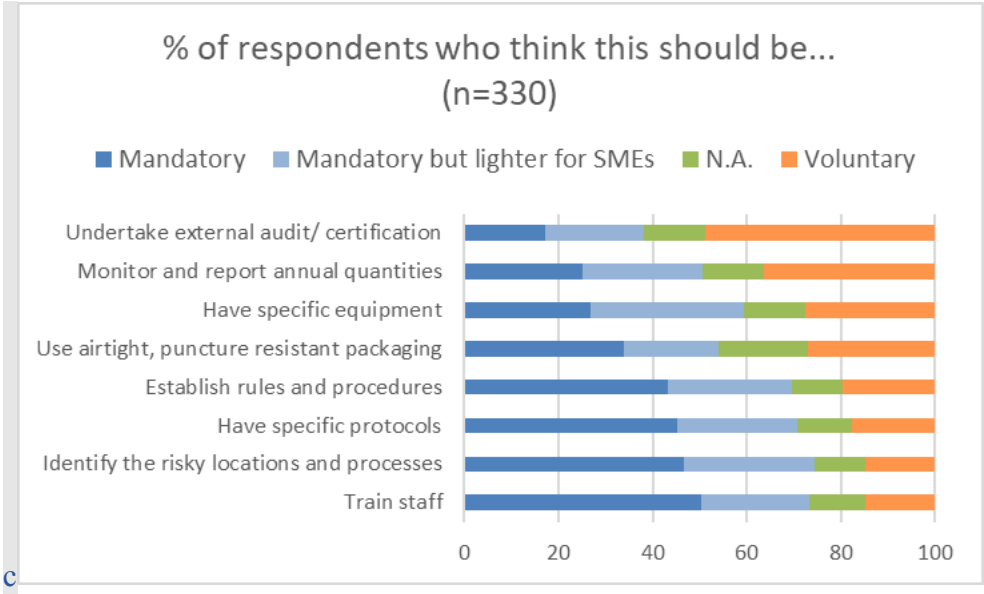

Figure 18: General opinion of respondents on the importance of possible plastic pellet management measures

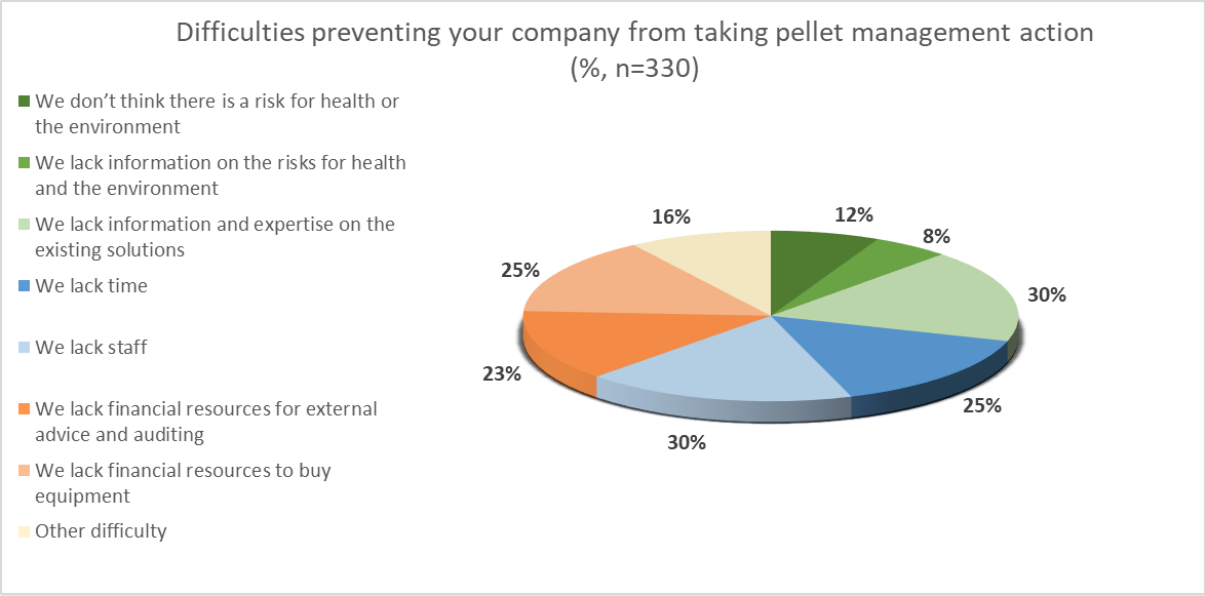

Figure 19: Barriers preventing respondents from taking pellet management measures

Among the other difficulties mentioned, we find a recurring statement around the lack of awareness (internally or among value chain partners). And the various following items: varied packaging formats from suppliers, damaged packaging, externalised storage /transport, difficulty to identify pellet containers among other containers, difficulty to measure the spills and losses, lack of space, lack of suitable equipment and technology solution.

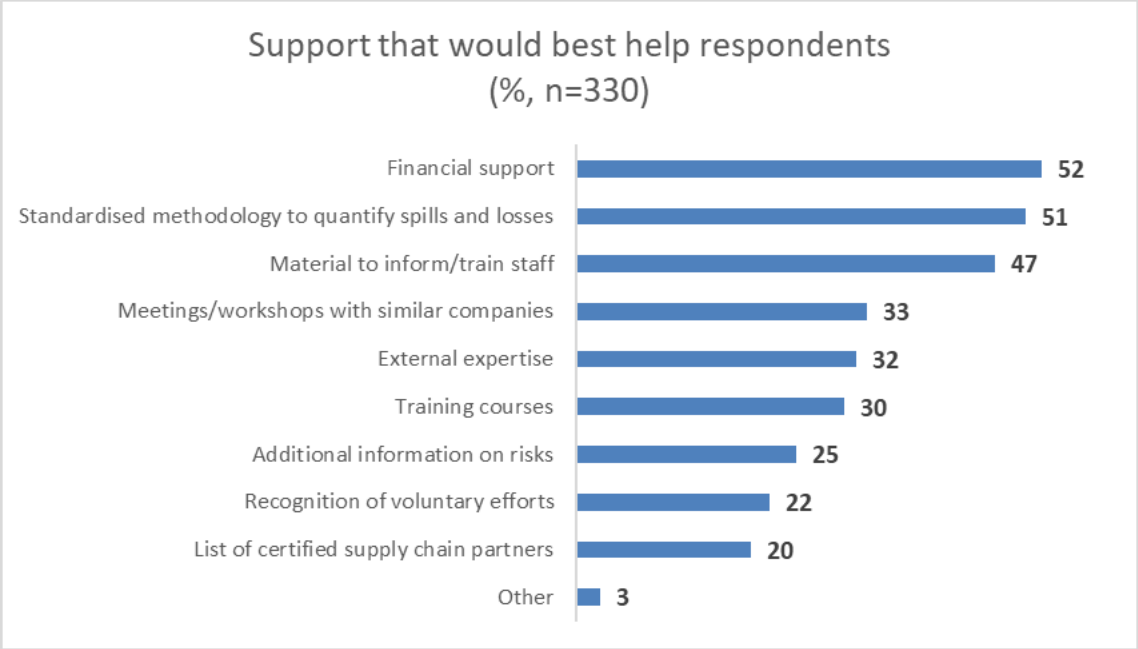

Figure 20: Support that would best help respondents

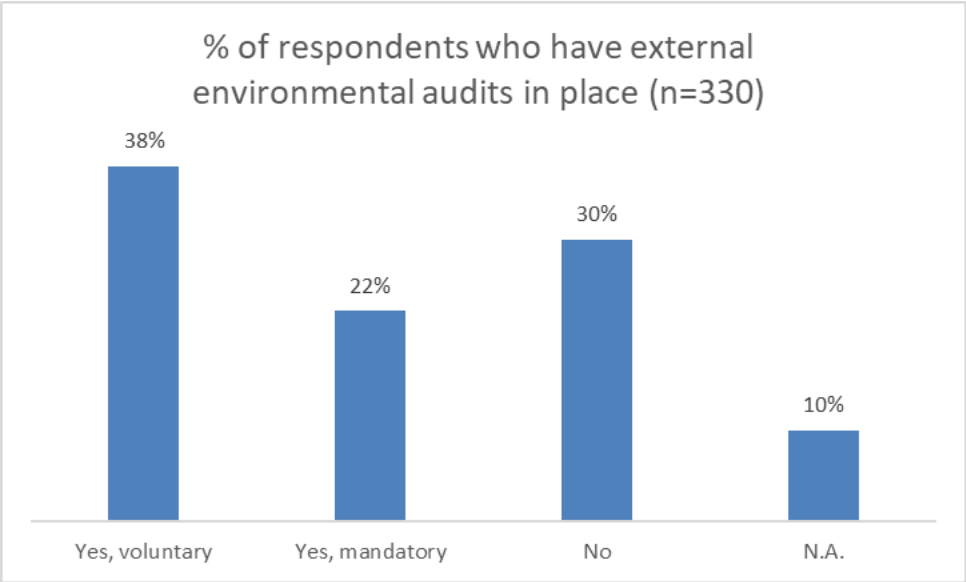

Figure 21: Respondents in percentage having external environmental audits in place

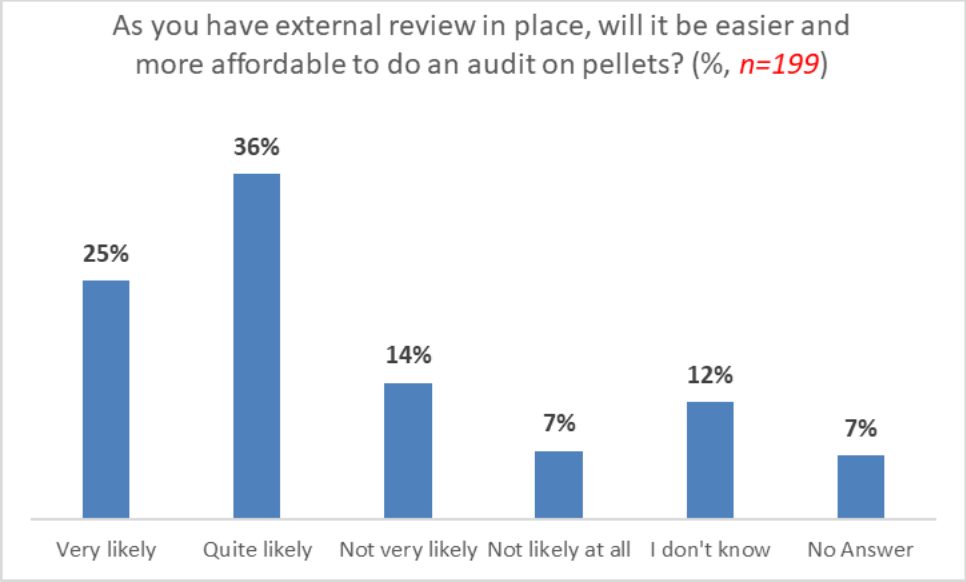

Figure 22: Audit on pellets with external review in place

3.2 Details of the results: analysis of estimated costs

Respondents were asked to estimate the costs in person/days and euros/year of the nine pellets management measures tested in the survey, plus the total combined costs of reducing pellets spills and losses in their company. The estimates show **large variations**, probably because respondents have a different understanding of the extent/depth of the measures to implement, plus they are starting from different levels of pellets management. For example, companies that replied "we implement OCS and will implement OCS Europe", i.e. companies that probably have already taken substantial action to reduce pellets losses, have estimated substantially lower investment costs for equipment in comparison with other respondents (this suggests they have likely already made investments). A company's organisation can be another factor. An extreme example comes from a large French recycler who estimated a total annual cost of EUR 950,000 and explains it as follows: "we have ***nine sites*** that handle plastic pellets overall. In question 9, we did a global estimation where the total estimated cost is ***the one of the first year*** (implementing operational procedures/systems). For the person/days/year value, we estimated 1 person per site (9 persons in total) on 220 days. This value includes all the staff involved in a year: QSE, risk analysis, training, audits, controlling, cleaning, equipment maintenance, etc."

3.2.1 Total cost of all actions to reduce pellet losses (combined cost)

The average total cost (combined cost) is **115 person /days per year** (Table 63). The larger the company, the higher the person/days (which is coherent, due to the larger operational perimeter). However, the burden is proportionally more significant for micro and small companies, considering their limited staff. The average absolute cost is **106 404 euros per year** (72 895 when retreated[239]). **The burden seems very significant for companies with a capacity below 1 000 tonnes (**Table 63**)** (this might also be due to estimated investment costs which should be amortized over several years for a more accurate cost estimation) and **significant for companies with 1 000 to 5 000 tonnes capacity** (accounting for 1 - 4% of their total sales), although the number of replies is insufficient for

[239] i.e. when removing very high or inconsistent values (e.g. negative/nil values)

this latter category to ensure definitive interpretation. The cost per tonne becomes insignificant beyond this 5 000 tonne threshold. If we assume a selling price of 800-1 800 euros per tonne of plastics, **the extra cost is considerable (3% of sales) for companies processing less than 1 900 to 4 000 tonnes per year, and substantial for companies process less than 5 900 to 13 000 tonnes per year**[240]. **The proportionally higher burden for smaller companies and capacities repeats in a similar way for all individual pellet management measures** (see below).

Table 63: Total cost for all measures (combined cost)

in person days			in euros/year/tonne		
	All data (n=163)	Retreated* (n=156)		All data (n=162)	Retreated[239] (n=150)
Average	**115**	**104**	**Average**	**984**	**600**
Micro	115	63	0-1kt	2513	1612
Small	73	67	1-5kt	27	14
Mid-sized	142	109	5-10kt	3	3
Large	370	183	10-50kt	7	7
			>50kt	3	1

* Inconsistent values (e.g. negative or extremely high) have been removed.

3.2.2 Costs per individual measures to reduce pellet losses

The sum of the costs for the individual measures is 262 person days per year, 130 069 euros/year, and 1 302 euros/tonne processed per year (Table 64). This is higher than the total combined costs shown in Table 63, which is coherent as **many companies only provided estimates for some of the measures** (i.e. they only selected those individual measures most relevant to their business operations).

Average values are however not very meaningful: more in-depth analysis shows that **costs are considerable or significant for micro and small companies and for companies with capacities below 1 000 tonnes, and limited for mid-sized companies or even negligible for large companies and capacities above 5 000 tonnes**.

The use of airtight, puncture-resistant and environmental sealed **packaging** shows the highest average costs in both person/days and euros/t/y, with **estimated significant costs for all sizes of company** (including 55 euros/t for large companies). Having specific **equipment** to reduce pellets losses is the other measure with significant costs whatever the company size (including 20 euros/t for large companies).

[240] This is however a calculation on averages, so to be used carefully. It somehow confirms the order of magnitude.

Table 64: Detailed estimated costs per measure

	Person days per year (average)	**Absolute costs/y (average)**	Costs in euros per tonne processed/y					
			Average for all	Micro	Small	Mid-sized	<1000 t	<5000 t
Expert advice	12.57	4443	**79**	94	107	5	217	2
Identify locations & processes	17.63	4371	**89**	774	69	13	233	1
Monitor	19.10	4905	**94**	147	36	17	83	1
Train staff	33.09	10 005	**108**	747	120	7	283	1
Establish rules & procedures	43.56	8680	**113**	288	131	33	208	2
External audit	41.20	5956	**116**	514	202	24	314	2
Have equipment	29.12	37 251	**186**	1664	112	20	528	12
Have protocols	15.98	3554	**199**	1987	32	15	515	0,8
Use specific packaging	50.01	50 914	**318**	2426	148	55	822	11
TOTAL	**262.26**	**130 079**	**1302**					

Colour	Cost represents X% of selling price of 1 tonne:
	35-133%
	11-35%
	2-10%
	<1%

3.3 Other detailed results

The majority of respondents indicated that it is important (49%) or very important (36%) for their company to reduce pellet spills and losses (Figure 23); however, only 31% quantify the pellet spills and losses at their site (Figure 24). 47% currently implement OCS Europe, 24% intend to implement OCS Europe in the futureFigure 25, and 9% implement another similar programme (Figure 25).

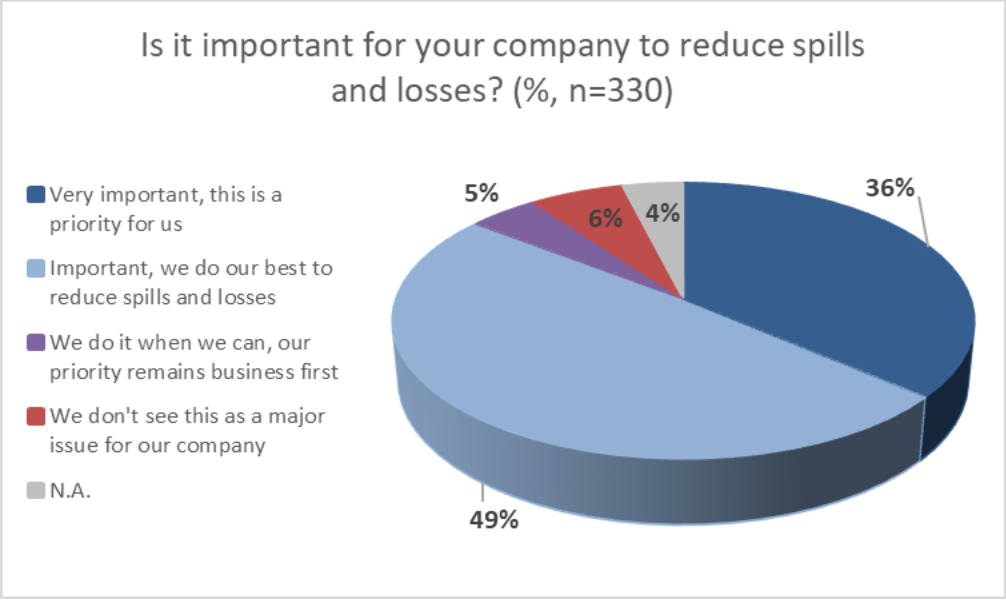

Figure 23: Importance of reduced pellet spills and losses

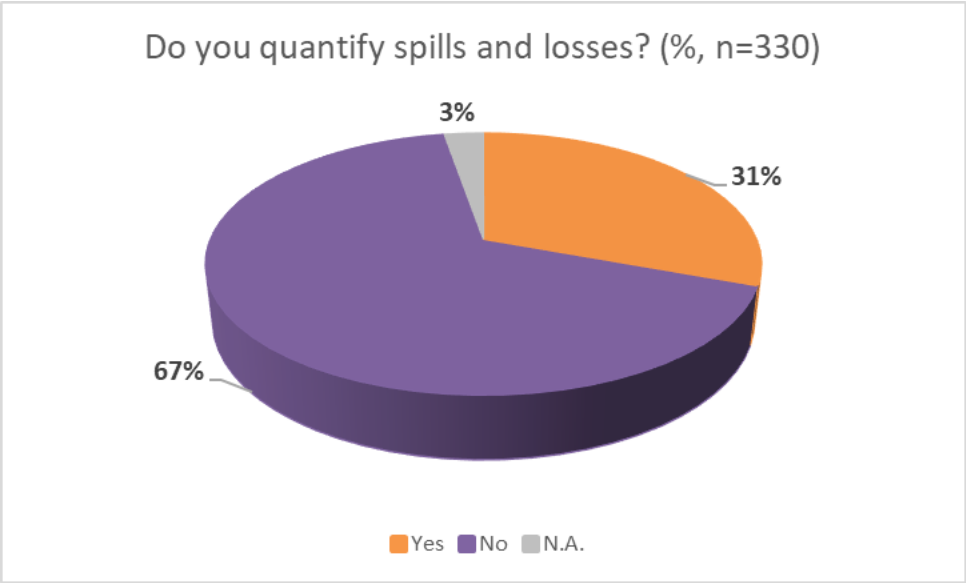

Figure 24: Quantifying pellet spills and losses[241]

[241] The data on estimated quantities of spills and losses are not reliable/exploitable for two reasons: 1) limited number of replies (36 in total, including 22 converters), and 2) it is unclear whether they indicated estimated quantities of spills or losses, hence replies show too large variations (e.g. from 0.01% to 33% for converters).

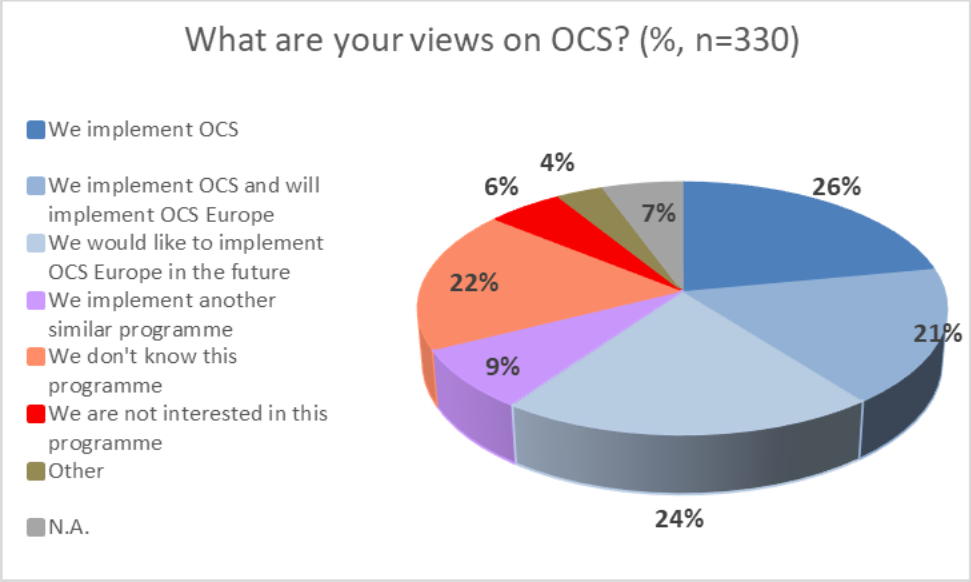

Figure 25: Views on OCS[242]

Other comments by respondents: Only 30 respondents submitted additional comments that can be summarised as follows. While they showed clear interest in good practices for zero pellet loss, the additional comments suggest general concern about the extra costs and burden associated with new requirements, leading to a potential disruption of the level playing field for EU companies. One respondent suggests that mandatory certification would only be acceptable to SMEs if available for free or at a reduced rate. Two respondents stress the improvement potential of packaging. Two respondents warned against classifying pellets as harmful under IMO. Two respondents plea for the OCS part of SQAS (note: the management system in place for transport) to become a recognised standard.

3.3.1 *Profile of* respondents

Respondents by country are shown in Figure 26. Regarding their business activity, 25 out of 28 respondents active in transport are in road transport. 41 respondents indicated an "other" activity, and out of these, 37 specified the following: 10 converters, 11 service providers (transport sector, consultancy), 8 companies from other plastics-using sectors (e.g. metal, wood, fertilisers), 3 waste operators, 2 business organisations, 1 distributor, 1 additives manufacturer, and 1 public authority (see Figure 27).

[242] The "other similar programmes" mentioned are in-house corporate programmes, ISO14001, EMAS, the IK voluntary programme 'Null Granulat Verlust' (Zero Pellet Loss), "AFNOR certification" and the implementation of the FR decree (perceived as redundant with OCS, except if OCS prove compliance)

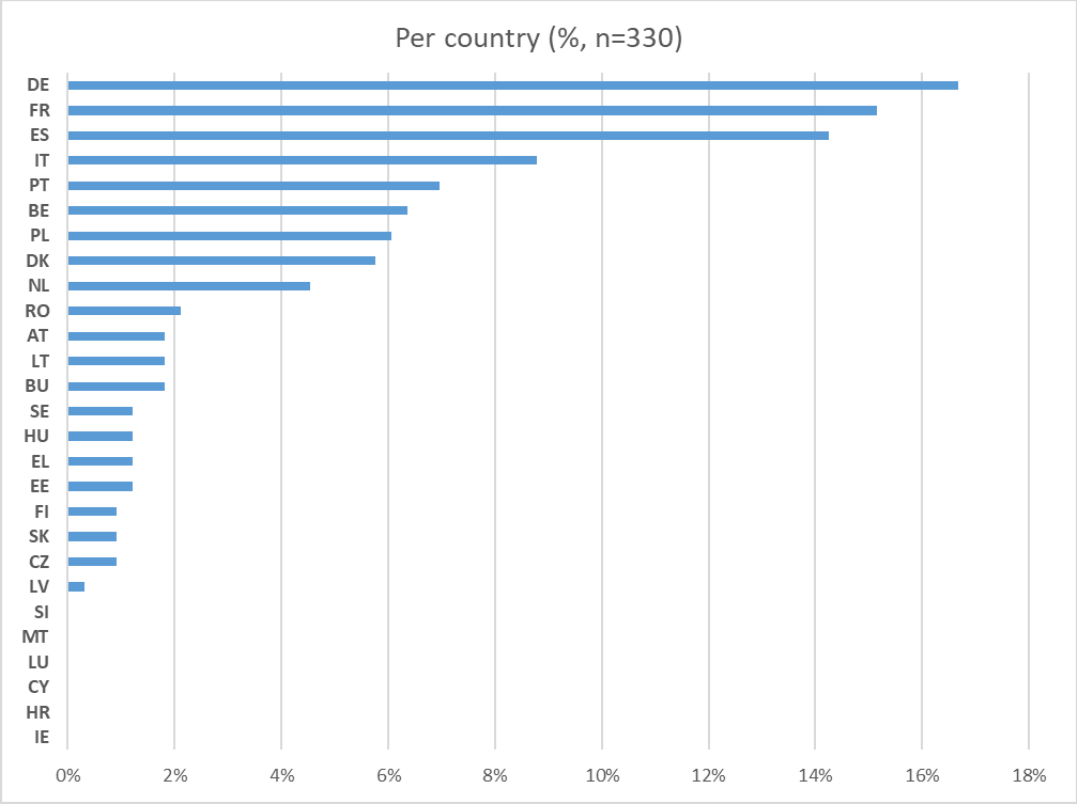

Figure 26: Respondents by country

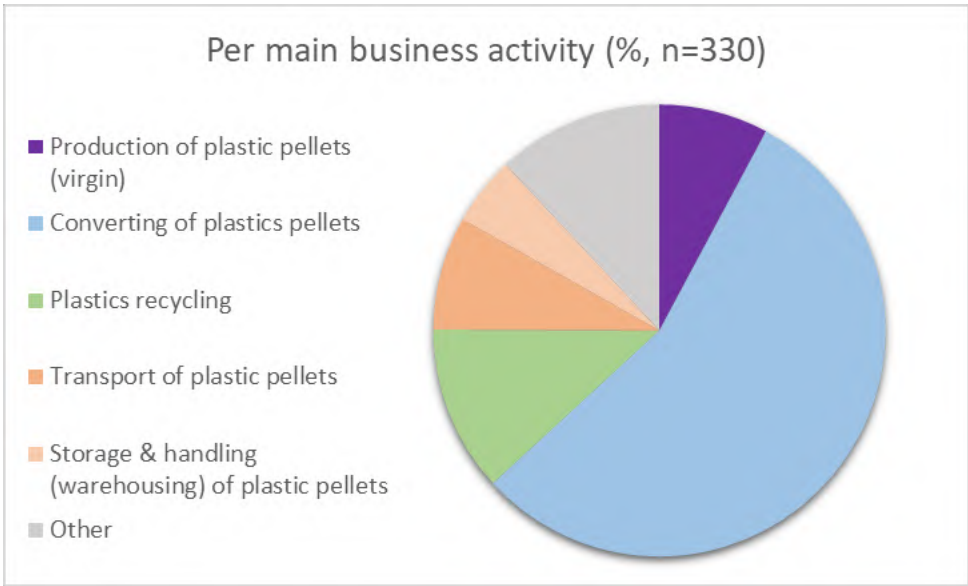

Figure 27: Respondents by business activity

Figure 28

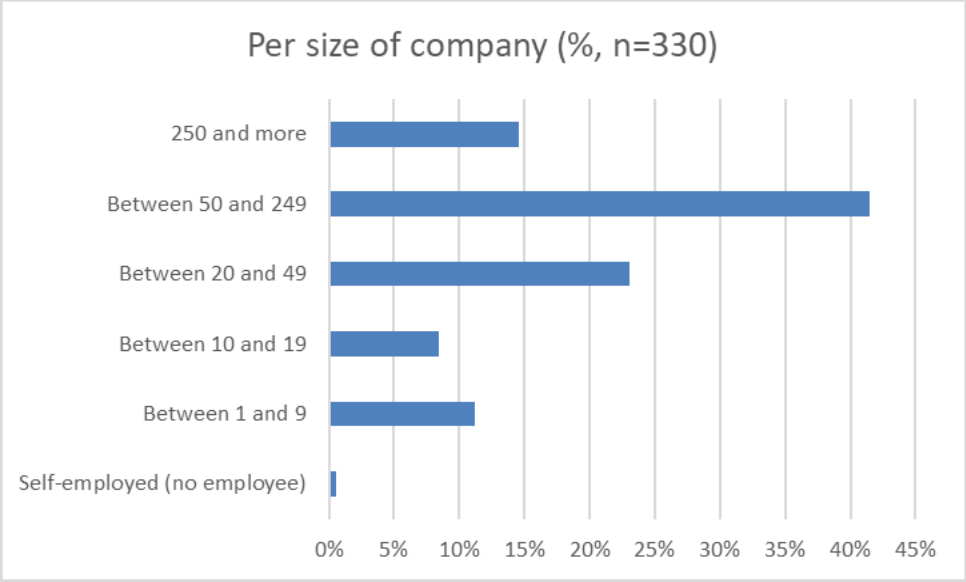

Figure 28: Respondents by company size

311 respondents indicated the annual tonnages they process, see details below in Table 65 and Table 66. Companies that process between 5 000 and 20 000 tonnes/y include 26% of micro and small companies. Companies processing over 20 000 tonnes/y include 10% of small companies.

Table 65: Average tonnages per size of company

Size of company	Number of replies	% of replies	Average tonnage	Lowest	Highest
self-employed	2	1%	0	0	0
1-9	31	10%	1140	0	15 000
10-19	29	9%	4261	0	70 000
20-49	73	23%	10 967	0	500 000
50-249	131	42%	52 240	0	3 117 977
>250	45	14%	214 728	0	4 000 000

Table 66: Declared tonnages vs. size of company

		Including				
Declared tonnage/y	**Nb of respondents**	***Self empl.***	***Micro***	***Small***	***Mid-sized***	***Large***
<1kt	122	2%	22%	43%	28%	5%
1kt<x< 5kt	63	0%	3%	44%	48%	5%
5kt <x<20kt	74	0%	3%	23%	55%	19%
> 20kt	52	0%	2%	8%	50%	40%

4 MEASUREMENT OF THE IMPACT ON SMES

Option 1: Mandatory standardised methodology to measure pellet losses

The cost of developing a mandatory standardised methodology to measure pellet losses was estimated to be between EUR 558 000 and 1 674 000. The testing cost of one facility would be about EUR 700 to 1 500 per test which means proportionally greater costs for SMEs and micro-enterprises than for larger companies. The lower costs are the more likely ones as ongoing OCS+ work can be used as a basis.

This option will help shed light on the actual volume of losses from SMEs. In the targeted SME consultation conducted by the Commission in January-February 2023 (see above), a standardised methodology to assess pellet spills and losses was mentioned by 51% of respondents as a support measure that could best help them to take action to reduce pellet losses.

66% of plastics converters are micro-enterprises and they account for only 4% of the quantities of converted pellets. While there is no data on the relationship between pellet loss and company size, it is likely that micro-enterprises do not account for a significant share of these losses. However, the costs for smaller companies would be more significant. In the targeted SME consultation, the cost of monitoring the quantities of pellet spills and losses was estimated to be 19 man/days/year. Nevertheless, according to REACH restriction, they would still have to report the pellet losses and having a standardised methodology could simplify the reporting.

Option 2: Mandatory requirements to prevent and reduce pellet losses in a new EU law

The introduction of a mandatory certification scheme for the pellet supply chain as proposed under the policy Option 2 would have a higher cost impact for micro-enterprises and other SMEs processing plastic pellets. It would impose concrete obligations on SMEs involved at different steps of the pellet supply chain, from production to compounding to converting to transport and recycling. These obligations would be the following:

- Conducting site risk assessments to document pellet handling activities and identify the risk of spills and losses and their potential impacts. The assessment should identify high-risk areas and pathways to the external environment and include measures, equipment and procedures for prevention, containment, handling and clean-up.
- Setting up internal procedures with a zero-pellet loss objective:
    - Define roles and responsibilities and routines in case of a pellet spill/loss incident;
    - Identify appropriate steps to prevent the reoccurrence of pellet spill/loss incidents;
    - Roles and procedures for informing the competent regulatory bodies;
    - Instructions for managing the clean-up, the use of clean-up equipment and disposal of the pellets after an incident in order to prevent impact on the environment; and
    - Guidance for good cleaning.
- Employee training and accountability for spill prevention, containment, clean-up and disposal, including written procedures.
- Regular auditing and performance reporting covering the following aspects:
    - effectiveness of the procedures to avoid spills and potential losses into the environment;
    - set intervals to carry out the audits;
    - management of any change in the operations of the facility;

- compliance with the routine inspection plan inside and outside its physical boundaries and its effectiveness;
- estimation of the amount of pellets lost per year to track progress towards the objective of zero pellet loss;
- training and or competence of the internal auditors;
- independence of the internal auditors;
- actions for non-conformities identified in the audits; and
- records of the audits.

The findings of the targeted SME consultation run by the Commission in January-February 2023 indicate a cost between 100 000 and 130 000 EUR/plant on average, with large variations depending on the company's business operations and past investments. This might indeed be the case for the larger firms. This impact assessment calculates the costs for micro-enterprises to around 4 000 EUR, and 113 000 for the large plants, equally based on figures coming from the converting industry, formed by many SMEs. Lighter requirements for the smaller firms are proposed.

Option 3: Improved packaging for the transport of pellets

A measure on improved packaging for the transport of pellets means potentially high extra costs. First, the currently used plastic bags should be replaced by more resistant holders; second, the automated filling unit of the manufacturing chain would likely need to be adapted or replaced. Contrary to the cheap price of plastic bags, IBC Container's pricing ranges from EUR 165 up to 4500[243] while HDPE barrels cost EUR 13 to 40[244] depending on their specifications e.g. size, material, type of opening.

In the targeted SME consultation conducted by the Commission in January-February 2023 (see above), the cost of "using airtight, puncture-resistant and environmentally-sealed packaging to store and transport pellets" was estimated at 50 man/days/year and 50 914 EUR/year, corresponding to an average 318 EUR/tonne processed/year. The cost was found to be considerable for companies processing less than 1 000 tonnes, as well as for micro- and small enterprises, and still significant for larger companies.

Option 4: EU/national targets to reduce pellet losses

Once a methodological standard for pellet loss assessment is available, an EU (or national) reduction target for pellet losses could be set, e.g. as an absolute maximum quantity of pellets losses or a maximum percentage of the processed quantities. Both scenarios imply costs and impacts comparable to option 2, as similar prevention and mitigation measures would be implemented.

5 MINIMISING NEGATIVE IMPACTS ON SMES

Phased implementation

Phased implementation with a longer implementation period for some companies may give them more time to adapt and align their compliance actions and investments with their normal business

[243] www.ibctanks.com/chemical
[244] www.hasdrums.com.sg

activities. The costs are slightly reduced where companies have more flexibility to build compliance into their normal investment cycle.

They could potentially choose to operate their existing facility until the compliance deadline before replacing it, but the longer-term benefits would be the same.

Size-related exemptions and derogations

Exemptions or derogations could be applied based on:

- the number of employees;
- the annual processing capacities;
- the turnover;
- the EU definitions of micro- and small enterprise[245]; and
- a combination of these criteria.

The targeted SME consultation, conducted by the Commission in January-February 2023, suggested a degree of correlation between company size (micro, small, mid-sized or large) and processing capacities. The processing capacities tend to increase with size:

- micro-companies who responded to the SME targeted consultation indicated an average capacity of 1 309 tonnes
- Small companies: 9 446 tonnes
- Mid-sized companies: 50 126 tonnes
- Large companies: 197 245 tonnes

However this correlation between size and tonnages is not perfect: in each size category, there are companies, including micro and small, that indicated processing capacities above 1 000 or even 5 000 tonnes per year, and some large companies indicated small tonnages (see above).

The targeted SME consultation suggested that the processing capacity of companies (in tonnes per year) is a key criterion to assess the impact of extra costs related to pellet management on the profitability. The consultation showed a disproportionate burden and considerable relative costs for micro and small companies, as well as companies with processing capacities below 1 000 tonnes of plastic materials per year.

Respondents estimated the total combined costs for implementing all measures at EUR 106 404 on average. Assuming a selling price per tonne of plastic material between EUR 800 and 1 800, then the costs would account for more than 3% of turnover for companies processing less than 1 900-4 400 tonnes per year.

In the SME targeted consultation, respondents with capacities below 1 000 tonnes accounted for a third of all respondents, but only 0.02% of all declared capacities. Respondents with capacities below 5 000 tonnes accounted for 55% of respondents, but only 1.3% all declared capacities.

As a reply to his SME targeted consultation, lighter requirements for micro-enterprises from the scope of the mandatory certification scheme are part of the preferred option. Marginal quantities of pellets

[245] https://single-market-economy.ec.europa.eu/smes/sme-definition_en

could be excluded from the scope. The French decree on plastic granulates[246] follows a similar logic where the operators processing less than 5 tonnes of pellets per year are excluded.

The targeted SME consultation also showed that mandatory monitoring of quantities of pellet losses and mandatory audit would be the least acceptable measures. Lighter requirements can be proposed for micro-enterprises involved in the production, storage, transport, storage and converting. Also small enterprises would be required to comply with less demanding requirements and could be given special assistance.

Financial support

In the targeted SME consultation, conducted by the Commission in January-February 2023, the lack of financial resources was mentioned by 48% of respondents as a barrier preventing companies from taking action to reduce pellet losses. Financial support came first as a support measure that could best help respondents to take action to reduce pellet losses (mentioned by 52% of respondents). The burden on SMEs could be reduced if Member States provide financial support to certain enterprises (e.g. micro-enterprises and other SMEs) to help them meet regulatory requirements.

In particular, EU state aid rules allow for:

- state aid with no prior notification to the Commission ("block exemption") covering up to 50% of consultancy costs in favour of SMEs, 60-70% of training costs, 50-60% (100% in case of competitive bidding complying with the conditions set out in Article 36(9)) of extra investment costs for improving environmental protection beyond Union standards in force or in the absence of Union standards or to comply with Union standards that have been adopted but are not yet in force at the latest 18 months before their entry into force [247] – the latter two options seem especially relevant as the preferred option envisages that requirements for smaller companies could be less demanding or apply at a later date.
- state aid subject to prior notification to the Commission[248] covering up to 50-70% of extra investment costs for projects preventing or reducing pollution in the absence of Union standards or going beyond Union standards as well as complying with Union standards adopted but are not yet in force at least 18 months in advance[249].

The financial support can be direct (e.g. loans or support programmes) or indirect (e.g. reduced fees). This approach would reduce compliance costs for SMEs but increase costs for Member States, depending on the specific measures adopted.

Non-financial support

The Commission and/or the Member States could provide some other support. In the targeted SME consultation, lack of staff/time and lack of information on risks and solutions were mentioned as barriers preventing action to reduce pellet losses by respectively 55 and 50% of respondents. Coherently, measures to improve information on pellet management (including a standardised methodology to assess spills and losses, information and training materials, training courses and

[246] Décret n° 2021-461 du 16 avril 2021 relatif à la prévention des pertes de granulés de plastiques industriels dans l'environnement

[247] Commission Regulation (EU) No 651/2014 ("General Block Exemption regulation"), in particular Article 18 on consultancy in favour of SMEs, Article 31 on training aid and Article 36 on investment aids for environmental protection, including climate protection.

[248] Member States may notify to the Commission a scheme (e.g., a national aid measure for SMEs), in which case it would in principle not be necessary to notify aid for each individual project supported under the scheme.

[249] Guidelines on State aid for climate, environmental protection and energy 2022, C/2022/481, Section 4.5 on Aid for the prevention or reduction of pollution other than greenhouse gases.

workshops) came second as support measure that could best help respondents to take action to reduce pellet losses.

Such support could take the form of advisory services to SMEs. For example, a project could be supported by the Commission which would:

1. develop SME-specific guidance and training materials and tools to help compliance with the new legal requirements. It is essential that these materials and tools are first tested with SMEs, before being rolled out, to ensure they are clear and relevant to SMEs;
2. deliver advisory services, e.g. through the Enterprise Europe Network and/or in cooperation with the relevant business organisations, to help SMEs understand the new legal requirements and prepare for compliance; and
3. establish a help desk/expert pool (5-6 contact persons with in-depth expertise of the new legal requirements and the compliance solutions) to assist first-level advisers and deal with more difficult questions or issues.

Such support can be open to larger companies but SMEs should be the primary targets, as they have fewer resources to understand and implement abatement technologies. This option would however incur costs for the competent authorities and/or the Commission (a first estimated budget could be around EUR 1 Million for a first project covering points 1 to 3 above).

Annex 13:
Prodcom codes used to quantify pellet production, export and import into the EU in 2020

Item	PRODCOM code
Linear polyethylene having a specific gravity < 0,94, in primary forms	20161035
Polyethylene having a specific gravity < 0,94, in primary forms (excluding linear)	20161039
Polyethylene having a specific gravity of >= 0,94, in primary forms	20161050
Ethylene-vinyl acetate copolymers, in primary forms	20161070
Polymers of ethylene, in primary forms (excluding polyethylene, ethylene-vinyl acetate copolymers)	20161090
Expansible polystyrene, in primary forms	20162035
Polystyrene, in primary forms (excluding expansible polystyrene)	20162039
Styrene-acrylonitrile (SAN) copolymers, in primary forms	20162050
Acrylonitrile-butadiene-styrene (ABS) copolymers, in primary forms	20162070
Polymers of styrene, in primary forms (excluding polystyrene, styrene-acrylonitrile (SAN) copolymers, acrylonitrile-butadiene-styrene (ABS) copolymers)	20162090
Polyvinyl chloride, not mixed with any other substances, in primary forms	20163010
Non-plasticised polyvinyl chloride mixed with any other substance, in primary forms	20163023
Plasticised polyvinyl chloride mixed with any other substance, in primary forms	20163025
Vinyl chloride-vinyl acetate copolymers and other vinyl chloride copolymers, in primary forms	20163040
Polymers of halogenated olefins, in primary forms, n.e.c.	20163090
Polyacetals, in primary forms	20164013
Polyethylene glycols and other polyether alcohols, in primary forms	20164015
Polyethers, in primary forms (excluding polyacetals, polyether alcohols)	20164020
Polycarbonates, in primary forms	20164040
Polyethylene terephthalate in primary forms having a viscosity number of >= 78 ml/g	20164062
Other polyethylene terephthalate in primary forms	20164064

Unsaturated polyesters, in primary forms (excluding liquid polyesters, polyacetals, polyethers, epoxide resins, polycarbonates, alkyd resins, polyethylene terephthalate)	20164080
Polyesters, in primary forms (excluding polyacetals, polyethers, epoxide resins, polycarbonates, alkyd resins, polyethylene terephthalate, other unsaturated polyesters)	20164090
Polypropylene, in primary forms	20165130
Polymers of propylene or of other olefins, in primary forms (excluding polypropylene)	20165150
Polymers of vinyl acetate, in primary forms (excluding in aqueous dispersion)	20165250
Polymers of vinyl esters or other vinyl polymers, in primary forms (excluding vinyl acetate)	20165270
Polymethyl methacrylate, in primary forms	20165350
Acrylic polymers, in primary forms (excluding polymethyl methacrylate)	20165390
Polyamide -6, -11, -12, -6,6, -6,9, -6,10 or -6,12, in primary forms	20165450
Polyamides, in primary forms (excluding polyamide -6, -11, -12, -6,6, -6,9, -6,10 or -6,12)	20165490
Polyurethanes, in primary forms	20165670
Petroleum resins, coumarone-indene resins, polyterpenes, polysulphides, polysulphones, etc., n.e.c., in primary forms	20165920
Petroleum resins, coumarone-indene resins, polyterpenes, polysulphides, polysulphones, etc., n.e.c., in primary forms	20165945
Petroleum resins, coumarone-indene resins, polyterpenes, polysulphides, polysulphones, etc., n.e.c., in primary forms	20165950
Petroleum resins, coumarone-indene resins, polyterpenes, polysulphides, polysulphones, etc., n.e.c., in primary forms	20165955
Natural and modified natural polymers, in primary forms (including alginic acid, hardened proteins, chemical derivatives of natural rubber)	20165960
Petroleum resins, coumarone-indene resins, polyterpenes, polysulphides, polysulphones, etc., n.e.c., in primary forms	20165965
Reclaimed rubber in primary forms or in plates, sheets or strips	22191000
Other compounded rubber, unvulcanised, in primary forms or in plates, sheets or strip	22192019

Annex 14:
Other sources of microplastics identified but not retained

1 ALL IDENTIFIED SOURCES

At the beginning of the analysis, relevant sources of microplastic releases were identified through literature review, stakeholder workshops and consultations. The table below summarizes the results of this exercise as of December 2022.

Table 67: Compilation of sources of microplastics

Source	Quantity (tonnes/year) EU
Paints	231 000 – 863 000
Tyres	360 000 – 540 000
Pellets	52 140 – 184 290
Road markings (included in paints)	94 358[a] according to Eunomia (2018) (20 000 according to EA study)
Artificial turfs (with granules)	18 000-72 000
Textiles	1 649 – 61 078
Geotextiles	6 000-19 750*
Brake pads	53 000
Detergent capsules	4 140 – 5 980
Fishing gear	478 – 4 780
Biobeads[b]	1442
Marine paints[c] (included in paints)	1 194 - – 5 970 according to Eunomia (2018) (probably grossly underestimated, EA study estimated 223 000)
Agricultural plastics	1 000 [d]
Shoe soles (data for Denmark)	100-1 000 [e]. (5.6%[e] of the country's total yearly microplastics emissions)
Indoor and outdoor building materials of plastic (data for Denmark)	80-480 (2.9%[e] of the country's total yearly microplastics emissions)
Cooking utensils and scouring pads (data for Denmark)	40-380 (2.2%[e f] of the country's total yearly microplastics emissions)
Cast rubber playground surfaces (data for Sweden)	16 (0.12% - 0.15%[g] of the country's total yearly microplastics emissions)
Artificial grass (data for Sweden)	2.4 (0.022% – 0.017%[g] of the country's total yearly microplastics emissions)
City Dust	Not quantified in Europe
Telephone poles and railway sleepers	Not quantified
Shipping	Not quantified
Cooling water	Not quantified

Plastic balls used in soft gun games	Not quantified
Macroplastics	Not quantified

*: This figure is probably a factor 10 too high, see the section on geotextiles (annex 15) for more explanation.

a: Extrapolated from German data,[250] neglecting the fact that not all Member States use sludge as a fertilizer (Germany represents 14% of agriculture production in the EU in value and emits 8380 tonnes of microplastics from sewage sludge, so 8380/0.14 = 59 857 tonnes).

b: UK data is thought to represent EU data given that the uptake of Biobeads for waste water treatment in the EU is limited.

c: Recent study suspects a gross underestimation of marine paints emissions to the environment, to the point of questioning the 80/20 ratio of microplastics emissions coming from land or water sources.[251]

d: Extrapolated from German data[250] (Germany represents 14% of agriculture production in the EU in value, and uses 139 tonnes of mulching plastics, so 139/0.14 = 1000 tonnes).

e: Calculated using the mean emission of microplastics for that source and the mean total microplastics emission for Denmark: 9 700 tonnes per year.[252]

f: Emissions from textile clothes are included in the estimation but should be included in the textile emissions, the quantities released thus are lower than in the table.

g: Calculated using total microplastics emissions of 10 437 – 13 457 tonnes per year in Sweden[253]

In Table 67, the results are summarised and ranked according to their contribution to EU microplastics pollution. The emissions are not given in g per capita because it would not be a good metric since citizens' habits and industry practices vary widely in the EU. The “ranking” provides information on the place in the emission hierarchy of microplastic emissions for each source using the higher estimate of the said contribution to get a worst-case scenario analysis.

The following sources were not retained in our analysis due to a lack of sufficient information being available.

2 SOURCES NOT RETAINED FOR ANALYSIS

2.1 Fragmentation of ‘macro’ plastics in the environment

In Europe, nearly 26 million tonnes of plastic waste is produced each year[254]. Substantial bibliographical evidence exists on the large accumulation of debris in European seas, sea floors, and coasts. Different environmental factors such as radiation, heat and mechanical stress lead to the

[250] Nabu.De, 2021, https://www.nabu.de/imperia/md/content/nabude/konsumressourcenmuell/210521-fraunhofer_oekopol_studie_plastik_landwirtschaft.pdf. Accessed 15 Oct 2021.

[251] Turner, Andrew. "Paint Particles In The Marine Environment: An Overlooked Component Of Microplastics". Water Research X, vol 12, 2021, p. 100110. Elsevier BV, doi:10.1016/j.wroa.2021.100110. Accessed 14 Oct 2021

[252] Lassen, C., S. Foss Hansen, K. Magnusson, F. Norén, N. I. Bloch Hartmann, P. Rehne Jensen, T. Gissel Nielsen and A. Brinch, Microplastics - Occurrence, effects and sources of releases to the environment in Denmark, 2015

[253] "Mikroplast Från Gjutet Gummigranulat Och Granulatfria Konstgräsytor". Ivl.Se, 2021, https://www.ivl.se/publikationer/publikationer/mikroplast-fran-gjutet-gummigranulat-och-granulatfria-konstgrasytor.html. Accessed 14 Oct 2021.

[254] EU Plastics Strategy, 2018 (https://environment.ec.europa.eu/topics/plastics_en).

fragmentation of larger plastic objects or macroplastics.[255] The resulting microplastics are referred to as secondary microplastics, as opposed to primary microplastics which are plastics manufactured deliberately in micron-scale sizes.

Maritime plastic litter (including fishing nets), mismanaged plastic waste and macroplastics, and discarded plastics, can therefore be sources of microplastics due to weathering, photolysis, abrasion or microbial disintegration. Indeed, in principle, all macroplastics sooner or later degrade into microplastics.

The fragmentation of macroplastics results in a continuous increase of secondary microplastics in the environment. In addition to the environmental factors, the fragmentation rate also depends on the type and composition of macroplastics. Fragmentation must be taken into account when assessing the long-term presence of microplastics in the environment.[256]

There is still an important distinction to be made. Macroplastics, when found in the environment, can fragment in pieces and ultimately end up as microplastics. In this case, it is first the macroplastic that is discarded into the environment, and therefor policies aiming at reducing discarding these macroplastics should prevail.

It is also possible that microplastics are released directly, for instance due to the abrasion of the use of larger plastics, or due to mishandling (e.g. of pellets). This is called the **unintentional releases of microplastics**, which is the focus of this analysis.

Combating the issue of macroplastics that are littered or found in the environment requires upstream policies preventing them from being thrown into the environment, and then solutions to remove those already in situ. Similarly, the issue of macroplastics' degradation should be handled before they degrade into microplastics as existing solutions to remove microplastics are very complex and costly. Macroplastic pollution is dealt with by various existing and forthcoming policy instruments so macroplastics as a source of microplastics fall outside of the scope of this IA.

Currently, the following EU-level actions target macroplastic pollution:

- The Plastic Bags Directive (Directive (EU) 2015/720), an amendment to the Packaging & Packaging Waste Directive, targets the use of lightweight plastic bags which have a wall thickness below 50 microns. Member States are required to adopt measures either reducing the annual consumption of lightweight plastic carrier bags or preventing these bags from being provided free of charge.
- The Single-Use Plastics Directive (Directive (EU) 2019/904) targets macroplastic pollution by ensuring that single-use plastic products, for which more sustainable alternatives are available and affordable, cannot be placed on the market. It also applies to products made from oxo-degradable plastic and fishing gear containing plastic. Specific targets on single use plastics include a 77% separate collection target for plastic bottles by 2025, increasing to 90% by 2029, and incorporating 25% of recycled plastic in PET beverage bottles from 2025, and 30% in all plastic beverage bottles from 2030.

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[255] Gomiero, A., Pierluigi S. & Fabi, G., 'From Macroplastic to Microplastic Litter: Occurrence, Composition, Source Identification and Interaction with Aquatic Organisms. Experiences from the Adriatic Sea', 2018 (https://www.intechopen.com/chapters/63956).

[256] Gomiero, A., Pierluigi S. & Fabi, G., 'From Macroplastic to Microplastic Litter: Occurrence, Composition, Source Identification and Interaction with Aquatic Organisms. Experiences from the Adriatic Sea', 2018 (https://www.intechopen.com/chapters/63956).

- The Waste Framework Directive (Directive (EU) 2008/98) establishes the waste hierarchy, placing the priority on waste prevention. Plastics fall within the scope of this Directive and Member States were required to set up the separate collection of plastics in order to ensure 50% of this waste stream was prepared for re-use and recycling by 2020.
- The EU Water Framework Directive (Directive 2000/60/EC) and the Marine Strategy Framework Directive (Directive 2008/56/EC) are also of relevance to macroplastic pollution as they should prevent litter from entering the marine environment. The MSFD also comprises regular monitoring and assessments of marine litter (including macro- and microlitter) in the marine environtment, putting in place measuses to achieve or maintain the good environmental status.
- From 1 January 2021, new EU rules apply also to shipments of plastic waste, including exports from the EU, imports into the EU and intra-EU shipments. These rules should help cut down on pollution by ensuring plastic waste is only traded if parties have proved they are able to deal with it properly.
- In March 2022, the EU was instrumental in the adoption of a resolution for negotiations on a legally binding global agreement. This agreement will establish an international instrument to prevent plastic pollution throughout the entire lifecycle. The EU is committed to ensuring this instrument focuses on upstream measures.
- On 30 November 2022, the Commission made a proposal for a new Packaging and Packaging Waste Regulation. By revising the existing Packaging and Packaging Waste Directive, the Commission hopes to reduce the generation of packaging waste, with a particular focus on plastic-containing packaging.
- The Port Reception Facilities Directive (EU) 2019/883) deals with waste coming from ships.

2.2 Sewage sludge

The microplastics emitted by sewage sludge are not generated by the sludge itself but accumulated there from other sources. Most of microplastics emitted in households (textile microplastics during washing and personal care product microbeads in majority) and those released on urban roads (tyre and brake pad wear particles, pellets when accidents have occurred) end up in wastewater treatment plants to undergo treatment before release to the environment. Indeed, there, microplastics will be separated from the inlet stream and caught in the sewage sludge. The microplastics quantities in the sludge are significant (it was estimated that 8380 tons of microplastics are released yearly from the use of sewage sludge as fertilizer in Germany alone) and are toxic due to the biofilms that develop on their surface since they are in contact with a high concentration of organic matter, microorganisms and bacteria within the sludge.

Since sewage sludge is used as fertilizer and that Germany represents 14% of the EU's total agricultural production (in value), an estimation of the total amount of microplastics emitted from sludge spreading as fertiliser in Europe is: 8380/0.14 = 59857 tons/year. However, this is likely an overestimate since not all countries spread sludge to fertilise their crops and that in countries where they do, the agricultural method differ and so may require different quantities of sludge to be spread. It is estimated that about half of sludge from urban wastewater treatment ends up on agricultural land.

However, the microplastics emitted by wastewater sludge are not generated by the sludge itself but rather released by it after having been accumulated there from other sources. This makes wastewater sludge a sink of microplastics and so the best way to reduce emissions of microplastics from sludge is through preventing microplastics from reaching the wastewater treatment plant altogether. Hence, sewage sludge is considered a pathway and not a direct source of microplastics.

Moreover, there is already a legislation regulating sewage sludge application in agriculture – the Sewage Sludge Directive. The issue of microplastics will be dealt with by the future revision of the Sewage Sludge Directive and also the UWWTD.

2.3 Brake Pads

The impact of brake pads is difficult to assess because of the impossibility of distinguishing them from other particles. Indeed, they are emitted at the same time as tyre wear particles, road wear particles, and road marking particles. Moreover, they are smaller particles mostly emitted to the atmosphere[112], rendering them even harder for the sample and thus quantify. Given the quantity of microplastics emitted by brake pads and their potential adverse effects on human health, and the uncertainties on the scale of the emitted quantities, it is recommended to have further research into microplastics emitted from brake pads in order to have more reliable numbers before further action can be undertaken. Further, the increasing penetration rate of electric vehicles will dramatically mitigate emissions from brake pads and disks. Electric vehicles, in fact, have a regenerative breaking system recovering the kinetic (when slowing down) and gravity (when going downhill) energy, recharging the battery. An average EV, used on a mix path, recovers between 15 and 25% of energy in this way. Brake pads usually last 4 times more in electric vehicles, compared to internal combustion ones and disks usually last even more than the vehicle itself.

2.4 Artificial / synthetic turf

Artificial / synthetic can be divided into two categories:

- Artificial turfs containing infill material;
- Artificial turf not containing infill materials (can also be called artificial grass); the same material is used as artificial grass with and without the granulate infill material.

Synthetic turf is typically used in regions with rainy or extremely dry climatic conditions.

Microplastics from infill material: In order to keep the synthetic fibres in an upright position and provide the desired elasticity of the field, granulates are often used as infill. This practice is typical for synthetic football and synthetic rugby pitches.

The total emission from microplastics generated from artificial turfs was between 18,000-72,000 tons per year. As per the ECHA dossier dated 11th June 2020, 16,000 tons of microplastics are released per year from artificial rubber granules used as infill in synthetic turf sport pitches. The dossier states that these are the largest contributors at European level in terms of both quantities of intentionally added microplastics used and released to the environment. The Commission proposal for a restriction on intentionally added microplastics includes a ban for the use of granular infill in artificial sport surfaces, with a transitional period of 6 years. The proposal is currently being discussed in the REACH Committee and could be adopted in the first half of 2023, after a positive vote in the Committee and the scrutiny by Council and Parliament. Since infill material is an intentionally added microplastic is out of the scope of this assessment.

Microplastics released from wear and tear of artificial grass fibres and granulates: Besides the infill material itself, which is a source of releases of primary microplastics, secondary microplastics may be formed from wear and tear of the artificial grass fibres with a typical straw length of 3-6 cm. The synthetic grass mostly consists of plastic fibres attached to a perforated polypropylene or polyester fabric. A latex-based glue is applied to the fabric, which is then cured. Infill is used between the fibres in order to stabilise the fibres as well as to achieve the desired functionality.

Wear and tear from the granulates may also occur. The use of ethylene-propylene-diene-rubber (EPDM) for playgrounds, school grounds and sports facilities is also increasing, and their wear and tear may also release microplastics.

Very little information was found regarding these sources of microplastics.

2.5 Cast rubber surfaces for playgrounds

These surfaces are used to cover playground areas in outdoor facilities, schools and running tracks. They are made of rubber granules made of either newly manufactured ethylene-propylene-diene-rubber (EPDM) or recycled SBR from old tyres and bonded with a polyurethane-based adhesive.

Very little information was found regarding these sources of microplastics.

Table 68: Comparison of microplastic releases from different sources

Surface	Emissions (g/m^2*year)	Tons/year
Artificial grass with granules	98	6.9 km2 * 98g / m2/ year = 676 tons / year
Artificial grass without granules	0.4-20	0.451 km2 * 5.3g / m2/ year = 2.4 tons / year
Cast rubber surfaces	0.6-48	1.2 km2 * 13.4g / m2/ year = 16 tons / year
Roads (5500 – 13000 AADT)	56	8 190

Source: Swedish Environment Protection Agency

Hence, artificial grass and cast rubber surfaces should not be priorities of the Commission further studies. However, the Swedish environment agency points out that extremely emitting cast rubber surfaces (up to 48g/m^2*year) are low hanging fruits to reduce microplastic releases from these surfaces and that they should be banned to remove the most polluting surfaces.

Artificial turfs containing granulate infill materials should also not be a priority for the Commission either since they will be tackled already by the REACH restriction. However, it should be kept in mind that the restriction is addressing the releases from the artificial infill, not from the artificial grass.[257]

Table 69: Microplastic releases from wear and tear of artificial grass

Study	Findings
(OSPAR, 2017)	4-6% of fibre release per year. Out of which 0.1-1% is released to surface water. Estimated release to surface water: 3-42 tons/year for OSPAR countries.
(Ryber et al., 2019)	Not identified.
(UN Environment, 2018)	Considered of low importance at global level as the artificial turfs are likely to be more common in northern countries.

** OSPAR 2017 and EC/Eunomia 2018 consider the Denmark data unrealistic as the average life of the turf is approximately 10 years.

[257] Annex XV addition to REACH Regulation

2.6 Fishing Gear

Fishing gear is a big source of marine litter. The microplastic pollution from fishing gear is a result of:

- Lost or abandoned fishing gear and its subsequent degradation; and
- Weathering of in use fishing gear.

Since fishing gear is a macroplastic already being addressed by the SUP and Fishing Gear Directive and Port Reception Facilities Directives, it should not be addressed in this study.

Table 70: Microplastic releases from wear and tear of fishing gear

Study	Findings
(EC/Eunomia, 2018)	478-4,780 tons/year in the EU. The report notes that "this estimate is highly speculative, and both the loss rate and the fishing net data are very uncertain at this stage".
(OSPAR, 2017)	Not quantified.
(Ryber et al., 2019)	Identified but not quantified due to lack of data.
(UN Environment, 2018)	Considered important source but could not quantified due to lack of data.

2.7 Agriculture plastics

Plastics are widely used in the agricultural sector, and found in applications such as silage bales, bags and horticultural foil. As in any sector, there is some loss of material. Weathering and abrasion might generate small plastic particles from agricultural plastics in use. The particle may be lost to the soil environment or be transported with the wind. The most likely pathway of releases of plastics from the agricultural sector is the generation larger pieces of plastics. Such larger pieces might fragment to smaller pieces generating microplastics in the environment.

The proportion of conventional plastic mulch films that are typically left remaining is not known (figures in the range of 5-25% are often quoted, but the root of these have no direct link back to a published scientific study). There is no demonstrable link between common practice resulting in a particular proportion being left on the field. It is also unclear what is achievable if best practice is employed and to what extent technological improvements in field removal machinery could achieve. Anecdotal evidence suggests thicker films will result in less residue, but further study is required to determine the exact thickness (and therefore strength specification) that would be required.

A recent study[258] calculates that if 5-25% mulch film remaining in the fields is averaged across the EU, the annual use of 83,000 tonnes of mulch film would result in 4,750 -20,750 tonnes of conventional plastic remaining on agricultural land every year. Several Member States have already established a collection scheme for these plastics, or are in the process of doing so.

[258] Eunomia, 2021. Circabc (europa.eu)

Table 71: Microplastic releases from wear and tear of agriculture plastics

Study	Findings
(EC/Eunomia, 2018)	Identified but not quantified.
(OSPAR, 2017)	Not identified.
(Ryber et al., 2019)	Identified but not quantified.
(NABU, 2021)[23]	556 tons/year of plastics for Germany, reduced to 139 tons/year for microplastics.
(UN Environment, 2018)	Considered of medium importance but could not be identified due to lack of data.

The amount of microplastics emitted from the agricultural sector is not well quantified, however, the recent German study indicates that 139 tons of microplastics are emitted yearly in Germany. This number is to be put in the European context; Germany's agriculture represents 14 % Europe's total production in value in 2019. (A worst-case scenario would be 1 000 tons per year).

The small and uncertain quantity of microplastics released by the European agriculture associated with its low toxicity may not be significant from unintentional microplastic release perspective.

2.8 City Dust

City dust is a generic name given to several sources that are grouped together because their individual contribution is small, but they account together for a considerable amount of losses as per some recent studies. While the UN Environment, study refers to data from IUCN report for calculating the microplastics generation through city dust, the definition of the city dust varies.

One of the reasons of city dust as a main contributor of microplastic pollution in global studies and not in the European studies could be attributed to the fact that the losses related to city dust are driven by population number and regions most associated with this number are Africa, China, India.

Table 72: Microplastic releases from city dust

Study	Findings
(Eunomia, 2018)	City dust is mentioned in the long list of microplastic sources and includes indoor dust and road dust only.
(OSPAR, 2017)	Mentioned as tyre dust, no quantification found.
(Ryber et al., 2019)	Global emissions 500 000 tons/year.
(UN Environment, 2018)	Global emissions 650 000 tons/year.

City dust is not a single identified source of microplastics but rather a collection of sources and cannot be tackled as a single entity. Therefore, to reduce city dust amounts, the efforts could be better focused on individual sources composing the city dust such as tyre wear particles, textile fibres, combustion engine particles, etc.

Indoor and outdoor building materials of plastic (Floorings, pipes, roof coverings, garden plastic furniture)

Plasticised as well as hard polyvinyl chloride (PVC) makes up the majority of the plastic building materials subject to deterioration and weathering. The main sources are believed to be flooring, roofing and gutters

While indoor microplastics releases typically go to the municipal sewage system, the outdoor parts are likely to release to the soil, surface water and urban run offs (entering the municipal sewage system and/or going direct to the local environment).

Table 73: Microplastic releases from indoor and outdoor building material of plastics

Study	Findings
(EC/Eunomia, 2018)	Mentioned in the long list of microplastic release source. No quantification found.
(OSPAR, 2017)	Not identified.
(Ryber et al., 2019)	Included in city dust.
(UN Environment, 2018)	Included in city dust.

Although containing flame retardants and other such toxic chemicals, given the lack of reliable information on the quantity of emissions from these sources, these sources may not need to be explored further.

2.9 Shoe soles

Soles of footwear are typically made of PVC, polyurethane or synthetic rubber. During wear microplastics particles are formed. The only finding that quantifies this source is Denmark 2015. The EC/Eunomia (2018) report refers to the same data.

Table 74: Microplastic releases from wear and tear of shoe soles

Study	Findings
(EC/Eunomia, 2018)	Identified and quantified only for Denmark.
(OSPAR, 2017)	No mention was found except in case of release from shoes after use of artificial turf.
(Ryber et al., 2019)	Included in city dust.
(UN Environment, 2018)	Included in city dust.

The data on the quantities emitted by shoe soles is too scarce and too uncertain to enable further analysis.

2.10 Cooking utensils and scouring pads

Wear and tear in tools, scouring pads and plastic clothes used in kitchens and bathrooms may cause a release of microplastics directly discharged to sewage.

Table 75: Microplastic releases from cooking utensils and scouring pads

Study	Findings
(EC/Eunomia, 2018)	Kitchen utensils identified in the long list of microplastics.
(OSPAR, 2017)	Not identified
(Ryber et al., 2019)	Included in city dust.
(UN Environment, 2018)	Included in city dust.

The main issue related to microplastic releases from kitchenware are the PFAs emitted from non-stick pans because of their toxicity. A potential solution to reduce the danger represented by these emissions could be to enforce a ban of these substances from kitchenware. The lack of information on the potential released quantities of microplastics makes it difficult further analysis.

2.11 Additional sources identified through stakeholder interactions

Telephone poles and railway sleepers

Plastic substitutes to the wooden or concrete telephone poles and railway sleepers were introduced in 2009. Microplastic releases from railway sleepers might exist especially from wear and tear but have not yet been quantified.

No information on quantities of microplastic release from these sources were found. Researchers at the Dutch RIVM are investigating the microplastic releases and will publish their results, thus if railway sleepers appear to be a significant source of microplastics, it can be considered.

Shipping

Shipping of goods by cargo worldwide is increasing and shipping activities incur losses of containers to the sea the 3-year average container loss for the period 2017 – 2019 was 779 containers. These containers can then release their content to the environment, thus (when containing plastics goods which is often the case) increasing the amount of plastic waste in the oceans. These plastic emissions although leading to an increase in the quantity of plastics in the sea are not microplastics directly, the microplastics will be emitted after the weathering of these plastic waste at sea under the conjugated effects of abrasion, salt water and UV.

As these are not microplastics resulting from the use phase of the materials nor are they manufactured as microplastics, this source was not assessed in this study. Moreover, legislative instruments are already in place to limit these emissions. This issue will be addressed with the transport of pellets.

Cooling water

No quantification of the emissions could be found and only one mention of cooling water as a source of microplastics was found in the scientific literature. Moreover, the Industrial Emissions Directive will tackle any emissions from the cooling water since it is an industrial effluent. **This leads to the conclusion the emissions are limited and that there is already a legislative framework in place.**

Plastic balls used in soft gun games

Microplastics from airsoft guns were mentioned in one article as having been identified in microplastics sampled on a beach. However, there does not seem to be a big amount of these specific microplastics released into the environment especially since users of these recreational guns are aware of the potential harm that plastic beads may have on the environment and so the industry and the users are shifting towards biodegradable pellets.

Given the lack of data combined with the expected low quantity of microplastics emitted from this source as well as the industry and players' shift towards biodegradable pellets, this source may not be relevant to explore further.

Biobeads

Biobeads or biological aerated flooded filter (BAFF) media are pellet like materials used in wastewater treatment plants for tertiary treatment. The losses occur because of failures of steel mesh retainers and because of continuous leaks (one the main manufacturer mentions 1% per year as a possibility but that if operated correctly there should be no losses). It uses polystyrene beads which are already known to cause microplastic pollution.

From the information provided by the Cornish Plastic Pollution Coalition, the European biobead pollution seems to be concentrated in the UK, it is possible that this specific type of BAFF medium is mostly used there. The emissions at that country's level may require action but they are no longer under the Commission's jurisdiction. In any case, these amounts would not justify launching a study in the near future, however, given the fact that biobeads bear a biofilm, there is a potential health risk letting them be released. Being emitted from pathways s (wastewater treatment plants) it should be possible to tackle these emissions with already in place legislative tools such as the Wastewater Treatment Directive or the Industrial Emissions Directive.