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"Microplastics are not microplastics are not microplastics": Making microplastics in the EU regulatory environment

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Abstract

Microplastics are commonly defined as plastic particles of varying shapes less that 5 mm in diameter (NOAA, 2024a). Compared to macroplastics waste, which is relatively easy to visualise and trace back to its source, microplastic pollution is largely invisible, yet pervasive, and exerts its toxic effects in insidious ways. Regulating microplastics therefore poses a significant challenge. Within the EU, microplastics was first discussed in 2013 in the context of waste regulation. In late 2023, a ban on microplastics intentionally added to products entered into force, while a regulation implementing measures to reduce plastic pellet losses is in its final stages of negotiation between the two executive bodies in the EU. Through a close reading of EU policy documents supplemented by expert interviews with both scientists and EU policymakers, this thesis explores how microplastics became an object to be regulated in the European context, considering how they were framed in order to make them a target of regulation as well as how they were problematized as an issue requiring EU-level regulatory action in the first place. Drawing on STS scholarship on issue formation (Marres, 2004), I argue that microplastics only became an issue of concern for EU policymakers when framed in the context of the broader circular economy discourse. This intertwinement between environmental and economic arguments is seen time and time again in order to justify regulatory action on microplastics. The concepts of classification (Bowker & Star, 2000), standardization (Busch, 2011), and ignorance (Proctor, 2008) provide a framework with which to understand how microplastics are categorized and defined as well as how key sources of microplastics are identified in order to transform them into policy objects. Considering the central role that technical assessments play within EU policymaking (Barry, 1994; Laurent, 2022) draws attention to the ways in which the spaces where regulation take form are not equally open to all. Finally, tracing policymaking from start to present reveals the ways in which regulatory timelines are extended in order to delegate taking action into the future.

Abstract (German)

Mikroplastik wird allgemein als Kunststoffpartikel unterschiedlicher Form mit einem Durchmesser von weniger als 5 mm definiert (NOAA, 2024a). Im Vergleich zu Makroplastikabfällen, die relativ leicht zu visualisieren und bis zu ihrer Quelle zurückzuverfolgen sind, ist die Verschmutzung durch Mikroplastik weitgehend unsichtbar, aber allgegenwärtig und übt ihre toxische Wirkung auf heimtückische Weise aus. Die Regulierung von Mikroplastik stellt daher eine große Herausforderung dar. Innerhalb der EU wurde Mikroplastik erstmals 2013 im Rahmen der Abfallregulierung diskutiert. Ende 2023 trat ein Verbot von Mikroplastik in Kraft, das absichtlich Produkten zugesetzt wird, während sich eine Verordnung zur Umsetzung von Maßnahmen zur Reduzierung von Kunststoffpelletverlusten in der Endphase der Verhandlungen zwischen den beiden Exekutivorganen in der EU befindet. Durch eine genaue Lektüre von EU-Politikdokumenten, ergänzt durch Experteninterviews mit Wissenschaftlern und EU-Politikern, untersucht diese Arbeit, wie Mikroplastik zu einem Gegenstand wurde, der im europäischen Kontext reguliert werden sollte, und untersucht, wie sie in einen Rahmen gefasst wurden, um sie zu einem Ziel der Regulierung zu machen, und wie sie als ein Problem problematisiert wurden, das überhaupt erst regulatorische Maßnahmen auf EU-Ebene erforderte. Unter Bezugnahme auf die STS-Forschung zur Themenbildung (Marres, 2004) argumentiere ich, dass Mikroplastik erst dann zu einem Anliegen für die politischen Entscheidungsträger der EU wurde, als es in den Kontext des umfassenderen Diskurses über die Kreislaufwirtschaft gerückt wurde. Diese Verflechtung zwischen ökologischen und wirtschaftlichen Argumenten wird immer wieder herangezogen, um regulatorische Maßnahmen in Bezug auf Mikroplastik zu rechtfertigen. Die Konzepte der Klassifizierung (Bowker & Star, 2000), Standardisierung (Busch, 2011) und Ignoranz (Proctor, 2008) bieten einen Rahmen, um zu verstehen, wie Mikroplastik kategorisiert und definiert wird und wie die wichtigsten Quellen von Mikroplastik identifiziert werden, um sie in politische Objekte umzuwandeln. Angesichts der zentralen Rolle, die technische Bewertungen bei der politischen Entscheidungsfindung in der EU spielen (Barry, 1994; Laurent, 2022), wird deutlich, dass die Räume, in denen Regulierungen entstehen, nicht für alle gleichermaßen offen sind. Schließlich zeigt die Verfolgung der politischen Entscheidungsfindung von Anfang an, wie die Fristen für Regulierungsmaßnahmen verlängert werden, um das Ergreifen von Maßnahmen in die Zukunft zu delegieren.

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Table of contents

List of tables vi
List of figures vii
List of acronyms viii
1 Introduction 1
1.1 Overview of the thesis 3
2 Literature review 5
2.1 Understanding microplastics 5
2.2 Conceptualising microplastics 10
2.3 Governing microplastics 16
3 Research approach 26
3.1 Research question 26
3.2 Methodological approach 27
3.3 Conceptual approach 31
4 Empirical findings 42
4.1 Making microplastics an issue 42
4.2 Three categories of microplastics and their key sources 49
4.3 Regulating intentionally added microplastics 61
4.4 Regulating unintentionally released microplastics 74
5 Discussion and conclusions 88
5.1 Linking together environmental and economic concerns 88
5.2 Technopolitical practices 89
5.3 Rethinking democratic participation 92
5.4 Politics of time 93
5.5 Final comments 95
References 97

List of tables

Table 1: Interview participants 31

Table 2: Timeline of early policy documents related to microplastics 45

Table 3: Sources of intentionally added microplastics considered at different points in the AMF report (Scudo et al., 2017) 54

Table 4: Sources of unintentionally released microplastics considered at various points in the Eunomia report (Hann et al., 2018) 57

Table 5: Changes to lower limit of microplastics 67

Table 6: Top six sources of unintentionally released microplatics identified by the Eunomia report and Impact Asessment Report 82

Table 7: Existing regulation addressing sources of unintentionally released microplastics (EC, 2023b) 85

List of figures

Figure 1: Contribution of each category to total mass of microplastics in the environment (ECHA, 2019a; Hann et al., 2018; Scudo et al., 2017) 50

Figure 2: Flowchart of the REACH restriction process (ECHA, n.d.-e) 63

Figure 3: Participants responding to the Call for Evidence (EC, 2022) 78

Figure 4: Participants participating in the Open Public Consultation (EC, 2022)..... 78

Figure 5: Participants providing feedback on the proposed plastic pellet regulation (EC, 2022) 78

List of acronyms

AMF	Amec Foster Wheeler
BAT	Best Available Technology
BFR	Brominated flame retardant
CEN	European Standards Organisation
CFC	Chlorofluorocarbon
DG ENV	Directorate-General for the Environment
DG GROW	Directorate-General for the Internal Market, Industry, Entrepreneurship and SMEs
EC	European Commission
ECHA	European Chemicals Agency
ECJ	European Court of Justice
EEC	European Economic Community
EFSA	European Food Safety Authority
EP	European Parliament
EPA	Environmental Protection Agency
JRC	Joint Research Council (EU)
KEMI	Swedish Chemicals Agency
MSFD	Marine Strategy Framework Directive
OCS	Operation Clean Sweep
OECD	Organisation for Economic Co-operation and Development
PBT	Persistent, bioaccumulative, toxic
PCB	Polychlorinated biphenyls
PNEC	Predicted no-effect concentration
POP	Persistent organic pollutant
RAC	Committee of Risk Assessment (ECHA)
REACH	Regulation ((EC) No 1907/2006) concerning the registration, evaluation, authorisation and restriction of chemicals
SCOEL	Scientific Committee on the Occupational Exposure Limits for Chemical Agents
SEA	Single European Act
SEAC	Committee for Socio-Economic Analysis (ECHA)
SVHC	Substances of very high concern
TSCA	Toxic Substances Control Act (US)
UNEP	United Nations Environment Programme
vPvB	Very persistent, very bioaccumulative

1 Introduction

It is difficult to imagine a life without plastic. We have grown up with plastic; we don't know a life without it. However, plastic has not always been as ubiquitous as it is today. The earliest manufactured plastic, Parksine, named after its inventor Alexander Parkes, was patented in 1962 (Science Museum, 2019). It was created in order to replace the dwindling supply of ivory and tortoiseshell used for items such as billiard balls, combs, and piano keys (Science Museum, 2019). It was only a few decades later in 1907 that Bakelite, the first synthetic chemical was invented, which had the properties of being easy to mass produce, affordable, and infinitely malleable (Science History Institute, n.d.; Science Museum, 2019). Plastics witnessed a production boom during the Second World War, seeing an increase in 30% in the US, as the need to preserve naturals resources led to plastics being used for applications from parachutes and aircraft windows to body armour and helmet liners (Science Museum, 2019). Plastics being diverted to the war effort mean that it became a rare commodity at home, providing it with a sense of glamour (Ball, 2004). Post-war, plastics providing a more affordable alternative to natural materials, providing everyone with "the superficial opulence of the rich" (Ball, 2004). This plastic mania did not last long: by the end of the 1960s, the tide had turned, and plastics were considered fake, cheap, and worthless (Science History Institute, n.d.; Ball, 2004). More recently, plastics have come to be associated in the public sphere with the pollution they cause (Buranyi, 2018).

This brief trajectory of perceptions surrounding plastics illustrates how potentially harmful impacts of innovations are only considered after the fact. Since the 1950s, 5.8 billion of the 8.3 billion metric tons of plastics produced globally has been disposed of as waste, of which 4.6 billion metric tonnes are simply somewhere in the environment (Chalmin, 2019). In the case of plastics, this situation is all the more serious due to their extreme persistence: all plastics ever manufactured since the beginning of the Plastics Age are likely still present in the environment today, albeit not in their original form, and will continue to exert their effect on the environment for millennia to come (Gabrys, 2013; Farrelly et al., 2021). Plastic waste can therefore be understood not only as residues, or "by-products of extractive and industrial technology, history, and organization" (Boudia et al., 2021, p. 8), but 'innovation residues', the unintended or unconsidered left-behinds of innovation activities which persist for long periods of time (Felt, 2021). This latter notion prompts us to extend the temporalities at which we evaluate innovations, bringing into perspective not only plastic waste, but microplastic waste. While plastic waste may appear to dissolve into the environment after some time, they will continue to exist in fragmented form for many years to come. Residues are furthermore sociomaterial entities—at once materially present and socially formed (Boudia et al., 2021).

Viewing microplastics through this sociomaterial lens sheds a light on their complex materiality as well as the ways in which they are framed in various social contexts.

Microplastics exert their toxic effects on the environment in multiple ways (Hale et al., 2020). Physically, they can find their way into the food we eat, the water we drink, and the air we breathe (Thompson et al., 2024). Chemically, they can contain toxic chemicals than can then leach into the body when ingested (Liboiron, 2016). In aqueous environments, persistent organic pollutants (POPs), being hydrophobic, are attracted to microplastics and absorbed into them, allowing them to travel much further than would have otherwise been possible (Farrelly et al., 2021; Takada, 2013). Both chemicals used in the manufacture of plastics as well as the POPs can be endocrine disruptors, interfering with the body's hormonal system even at low levels of exposure (Liboiron, 2016). Generalising the effects of these substances, however, is near impossible, given their large number and their diversity of means of interaction with living organisms (Boudia et al., 2021). Biologically, biofilms can form on microplastics in the environment, transporting pathogens and antibiotic-resistant genes to new sites and disrupting local ecologies (Bergmann, 2021; Yan et al., 2024; Napper et al., 2021; Coleman & Smith, 2007). Not only do microplastics exhibit a materiality different from that of macroplastics, but they themselves are hard to characterise, interacting with the environment in a diversity of ways.

Given their unruly nature, how, then, can microplastics be comprehended in the social and policy sphere? How can the scientific means of comprehending microplastics be translated into an issue to mobilize behind and develop regulation about? STS scholarship has written about how peoples' concerns are centred around objects, and this certainly appears to be the case for microplastics (Venturini & Munk, 2022). Amongst the general public, awareness around microplastics originates in the work of environmental organisations campaigning to reduce the use of microbeads in cosmetic products (Dauvergne, 2018). The campaigns against microbeads were instrumental in spurring regulatory actions across the world. Notably, the US signed the Microbead-Free Waters Act in 2015 which banned companies from producing and selling rinse-off products with microbeads (Kentin, 2018). Within the EU as well, I argue that the role of 'Beat the Microbead' campaign of the environmental group Plastic Soup Foundation in initiating the discussion on microplastics at the EU level was a central one, eventually leading to a restriction of microplastics added to products under the REACH regulation (Regulation ((EC) No 1907/2006) concerning the registration, evaluation, authorisation and restriction of chemicals) which governs chemicals in the EU. Buranyi (2018) describes how the campaigns against microplastics were also a turning point for the anti-plastic movement generally, transforming plastic from harmless litter in peoples' minds to a pollutant with dangerous effects.

Within the realm of policymaking, an object needs to be problematized such that it becomes an entity worth regulating and defined in a way that allows regulations to be applied to it. Studying how the EU handles the issue of microplastics is especially interesting for a number of reasons. Firstly, the EU, despite its origins as an economic union, has, through revisions to their founding treaties that incorporate environmental objectives, come to be seen as being "at the forefront of the global environmental struggle" (Mathis, 2020). Following how microplastics becomes an issue for the EU reveals what values and interests are at play in setting the policy agenda. Secondly, the EU's institutional structure is such that political tasks are often delegated to technical institutions (Barry, 2001). STS is therefore uniquely suited to exploring how technical practices do the work of reconfiguring microplastics into regulatable entities in ways that reflect the interests of those involved. Finally, throughout the writing of this thesis, EU microplastics policy was very much in the making, with the ban on intentionally added microplastics (a category including microbeads) only being adopted in September 2023 (Commission Regulation (EU) 2023/2055) and the plastic pellet regulation outlining mandatory measures to reduce plastic pellet loss along the supply chain being in trilogue negotiations at the time of writing (EP, 2025). This provided me with the unique opportunity to follow the trajectory of these regulations on microplastics as they were/are being developed.

1.1 Overview of the thesis

This thesis aims to unpack the ways in which microplastics are configured in order to make it an object of European Union policy. In doing so, it touches upon the uptake of microplastics as an issue of concern within the EU, the technical practices through which microplastics were shaped into regulatory objects, and the actors involved in these processes. In the section that follows ('Literature review'), I begin by providing an overview of the scholarly literature related to the thesis topic, sketching a picture of how microplastics are broadly understood and exploring both natural science approaches to understanding the environmental effects of microplastics as well as STS perspectives on conceptualising microplastics and other similar substances. Section 3 ('Research approach') outlines my research questions, methodological approach, and conceptual frameworks. The observations garnered from my document analysis, supplemented by interviews, are presented in section 4 ('Empirical findings'). This section is ordered roughly chronologically, starting with how microplastics became an issue in the EU, then exploring how microplastics were categorised in two early reports, before delving into the development of microplastics regulation. Here, two regulatory initiatives are the focus of analysis: the restriction of intentionally added microplastics under the REACH regulation and the regulation of plastic pellets. The final section ('Discussion and conclusions'), organises the empirical work by theme. More concretely, it argues that weaving together economic and environmental issues is characteristic of EU policymaking; practices of classification,

standardization, and data (un)availability shape the trajectory of regulation in significant ways; participation within the EU is skewed towards actors with scientific expertise, although this balance can be shifted by considering a more object-centred politics; and, regulatory instruments can be utilized in order to both manipulate the temporalities at which microplastics come to be regulated.

2 Literature review

The starting point for this literature review is understanding microplastics—how they are defined (if this is at all possible) as well as their prevalence in the environment and the effects they exert on it. As we will see, while there are broad points of agreement, the scientific literature presents far from a unified voice on the topic. The review then presents several key perspectives from the social sciences in understanding microplastics. Here I draw on literature not only specifically pertaining to microplastics, but chemicals and macroplastics as well. Finally, various approaches to governing microplastics are presented, touching upon risk assessment, the precautionary principle, and thresholds, as well as how governance can be made more democratic.

2.1 Understanding microplastics

This section first touches upon the difficulty of precisely defining the term 'microplastics' and traces the history of microplastics research before giving an overview of the current state of microplastics research. To date, microplastics have predominantly been studied in the marine environment. More recently, research has shifted from quantifying the presence of microplastics toward studying the various pathways—physical, chemical, biological—by which microplastics can potentially cause harm to organisms, although findings in this area are far from definitive.

2.1.1 What are microplastics?

Microplastics are often described as ubiquitous (Hartmann et al., 2019): "There is nowhere you can go to escape plastic. It is in the Arctic, the Mariana Trench—the deepest place on earth, over ten thousand meters beneath the surface of the Pacific Ocean—and on remote mountaintops in the high altitudes of the Pyrenees. It is in the air we breathe and the water we drink. Plastic microparticles circulate through our bodies; nanoplastics penetrate our cell walls" (Davis, 2022, p. 3). Their ubiquity is attributed to their low density and long lifespan, which allows them to travel far and wide without deteriorating (Ryan, 2015; Zhou et al., 2021; Duis & Coors, 2016; Wright et al., 2013). Despite widespread agreement on the ubiquity of microplastics, the definition of the term is much less fixed. An expert meeting hosted by the National Oceanic and Atmospheric Administration (NOAA) in 2008 established a working definition as plastic particles less than 5 mm in size, which has since become widely adopted (Duis & Coors, 2016; Zhou et al., 2021; Bank et al., 2021; NOAA, 2024a.; GESAMP, 2019). However, no formal definition exists, as demonstrated by the diversity of definitions used in microplastics literature (Hartmann et al., 2019; Ryan, 2015; Evangeliou et al., 2020). Following nomenclature, microplastics could be defined as plastic particles in the size range 1 to <1000 µm (and nanoplastics in the size range 1 to <1000 nm). More pragmatic definitions take 333

µm as the boundary between microplastics and nanoplastics due to constraints imposed by sampling instruments (Hartmann et al., 2019). In attempting to introduce a common framework for defining and classifying microplastics, Hartmann et al. (2019) also introduce geometry, colour, and origin as further categorizing principles. In scientific literature, the distinction between primary and secondary microplastics appears repeatedly (Duis & Coors, 2016; Wright et al., 2013; Hale et al., 2020; Gomes et al., 2022), where primary microplastics are defined as microplastics produced as such, such as microbeads in cleansers, while secondary microplastics are defined as those produced through the wear or disintegration of larger pieces of plastic. It is estimated that a considerably larger proportion of microplastics in the environment is secondary (Ryan, 2015), and that this is especially the case in marine environments (Bergmann, 2021).

2.1.2 Brief history of microplastics research

Scholarly work on microplastics often traces the beginnings of the field to publications by Carpenter and colleagues in 1972 (Carpenter & Smith, 1972, Carpenter et al., 1972) (Rochman, 2020; Duis & Coors, 2016; Wright et al., 2013). Ryan (2015), narrating the history of research on marine litter, clarifies that while they were not the first publications, at least two papers having been published in 1971, they played a significant role in highlighting the ubiquity of microplastics in the marine environment and their possible detrimental effects on marine life. Nonetheless, research on microplastics only gained momentum in the early 2000s following a series of events which brought them into the mainstream (Ryan, 2015). In 1997, Charles Moore, sailing home across the Pacific Ocean following his third-place finish in a yacht race, discovered what is now known as the Great Pacific Garbage Patch, an agglomeration of plastic debris in the North Pacific Subtropical Gyre (Rochman, 2020; Moore, n.d.). Moore returned to conduct research on his chance finding, publishing in 2001 his shocking findings that there were six pounds of plastic for every pound of zooplankton present in the North Pacific Subtropical Gyre (Moore, 2003; Ryan, 2015; Rochman, 2020). More recent research has demonstrated that while microplastics made up only 8% of the total mass of the Great Pacific Garbage Patch, they comprise 94% by count, or 1.8 trillion pieces (Lebreton et al., 2018). The issue was brought the public in 2006 following the publication of the Pulitzer-prize winning newspaper article on the Eastern Garbage Patch in the Pacific Ocean, vividly described as “a slowly rotating mass of trash-laden water about twice the size of Texas” (Weiss, 2006) about published in the LA Times (Rochman, 2020; Bauer, 2025). This, combined with the 2004 article published by Thompson et al. coining the term ‘microplastics’, used to describe truly microscopic particles around 20 µm in diameter (Thompson, 2013) and calling for more research on the topic can be credited for the rise in microplastics research since (Ryan, 2015; Rochman, 2020; Hale et al., 2020; Hartmann et al., 2013). A bibliographic analysis conducted

by Zhou et al. (2021) shows exponential growth in research on microplastics since the first mention of the word in 2004.

More recently, in focus groups conducted in late 2016 and early 2017 as well as interviews conducted in May 2021, the topic of plastic islands in the ocean were brought up spontaneously (Henderson & Green, 2020; Janzik et al., 2023), suggesting the image dominates lay perceptions of microplastics. In reality, rather than forming solid masses, plastics that accumulate in the oceanic gyres better described as a plastic soup as they are dispersed across a large area and underneath the surface such that it possible to sail through parts of these patches without seeing much litter (NOAA, 2024b; Evern, 2025). Furthermore, there is not one garbage patch but multiple: there are five oceanic gyres, and each contain these “plastic islands” to varying degrees (NOAA, 2024b). Some scientists have criticized the attention that microplastics are receiving as disproportionate and divesting resources from other more pressing environmental issues such as climate change (Stafford & Jones, 2019; Backhaus & Wagner, 2018).

2.1.3 Current state of microplastics research

Zhou et al.’s (2021) bibliometric analysis of microplastics research found that the majority looks at microplastics in the marine environment, as evidenced by ‘marine environment’ being the number one co-occurring keyword in their analysis and the Marine Pollution Bulletin being the journal in which most microplastics-related articles were published. It is only in the past decade that microplastics have been studied in freshwater, terrestrial (urban and agricultural), and atmospheric environments (Duis & Coors, 2016; Hale et al., 2020; Evangeliou et al., 2020; Campanale et al., 2022; Hoellein & Rochman, 2021). Several reasons have been posited for this emphasis on microplastics in the marine environment—what Bank et al. (2021) describe as “biases in current plastic and microplastic monitoring” (p. 7770). The study of microplastics originated in marine ecosystems, where plastic litter is visible (Hoellein & Rochman, 2021; Duis & Coors, 2016) and sampling is relatively straightforward (Hale et al., 2020). The marine environment, especially beaches and subtidal sediments, is viewed as a sink (Ryan, 2015; Duis & Coors, 2016), and as a result “terrestrial and freshwater ecosystems have generally been considered merely as conduits for plastics to the ocean and are largely overlooked as another sink” (Hoellein & Rochman, 2021, p. 176). Plastics are seen to pose the largest threat at sea (Ryan, 2015); this is possibly due to plastics in aqueous environments attracting oily chemicals due to their hydrophobicity and/or harbouring microbial communities, which may increase the risk they pose to marine species. While microplastics take a long time to biodegrade, they readily photodegrade and, in the ocean, they are exposed not only to sunlight, which makes them more brittle, but also the mechanical action of the waves, causing them to break into smaller pieces (Davis, 2022).

In addition to the shift in the environments in which microplastics are studied, Zhou et al.'s (2021) analysis also suggests a change in the topics microplastics research: early microplastics research primarily focused on the topics of (plastic) pollution, plastic waste, marine debris, and transportation, while more recently, the focus has shifted towards adsorption, biodegradation, ingestion and accumulation models, toxicity analysis, spatial distribution, and sample collection, signalling an emerging concern surrounding the toxicity of the microplastics. Harmful effects induced by microplastics take various forms: "physical interactions with the microplastics, chemical exposure to plastic constituents (e.g. additives), sorbed toxins (synthetic or natural), or surface-associated organisms (e.g. pathogens)" (Hale et al., 2020, p. 22). While the ingestion of plastic is not an issue specific to microplastics, the small size of microplastics means that more animals are able to consume them, i.e., microplastics pose a hazard to a greater number of marine species (Liboiron, 2016). Some observed effects of microplastics ingestion include filling of the digestive tract, internal abrasions, and blockages, which can affect the ingestion and assimilation of food (Hale et al., 2020; Duis & Coors, 2016; Wright et al., 2013). Smaller microplastics have also been detected in the circulatory system and surrounding tissue of some species, suggesting translocation from the digestive tract (Hale et al., 2020; Duis & Coors, 2016). While some studies have demonstrated adverse effects due to microplastic ingestion and translocation, other studies have observed no effect (Hale et al., 2020). Microplastics have also been demonstrated to travel up the food chain, although whether they bioaccumulate and/or biomagnify has not yet been established (Wright et al., 2013; Hale et al. 2020; Duis & Coors, 2016).

More pressingly, molecules that make up the plastic but are not chemically bound to the main structure can escape into the environment, especially when that environment is the acidic, abrasive one of the stomach (Liboiron, 2016). These molecules can be very many different things. Additives—incorporated into the polymer during the manufacturing process in order to confer desirable properties such as colour and flexibility—and unreacted monomers—plastic precursors that failed to take part in the polymerisation process—have the highest chemical hazard ranking and can cause carcinogenesis and endocrine disruption (Wright et al., 2013), but catalysts and solvents for the polymerization process are also likely hazardous (Liboiron, 2016; GCSA, 2019; Farrelly et al., 2021). In aqueous environments, hydrophilic (water-repelling) plastic attract POPs, which then get incorporated into the plastic matrix (Liboiron, 2016; Farrelly et al., 2021; Wright et al., 2013; Ryan, 2015). These toxicants can bioaccumulate in organisms and biomagnify as they are consumed by other organisms higher up the food chain, increasing their toxic effect (Liboiron, 2016; Farrelly et al., 2021). Many of these molecules are toxic in that they are endocrine disruptors, i.e., interfere with the hormonal system and do so in significant ways even at low doses (Liboiron, 2016). Endocrine disruptors

have been linked more generally to a myriad of adverse health consequences, including "recurrent miscarriages, feminization of male fetuses, early-onset puberty, early-onset menopause, obesity, diabetes, reduced brain development, cancer, and neurological disorders such as early-onset senility in adults and reduced brain development in children" (Liboiron, 2016, p. 12) as well as low semen quality and infertility in men (Liboiron, 2016). Hale et al. (2020), however, notes that most toxicological studies have been conducted in laboratory conditions and therefore do not truly mimic real-world mechanisms. Similarly, Backhaus argues that while microplastics are likened to PBT (persistent, bioaccumulative, and toxic) or even vPvB (very persistent and very bioaccumulative) chemicals, “this is a false equivalency” (Backhaus & Wagner, 2018, p. 20) as they do not bioaccumulate or biomagnify in the way PBT and vPvB chemicals do (Backhaus & Wagner, 2018). With regards to endocrine disruptors more specifically, Duis and Coors (2016) in their comprehensive review of scientific literature on microplastics, express scepticism at a study by Rochman et al. (2014) postulating a link between polyethylene ingestion and endocrine disruption.

Marine biologists have also demonstrated the presence of bacterial communities present on microplastics (Bergmann, 2021). They have been linked to a higher likelihood of ingestion and have been shown to harbour species causing algal blooms and the class of pathogens responsible for necrotizing wound infections, sepsis, and gastroenteritis (Hale et al., 2020; Duis & Coors, 2016). Microplastics, due to their buoyancy and stability, can serve as carriers of potential pathogens to new environments where they might thrive and alter the local ecology (Yan et al., 2024; Napper et al., 2021). Modelling has demonstrated that pathogens can survive for up to 25 days on the surface of microplastics and several studies have identified the presence of several pathogens on microplastics along the Mediterranean coast, the North Pacific, the North Sea, the Baltic Sea, and the North Atlantic Ocean (Yan et al., 2024). In addition to pathogens, microplastics may transport antibiotic resistant genes which can be easily transferred from cell to cell, generating antibiotic resistance not only within a population of bacteria, but among multiple species of bacteria (Yan et al., 2024; Coleman & Smith, 2007).

In 2018, Backhaus observed that while "[m]ore and more hard empirical data are emerging on the occurrences of microplastics in marine ecosystems, freshwater, air and soil”, “empirical data on their toxicity to environmental organisms and to humans remain surprisingly sketchy and almost elusive" (Backhaus & Wagner, 2018). The latter sentiment is echoed by other scientists (Gomes et al., 2022; GCSA, 2018b). The survey of literature above has shown that while there are multiple mechanisms by which microplastics can interfere with living organisms (physical, chemical, biological), there is no strong consensus as to whether they induce adverse effects in practice and if these findings can be extended to the broader environment. Furthermore, there can be difficulties in isolating the source of toxicity, for example, if the

adverse effects observed in organisms exposed to microplastics are a result of chemical additives or to the plastic matrix itself (Gomes et al., 2022). The lack of a comprehensive literature on the toxicity of microplastics can in part be attributed to the lack of standardized methods for the assessment of microplastic hazard (SAPEA, 2019) as well as the diversity of microplastics present in the environment, which complicates predicting toxicological effects (Hale et al., 2020). The state of the scientific research on microplastics in 2018 was such that scientific experts consulted by the European Commission's Group of Chief Scientific Advisors concluded that "scientific advice based on a classical hazard/exposure risk assessment approach on the impact of MNPs [micro- and nanoplastics] on biota, ecosystems and human health, is not yet possible based on current knowledge" (GCSA, 2018a, p. 2).

2.2 Conceptualising microplastics

While the previous section presented the natural science perspectives on microplastics, this next section examines how social scientists have framed microplastics and related entities. The sociomaterial perspective on microplastics considers them as both materially active and socially constructed entities. The notion of matter out of place points to the social mechanisms by which pollution is deemed as such (Liboiron, 2016). Hawkins (2009) and Stanes (2021) consider ways of engaging with microplastics in ways other than as pollution. On the flip side, the concept of residual materialism draws attention the ways that the toxic materialities of microplastics are put in place, deemed safe even when their physical effects suggest otherwise (Boudia et al., 2021). Liboiron (2016) and Takada (2013) provide examples of how the chemical effects of microplastics are hidden behind scientific approaches to pollutants. The section on new entanglements presents scholarship that, grounded in their materiality, present microplastic in a new light (Gabrys et al., 2013).

2.2.1 Matter out of place

The notion of dirt as 'matter out of place' is oft referenced in literature pertaining to plastic and chemical pollution (e.g., Hawkins, 2006; Liboiron, 2016; De Wolff, 2017; Farrelly et al., 2021a; Bergmann, 2021; Boudia et al., 2021). In most cases, the phrase is used to describe how pollution does not belong in nature. The phrase as a theoretical concept, popularized by anthropologist Mary Douglas, refers to the idea that what makes something dirt is not a property inherent to the thing itself, but whether if fulfils a social criterion (Liboiron, 2016). For example, "[s]hoes are not dirty in themselves, but it is dirty to place them on the dining table; food is not dirty in itself, but it is dirty to leave cooking utensils in the bedroom, or food bespattered on clothing" (Douglas, 1966, p. 37). This reading of the phrase points to the cultural conditions that render the presence of microplastic in the environment as wrong, prompting us to reexamine their materiality in order to consider other forms of relating to plastic

(Farrelly et al., 2021). In this respect, Hawkins' (2009) ethnographic work on the plastic bag and Stanes' (2021) on polyester clothing provide excellent examples. Gabrys (2013) extends this attention to materiality, considering how the materiality of plastic is not static, but ever changing as they slowly degrade into smaller pieces.

Hawkins (2006, 2009, 2010) repeatedly demonstrates how paying attention to the materiality of plastic bags has the power to disrupt our natural perception of them as waste. Different depictions of plastic bags bring to the fore different elements of their materiality, which can in turn dictate our affective attachment to them (Hawkins, 2009). This she illustrates through two contrasting depictions of plastic bags. Plastic bags in campaigns to reduce their use highlight their slow decomposition, the harm they cause to marine animals, and their ubiquity in nature, painting them as polluting entities that resist human control. This view of plastic bags she contrasts with how they are depicted in an Adidas campaign featuring a young boy who runs around collecting plastic bags that are flying in the wind, stuck in a fence, covered in dirt, and turning them into a soccer ball. Whereas the waste campaigns generate the moral imperative to abstain for using plastic bags, the Adidas advertisement illustrates a more collaborate and generative way of relating to them. Different environmental practices can likewise emphasize or downplay specific aspects of plastic's materiality (Hawkins, 2010). Extending the shelf life of certain produce by means of shrink wrapping—such as in the case of cucumbers, which extends its shelf life almost threefold (Shrivastava et al., 2022)—emphasises the material quality of plastics to retain moisture, while those who aim to reduce plastic packaging may point to their persistence in the environment. This is not simply analytical observation: "[w]hen matter disturbs and defamiliarizes it makes trouble for previous ways of understanding and *acting*" (Hawkins, 2009, p. 50, italics added). Relating to waste in ways other than guilt can lead to alternative means of living with them. Hawkins (2006) points to some of these, such as compositing initiatives which celebrate organic waste as source of nutritious soil, and "Enjoy Your Garbage" campaign by the Brisbane City Council which encourages one to find joy in attending to waste. Hawkins (2006) acknowledges that while such responses may seem weak and ineffective, neither are guilt, resentment, and anxiety politically productive as they dictate one course of action at the expense of many others.

Drawing on her ethnographic study of fashion practices, Stanes (2021) investigated the variety of different engagements with polyester clothing that brought to the fore different elements of its materiality (Stanes & Gibson, 2017). An environmentalist valued the durability of polyester that allowed him to extend the lifetime of his clothes, while a nurse valued the same property for a different reason—that it was robust enough to withstand the wear and tear accompanying nursing work. An athlete, on the other hand, appreciated the polyester in his sports clothing for its compression and lightness. Conversely, those who were averse to polyester clothing

highlighted different properties of the material: its plasticky feel, its lack of breathability, and that it holds odour. As in Hawkins' investigation of plastic bags, we see that different aspects of polyester materiality evoke a range of emotions "from attachment to disgust, comfort to discomfort, pleasure to deception, nonchalance to neglect" (Stanes, 2021, p. 125). Gabrys et al. (2013) complicate the study of plastics from a material perspective by pointing out that the materiality of plastic is not stable, but processual. Stanes (2021) takes up their call to consider the processual materiality of plastics by being attentive to how polyester clothing degrades over time (Stanes, 2021). As polyester clothing is worn and washed, the polyester fibres are gradually weakened and escape down the drain during the laundry cycle. As these releases are quantified and science reveal the environmental effects of polyester, Stanes (2021) observes how "clothes that contain polyester are beginning to acquire an identity and politics more common to plastic bags and water bottles" (p. 126). Highlighting the microplastic emissions of polyester clothing therefore recasts them as polluting entities. While Stanes presupposes the association of microplastics as pollutant, Hawkins would perhaps prompt us to consider what aspects of their materiality may allow for a different form of connection.

2.2.2 Residual materialism

Considering how matter is made to seem out of place also raises the question of the ways in which plastic and microplastics are made to seem in place (Farrelly et al., 2021). Boudia et al. (2021) explore this in detail in their book on chemical residues, "by-products of extractive and industrial technology, history, and organization and also catalysts escaped from the landfill, or the mine" (p. 8). Despite the havoc they may cause, they are often rendered invisible for reasons of political convenience and are in this way put in place. The approach of residual materialism highlights the materiality of these residues and allows the analyst to see how they "persist materially and dynamically in the environment even as they socially disappear" (Boudia et al., 2019, p. 121). Liboiron (2016) examines how thresholds attempt to neutralise the threat of endocrine disrupting chemicals in microplastics, while Takada (2013) illustrate show scientific practices can inadvertently make plastic pellets loaded with POPs disappear.

Liboiron (2016) examines what they call the threshold theory of pollution, the traditional view in toxicology that 'the danger is in the dose' and the material effects of microplastics on marine fauna. Drawing upon the Douglasian notion of 'matter out of place' and relating it to the present day with the observation that "[s]cience, rather than religion, is our contemporary arbitrator of matter out of place" (Liboiron, 2016, p. 7), they demonstrate how thresholds attempts to put microplastics in place by making the presence of microplastics in the ocean at levels under the limit an acceptable state of being. Paying attention to the materiality of plastics, however, reveals that microplastics often behave in ways that defy traditional toxicological approaches. Plastics are harmful not only in their physical effects, but when individual chemicals,

intentionally present or unintentionally adsorbed, escape the plastic matrix. Some of these chemicals are endocrine disruptors, which are especially insidious as they can have detrimental effects at low doses. However, their effects are difficult to isolate, time delayed, and complex, making it impossible to capture them in clear, causal relationship required to inform the setting of thresholds. Liboiron (2016) concludes with the imperative that "we need to wed the cultural aspects of pollution … with the particular material agencies of industrial matter" (p. 17) in order to come up with effective solutions to the issue of microplastics in the oceans. To this end, they propose a move away from what they call the particle model of harm, which attributes harm to a single source, to the influence model, which takes a more holistic approach. Such a perspective would allow policymakers to immediately implement a wider range of solutions rather than waiting on definitive scientific studies to set thresholds and furthermore encourage "[b]road-brush universal frameworks … rather than piecemeal legislation" (Liboiron, 2017, p. 145).

In describing his citizen science project, International Pellet Watch, Takada (2013) details how the materiality of microplastics can be hidden not only by thresholds, but also through scientific practices. International Pellet Watch asks people to collect and send in plastic pellets which are then analysed for POP concentration in order to map POP distribution across the world. Takada (2013) describes how pellets with a high concentration of POP will sometimes appear in a region of low POP presence, having been transported on the back of the plastic pellet from a more contaminated area. This points to another way in which thresholds fail: although the threshold model would allow for the presence of low levels of microplastics, Takada's work demonstrates how the presence of even a single highly toxic microplastic is sufficient to cause harm. Additionally, Takada (2013) describes how POP concentration is determined by taking median values, which effectively remove outliers from the analysis. This is a problem because "marine organisms cannot take median dose – they take everything!" (Takada, 2013, p. 193) This is another example of how the materiality of microplastic escapes scientific attempts to characterise them.

2.2.3 Novel articulations

In paying attention to the materiality of microplastics, what new forms of engaging with them come to light? Bergmann (2021) considers how foregrounding the size of microplastics and differentiating them from other types of microplastics leads to novel ways of considering plastic pollution. Gabrys (2013) takes a broader perspective, considering the novel marine processes that have come about due to the presence of microplastics in the ocean, one of which De Wolff (2017), and Bergmann (2021) examine in more detail. While these approaches do not necessarily present the ideal way of engaging with microplastics, they serve as examples of

how engage with microplastics in a manner that goes beyond simply seeing them as purely polluting entities (Gabrys et al., 2013).

Bergman (2021) comments on the classificatory work that the term ‘microplastics’ undertakes, drawing upon Bowker and Star’s (2000) idea that “classification schemes are entities with consequences” (p. 231). On one hand, the identification of microplastics as a distinct type of plastic has allowed for the organization of social initiatives focused on microplastics such as awareness campaigns, beach clean-ups, and citizen science programmes as well as scientific investment in the field (Bergman, 2021)—the EU invested €7.5 million in microplastics research in 2015 (Farrelly et al., 2021). On the other, they have troubled existing ways of thinking about plastic pollution, as their material properties diverge from macroplastics in multiple ways (Bergman, 2021). While plastics are immediately visible, microplastics require closer inspection or can be invisible to the human eye. Plastics can be easily linked to their original uses, but it is near impossible to trace microplastics back to the component of which they originally were part, even with advanced scientific measurements. The dangers posed by larger plastics is evident, such as ingestion or entanglement, while microplastics exert their harmful effects in more insidious ways, such reduced feeding or hormonal changes, which are not yet fully understood. Relatedly, images of animals entangled in plastic evoke emotion, but the same is not the case for photos of microplastics, which can appear so small as to be harmless. Though being attentive to the effects of classification, Bergmann (2021) demonstrates how looking at size as a means to classify plastic waste leads to new arrangements for acting on them and articulating plastic pollution.

Gabrys (2013) takes this one step further, asking readers to consider microplastics beyond simply a form of environmental contamination: “In what ways do the plastics that are accumulating in oceans give rise to new environmental processes? Who or what are the agents involved in working through the new materialities and effects of plastics as they accumulate and break down in the earth’s oceans?” (p. 208). She uses the notion of carbon workers in order to make these processes visible. In the context of climate change policy discourse, the term refers to the human (e.g. tree planters and tenders, measurement technicians, landscape deforestation modellers, and carbon accountants, certifiers, and verifiers) and non-human (e.g. trees) actors involved in biological carbons sequestration. Given that plastics are “composites of carbon” (Gabrys, 2013, p. 210) and doubly so as they are not only hydrocarbons but require energy from carbon for their manufacture, Gabrys extends the term to refer to the various entities that work upon plastics, such as fishers fishing for plastic, researchers investigating the effects of (bio)degradation, NGOs raising awareness around plastic pollution, and animals that ingest plastic waste. Here we see local economies cropping up around the microplastics in the environment. If the perspective afforded by carbon

work troubles the straightforward assumption that plastic is pollution, it also questions the discourse of circularity and biodegradability. Given that plastic waste is entangled with an array of livelihoods, it cannot simply be extracted and reintroduced in an earlier step of the plastic lifecycle. Similarly, the concept of biodegradability attempts to naturalize plastic materials, downplaying the contribution of all the actors that go into making biodegradability possible. Being attentive to the carbon work taking place when plastics break down demonstrates that the degradation of plastics proceeds in collective manner, involving contributions from sunlight, oxygen, transition metals and/or microbial life. By questioning these preconceived understandings of plastics and biodegradability, Gabrys (2013) opens the door to “rethinking the trajectory of our material politics … to a more extensive understanding of and speculative approach to the complex and collective carbon work that emerges from our lived plastic materialities" (p. 224).

Like Gabrys (2013), De Wolff (2017) explores ethnographically the variety of ways in which plastics becomes entangled with marine life. Within marine biology, these novel interactions, often supportive of marine life, are described by the term ‘plastisphere’, such as a jellyfish with plastic fragments worked into their gelatinous surface, creatures housed in bundles of stray fishing equipment, and water insect eggs laid on plastic. Disentangling the plastic from these arrangements would adversely affect the relationships they are engaged in. Nevertheless, scientific knowledge and public education propagate the message of division thorough laboratory practices that separate plastic from living species and posters that present plastic as hazardous in the environment. These articulations propose clean-ups as the solution to plastic pollution, failing to recognize that as long as plastics continue to be produced, they will continue to enter the environment. De Wolff (2017) suggests understanding the “lively and generative materialities of plastic” (p. 42) as a starting point in considering other forms of living with them. Bergman (2021) similarly takes the plastisphere as his object of study, specifically looking at the biofilm that forms on microplastics at sea. He not only considers the microbes on the plastic itself, but how their presence impacts how other organisms react to it: the biofilm may confer to the microplastic a scent that makes it more appetizing; when swallowed, it can alter the gut microbiome of the host organism; when excreted, it can contain pathogens that go on to infect other organisms; it can transport biological entities beyond their natural habitat and effect change in ecologies. In this way, plastispheres problematize the idea of a pristine ocean polluted by plastic; such view disregards the agency of the ocean and the agents within it to accommodate change. Bergman (2021) warns, however, that a collapse in the distinction between nature and culture should not make us apathetic to the issue of plastic pollution, but rather warm us against those technological solutions that stem from such a divide. Here he points to The Ocean Clean-up as one example. The project aims to remove plastics from the

ocean with a large flotation device in a manner that disregards the way in which the garbage patch has become a site of new types of bodily engagements (Gabrys, 2013; Bergman, 2021).

2.3 Governing microplastics

This last section of the literature review deals with perspectives on the governance of chemicals more generally as well as microplastics more specifically. It beings with a short history of chemicals regulation, which highlights the risk-based approaches that have been taken in the past as well as attempts to move towards a more precautionary form of governance. Several authors point out, however, that while celebrated in theory, the precautionary principle has been elusive in practice (Boudia et al., 2021; Laurent, 2022). The discussion them moves onto the topic of thresholds, a specific mode of regulatory intervention, and outlines their characteristics: they have a simplifying effect, harm some at the expense of others, and are a product of negotiation (Boudia et al., 2021; Laurent, 2022). Following the call of the body of literature on post-normal science for more public participation where the science is uncertain and stakes are high (Ravetz, 2004), the literature review concludes with a consideration on various forms of democratic engagement that have taken place with respect to chemicals and microplastics.

2.3.1 Regulatory approaches: Risk and precaution

Boudia et al. (2021) trace the emergence of chemical regulation, illustrating how it emerged step wise in response to external events, often drawing upon preexisting agencies and regulatory tools. The history of chemicals regulation begins in the US post-World War 2 and takes off in the 1960s following the publication of Rachel Carson's *Silent Spring* in 1962. Early environmental regulation was fragmented and while the Environmental Protection Agency (EPA) was established in the 1970s to consolidate these regulations, this was not the case in practice, and several classes of chemicals remained unregulated. The Toxic Substances Control Act (TSCA) was passed in 1976 in response to a chemical accident at a pesticide plant and while it did not rectify the fragmentation as it only applied to those chemicals not already regulated, it signalled a new, more encompassing approach to chemicals regulation. However, regulatory elements introduced in order to satisfy industry actors rendered the regulation much less effective than originally planned. Legacy chemicals that had been in use for a long time were allowed to be produced unless a strong enough case could be made for any additional testing. Manufacturing new chemicals required registration, which included appending available toxicity data, but did not mandate this testing (Johnson et al., 2000; Boudia et al., 2022; Loprieno, 1983). The EPA could only ask for additional information with sufficient evidence demonstrating unreasonable risk and this had to be done within 90 days of registration (Boudia et al., 2022). Furthermore, once a new chemical was registered, this was

added to the inventory of legacy chemicals such that subsequent manufacturers could proceed without notification (Johnson et al., 2000; Loprieno, 1983). In this way, the EPA, rather than ushering in a new era of chemicals regulation, served more as a show of action to appease the environmental concerns of the US public (Boudia et al., 2022).

In 1979, the EU passed updated its own chemicals regulation, the Directive on Dangerous Chemical Substances, which differed from the TSCA in that it required all new chemicals undertake registration prior to being placed on the market with stricter requirements for data that was to be included (Johnson et al., 2000; Boudia et al., 2021; Loprieno, 1983). Unlike the TSCA, the inventory of chemicals was closed, meaning that each company had to register their chemical even if the same compound had already been registered (although test results from the prior registration could be used) (Johnson et al., 2000; Loprieno, 1983). The differences in chemicals regulation posed a non-tariff barrier to trade, so at this point the Organisation for Economic Cooperation and Development (OECD) stepped in to harmonize regulations that would allow for the growth of the chemicals industry in a manner that was acceptable, i.e. taking into consideration minimum environmental and health concerns (Boudia et al., 2021).

In 2006, the EU overhauled their chemicals regulation, introducing REACH, which requires registration of all chemicals, including those previously exempt (those placed on the market before 1981), as well as providing legal mechanisms of controlling the use of dangerous substances (authorization) or banning them altogether (restriction) (BfR, n.d.; Boudia et al., 2021). The regulation was viewed as a departure from the US model towards a precautionary approach, according to which preventative action should be taken in cases where there is probable risk but no scientific consensus (Laurent, 2022; Boudia et al., 2021; EU, n.d.-d). In fact, Article 1 of the REACH regulation, the European chemicals regulation, explicitly references the precautionary principle (Regulation (EC) No 1907/2006). In studying the application of REACH in specific cases, however, Boudia et al. (2021) and Laurent (2022) show how such is not the case in practice. Boudia et al. (2021) identifies several of shortcomings in the registration process: chemicals produced at low volumes need not provide extensive safety data, there exists an asymmetry of data between industry and regulators, committees granting authorization revert to economic considerations when insufficient safety data is provided, and various loopholes exist for companies to gain authorization for chemicals that would otherwise have not made it to the market. These observations lead Boudia et al. (2021) to conclude the REACH regulation to be “an ostensibly precautionary system that does not diverge so radically from the risk assessment approach of the United States” (p. 39). Furthermore, while the REACH regulation outlines mechanisms by which to ban hazardous chemicals, Laurent (2022) describes how this hazard-based approach, which calls for

dangerous substances to be banned without exception, is transformed, through the process of drafting the regulation, into taking a more risk-based approach, which takes the more lenient stance of deciding on the boundaries of the restriction based on exposure risk. He illustrates this through several case studies. Defining a substance as a Substances of Very High Concern (SVHC) is straightforward, but restricting the same substance depends upon on the volume used, nature of exposure, and type of use. Phthalates are included in Annex XIV, the list of restricted chemicals, but various uses can be authorised. Decabromodiphenyl ether likewise is in principle restricted but uses in certain industries and in products regulated through other means are exempted. Similarly, the 2009 pesticide regulation banned fertilizers with endocrine disrupting properties, but with endocrine disruptors not having a clear definition, left room for manoeuvre. Here again, we see that rather than taking a precautionary approach—banning chemicals until they are proven to be safe—they tacked on the basis of risk assessment. In practice, this means that different chemicals and their various uses are examined for their risks on a case-by-case basis before restrictions are introduced (Laurent, 2022). These processes not only fail to protect against potential risks but are also inefficient on a number of counts: they only deal with one compound at time, discussions are lengthy, and also require significant financial resources (Boudia et al., 2021). This approach follows a broader trend within the EU whereby the precautionary principle severs more as a rhetorical tool than driving force within legislation (Eckley & Selin, 2010). Eckely and Selin (2010) observe that while the precautionary principle has been integrated in EU regulation since 1990 with the Dublin Declaration, regulation on polychlorinated biphenyls (PCBs) and brominated flame retardants (BFRs) was only put into place once toxicity humans could be definitely proven.

Like the chemicals guidelines put in place by the OECD to prevent non-tariff barriers to trade, Laurent (2022) observes that REACH is similarly “better described as a device meant to organize the market primarily by stating the characteristics that all chemicals need to follow to be granted the ability to circulate throughout Europe” (p. 118) and does so in a way that provides an advantage for industrial actors. REACH only ensures the smooth functioning of the chemicals market by providing one point of access through registration but also creates uniform measures for the conditions of use under hazardous chemicals can be marketed anyway (authorisation) as well as defining chemicals that cannot be placed on the market at all (restriction). Furthermore, the risk-based approach employed by the European Chemicals Agency (ECHA) means that economic benefits are factored into the equation and spaces for negotiations proliferate. In contrast to the US, where federal institutions such as the EPA and the Food and Drug Administration (FDA) conduct technical assessments, the EU relies on working groups that enrol a range of experts including from Member States and private

companies, meaning that each site of negotiation allows for the introduction of industrial interests. Crucially, these spaces are ones where the everyday citizen is rarely included (Laurent, 2022).

The United Nations Environmental Programme (UNEP) has described the present state of plastics regulation similar to how Boudia et al. (2022) have characterised chemical regulation more broadly: “reactive, piecemeal and isolated, and with mixed success” (UNEP, 2012, p. 170, as cited in Farrelly, 2021). Farrelly (2021) points out how international agreements that target POPs as well as those related to marine debris are an imperfect patchwork of regulation. While many toxicants associated with plastics are banned under the Stockholm Convention on Persistent Organic Pollutants (2004) and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992), not all countries are signatories of these conventions, meaning that they can be used in the manufacture of plastics and exported into other countries or that they can cross international boundaries through the mechanism of microplastic pollution. Furthermore, some endocrine disruptors are not classified as POPs and therefore not included within the scope of the Stockholm Convention. Similarly, the UN Convention of the Law of the Sea (1994) and the UN Washington Declaration on the Protection of the Marine Environment from Land-Based Activities (1995) are both limited in power, the former due to the lack of common standards and clear objectives and the latter, due to its non-binding nature.

The mechanisms by which chemical residues cause harm are not easily detectable with established forms of apprehending toxicity (Boudia et al., 2021). Rather than eliciting a straightforward cause and effect, microplastic exert their toxic effects through diffuse and time-delayed ways that are difficult to trace back to their origin (Liboiron, 2013; Liboiron, 2016). They follow a miasma or interference model of harm, rather than a germ or particle model (Liboiron, 2013). Ecotoxicologists agree that “[classical risk assessment] is not built to address the ecological consequences of long-term exposures to low concentrations of chemical mixtures” (Backhaus & Wagner, 2018, p. 9). Not only are the effects of microplastic difficult to ascertain, but they are potentially harmful to marine creatures and human beings. As a result, microplastics research can be described as an instance of post-normal science, characterised by scientific uncertainty and high stakes (Farrelly, 2021; Ravetz, 2004; Funtowicz, 2021). Where science cannot straightforwardly point to a course of action and lives are potentially at stake, risk assessments are insufficient and the precautionary principle needs to be mobilized (Liboiron, 2013; Farrelly et al., 2021b; Ravetz, 2004). Liboiron (2013) contrasts REACH with bans on individual chemicals as an example of regulation taking the precautionary approach, but as other scholars have demonstrated, REACH is not as precautionary as it appears to be. Farrelly (2021) points to the Montreal Protocol (1987) for chlorofluorocarbons (CFCs) as a

model to be imitated. It classified CFCs as hazardous, was legally binding, and provided financing for developing countries in order to support them in fulfilling their commitments, resulting in 98% of CFCs being phased out of use. Despite the UNEP calling for precautionary action on plastic marine debris and microplastics in the oceans as well as the existence of precedent for such a commitment, Farrelly (2021) describes how no such approach to microplastics appears to be on the agenda. They attribute this failure to the inability of science to reflect on whether an innovation should be made in the first place as well narrow framings of the problem. In order to counter these issues, Farrelly (2021) proposes democratic engagement in policymaking, specifically the inclusion of those who live with the effects on plastic pollution.

2.3.2 Thresholds

Thresholds have been used in the majority of environmental law since the 1970s (Liboiron, 2018). Laurent (2022) identifies two types of thresholds as they pertain to environmental concerns, both of which have the effect of transforming a complex issue into a simple, quantifiable metric. The first are thresholds on the allowable amount of pollutant in the environment. Examples of this kind of environmental threshold are the Directive 2008/50/EC on ambient air quality and cleaner air for Europe and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants, both of which set upper limits on the allowable amount of pollutant in the atmospheric environment. The Water Framework Directive (2000) provides a counterexample where rather than a threshold, it tried to implement ecological objectives which were more sensitive to the variety of factors that contribute to healthy waters. As a result, assessments of water quality proliferated. Public agencies had difficulties working with this diversity of assessments and therefore returned to the simpler indicators that the directive was trying to move away from, illustrating the allure of thresholds as a mode of regulation. The second form of threshold are emission thresholds placed on polluting objects, such as emission limits on cars, or even on entire industries, i.e., caps on carbon emissions. With these kinds of thresholds as well, we can see how reduction to a specific value can oversimplify environmental metrics: biofuels can be considered carbon neutral when only looking at carbon emissions despite the role they play in deforestation (Laurent, 2022; Prather, 2020; T&E, 2020). In this way, setting thresholds can be understood as a “process of domestication” that “renders chemicals and chemical products administrable and manageable” (Boudia et al., 2021, p. 93). Despite the fact that thresholds simplify otherwise complicated indicators of environmental wellbeing, it is nonetheless difficult to identify instances of non-compliance due to the legal structure of EU environmental law. Environmental laws in the case of the EU take the form of directives, which need to be transposed to the national level, which in turn makes demonstrating evidence of non-

compliance a heavily bureaucratic task and is often neglected (Laurent, 2022; Boudia et al., 2021). In that chemicals operate in ways more complex than captured by simple thresholds and that thresholds in the EU are difficult to manage, they can be said to “permeate the boundaries of political control” (Boudia et al., 2021, p. 19).

In addition to simplifying the complex issue of environmental harm/wellbeing, thresholds are also a political tool that harm some at the expense of others. Boudia et al. (2021) illustrate this through the case of asbestos, which have several properties similar to microplastics: they can be crushed down to microscopic size, travel far and wide, and lodge themselves into human bodies from where they exert their toxic effects, even at low levels of exposure, over decades. Despite the fact that unlike microplastics, asbestos has been definitively linked to asbestosis and mesothelioma, a type of cancer which has asbestos exposure as its only known cause, the existence of limit values allows for its continued use. Given that the one molecule has the potential to escalate into cancer, the threshold on asbestos represents a trade-off whereby the lives of workers are risked in the service of the continued operation of the asbestos industry and those it services. In line with this, Liboiron (2018) understands toxic harm as “the contravention of order at one scale and the reproduction of order at another” (p. 335), for example when arsenic in water disrupts the reproductive capabilities of fish (contravention) but allows for mining companies to continue to leave their tailings out in the open (reproduction). This is made possible through thresholds, which normalize exposure and thereby eliminate the need to maintain a workplace free of risk (Boudia et al., 2021; Laurent, 2022).

A third feature of thresholds is that despite the fact that their political power comes from their rootedness in science, they are the product of negotiations (Boudia et al., 2021; Laurent, 2022). Setting thresholds in the EU involves negotiations between Member States, members of the European Parliament, and interest group and therefore are not purely scientific discussions, but ones that involve consideration of economic and political factors as well (Laurent, 2022). The role of industry in the setting of thresholds is illustrated in the case of the EU’s Scientific Committee on the Occupational Exposure Limits for Chemical Agents (SCOEL) (Boudia et al., 2021). Boudia et al. (2021) follow the process by which the SCOEL updated their occupational exposure limits for two chemicals and demonstrate how they are raised in response to new studies published by industry. In the case of aniline, we see how questions as to the rigour of the study is superseded, while in the case of formaldehyde, decisions are made informally and the science underpinning the decision is assembled after the fact. An example of national interests at play is the setting of national emission ceilings where Germany agreed to give up its allowance of ammonia emissions, released in agricultural processes, for a higher limit for its industrial emissions (Laurent, 2022). Evidently, thresholds are “the result of social

compromise between public health and economic growth" (Boudia et al., 2022, p. 101), the lack of transparency about how such thresholds are set allowing them to retain their veneer of objectivity. Furthermore, once set, the production and implementation of thresholds is left to Member States, who delegate the task further, sometimes onto private actors (Laurent, 2022). In France, for example, the Citepa (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique), comprised of professional bodies, is in charge of monitoring air pollution; in other words, monitoring is being conducted by the very actors who are producing the pollutants in the first place (Laurent, 2022).

Best Available Technologies (BATs) can be considered another form of threshold. The Industrial Emission Directive requires that industrial plants obtain an environmental permit, which require the implementation of BATs (Laurent, 2022), defined as "the most environmentally effective and economically and technically viable for the prevention and control of emissions" (EC DG ENV, 2025). Although they were introduced as an alternative to setting thresholds on pollutants, Liboiron et al. (2018) still considers them a type of threshold, one not set by a fixed quantity but rather based on the emission reduction capabilities of the identified BATs. Whereas the political negotiations underlying the scientific thresholds are less obvious, in the case of BATs, economic interests more explicitly are taken into environmental considerations (Laurent, 2022; Liboiron et al., 2018). BATs ensure that environmental protection do not come at too steep a price for industrial actors to afford (Liboiron et al., 2018). As with thresholds, negotiations about what constitutes a BAT involve multiple parties, some of which–governmental officials and industry representatives—have more of a say than others—researchers and NGOs (Laurent, 2022). Implementation is difficult to monitor because different techniques result in different emission limits. Several criticisms have been raised, such as the method of calculation (ration of mass of pollutant to volume of total emissions) being insensitive to peaks in pollution and favouring large facilities as well as the exclusion of POPs and heavy metals from the list of pollutants. That these have not been integrated into the policy can be read as another instance of environmental concerns taking a back seat to industrial interests. Evaluations of installations in Spain and in the UK have demonstrated that implementation of BATs do not necessarily lead to the projected decrease in emissions and broader assessments have likewise been unable to connect the introduction of BATs to a decrease in industrial emissions (Laurent, 2022).

2.3.3 Democratic participation

If thresholds, and regulation more broadly are not strictly based on science, but rather involves a negotiation of values, as Boudia et al. (2021) and Laurent (2022) have demonstrated, then these spaces of discussion should be accessible to all those who have a stake in the discussion, beyond national bodies and industrial representatives. This is all the more the case

when the type of science being dealt with is post-normal. In post-normal science, scientific knowledge is overwhelmed by uncertainty and values take center stage (Ravetz, 2004). Discussions therefore need to take place among an 'extended peer community' that expands notions of expert and expertise to include all those whom the issue concerns (Ravetz, 2004). The literature introduces several forms of citizen participation, including democratic involvement in regulatory initiatives (Farrelly, 2021), citizen science projects (Takada, 2013; Borelle et al., 2021), and the use of objects as a means of mobilizing concerned publics (Laurent, 2022; Tarpgaard, 2021).

Farrelly (2021) argues for more democratic participation based on the recognition that risk assessments have come to displace political negotiation as the site of advocating for interests as well as existing scientific methods foreclosing alternative ways of conceptualising issues, such as looking at the cocktail effect of chemicals rather than simple cause-and-effect relationships. She points to the United Nations Environment Assembly and the work of the Ad Hoc Open-Ended Expert Working Group with respect to plastic pollution and the establishment of a Scientific Advisory Group to consult on marine plastic litter and microplastics as examples of democratic participation. A variety of civil society groups were represented in the Working Group from famers to local authorities, and they were asked to advise on the Resolution on Marine Litter and Microplastics. The Scientific Advisory Group was likewise comprised of both natural and social scientists form over 70 different countries in order to provide country-specific inputs. Borelle et al. (2021) likewise describes a successful instance of participation through input on the material ways in which microplastics affect livelihoods. For the Canadian Inuit, the ingestion of plastic by seabirds that are part of their diet as well as their excrement of said plastics on the national wildlife areas they inhabit make plastic pollution a pressing and personal concern. During the Stockholm Convention, the testimony of the Inuk president of the Inuit Circumpolar Council of Canada was central in controlling the release of the 'dirty dozen', a list of 12 POPs that are known to bioaccumulate up the food chain.

Bergman (2021) argues that the distinction between macroplastics and microplastics have relegated citizen science to the realm of the former as microplastics research, requiring more expensive tools, infrastructure, techniques, such as sampling nets and spectroscopy equipment to identify polymer type, are not as easily accessible to citizen scientists. Nonetheless, Borelle et al. (2021) and Takada (2013) detail ways in which scientists have worked with indigenous communities and citizen scientists, respectively, in order to further knowledge on microplastics and the POPs they contain. Borelle et al. (2021) describes how considering indigenous populations extends beyond acknowledging their concerns to viewing them as collaborators in scientific practice. Data on plastic ingestion by seabirds has largely been collected by Inuit hunters and their knowledge of hydrology make them experts in

collecting samples to assess the spread of microplastics via excretion. Takada (2013) details his work with the International Pellet Watch, a citizen science project with employs the specific materiality of plastic pellets in order to monitor the concentrations of POPs across the globe. Plastic pellets are produced from crude oil and retain its qualities through processing, while many POPs are hydrophobic and are attracted to lipids. POPs in the marine environment are therefore attracted to plastic pellets and gather in high concentrations within them. For example, PCBs are present in pellets in levels a million times higher than in the surrounding sea water, in simpler terms, five plastic pellets contain the equivalent amount of PCBs as does 100 litres of sea water. These two qualities of plastic pellets—that they attract POPs and concentrate them in high amounts—allows them to serve as indicators of POP levels that are easy to collect and transport. Citizen scientists are asked to collect plastic pellets (at least 100 but preferably 200) and post them in an envelope to the laboratory, where they are then analysed in order to paint a picture of POP concentration across the globe.

Laurent (2022) discusses how European objects are currently regulated by technical experts but have the power to make these processes more democratic because they "are tied to collective concerns …. People care about the food they eat and the chemicals they are exposed to, the quality of their living environment and the access they have to affordable everyday goods, and the energy they can have access to and the future of the climate" (p. 8). These objects do not have to remain "technocratic creatures" (Laurent, 2022, p. 198) but can serve as entry points for citizens to make their concerns heard, opening up spaces of discussion to a broader range of people. Bergmann (2021) and Tarpgaard (2021) provide some first glimpses into what this could look like in the case of microplastics. This power of objects can be understood through Marres' (2014) notion of augmented objects, in which objects come to resonate with a range of issues.

Although Bergmann (2021) considers there to be much more hazardous substances in the oceans—here he gives dichloro-diphenyl-trichloroethane (DDT), trinitrotoluene (TNT), and radioactive substances as examples—he recognizes that finding microplastics in food has an emotive impact that triggers concern for the health of oceanic health more generally. He notes, however, that there seems to be a disconnect between plastics in the ocean, such as that which marine animals consume, and plastics in social life, such as produced via the cutting board. Tarpgaard's (2021) ethnographic work, however, demonstrates that it is possible to link everyday objects with the microplastics in the ocean and that people are not only motivated by concern for their own personal health, but for that of the environment as well. She takes the example of the plastic dishcloth around which the Danish public mobilized in 2015. Upon learning about how they release microplastic fibres down the drain, the Danish public were prompted to buy dishcloths made from non-plastic materials or to knit their own. Tarpgaard

comments that while this movement may appear to be a neoliberal project, especially considering that downstream filters capture the 99.7% of the fibres, it nonetheless served as a major catalyst for bringing awareness around plastics to the Danish population. This dishcloth anecdote was one part of a larger ethnographic study following Plastic Change, a Danish NGO raising awareness around plastic pollution, the results of which led Tarpgaard (2021) to conclude that “raising awareness among the public is indeed a crucial part of movements toward larger structural and legislative changes" (p. 218). As we will see, in the European setting, the use of microplastic beads in personal care products played a similar role in drawing attention to the issue of microplastics as well as pointing towards a first legislative step to be taken.

The emotive power of these objects can be understood through what Marres (2014) calls augmented objects, which she contrasts with the notion of scripted objects. Augmented objects are those that resonate with a range of issues, rather than exerting specific effects on their subjects, as scripted objects do. In the case of the former, the degree of politicization is the number of issues the object resonates with, while in the latter, it is the degree to which it can induce a specific effect. Augmented objects are furthermore explicit in their messaging while scripted objects are latently political. The example Marres (2014) uses to illustrate her point are augmented teapots—kettles with extra element that imbue them with their messaging, for example, a kettle with measuring increments on the side to prompt to the user to boil the appropriate amount of water for a cup of tea or one with a sensor that informs the user of the carbon intensity of electricity supply at the current moment in time. The purpose of these objects is more than to ask of specific actions from their users, but to bring broader issues, be that climate change, smart grid, sustainable design, or fossil fuels, into the everyday setting. These categories are not mutually exclusive; rather, the question is which lens is the most useful in highlighting the politics of a given object. Microplastics can certainly be considered an augmented object. Bergmann (2021) sees microplastic in food as a way to bring into awareness issues of oceanic pollution. Likewise, for Tarpgaard (2021), the knitted dish cloth is not so much about reducing the microplastics that are released from them, but to bring the topic of microplastics to the table.

3 Research approach

In this chapter, I first introduce my research question before detailing my methodological and conceptual approach to collecting and analysing my empirical material.

3.1 Research question

My empirical work was motivated by my interest in the ways in the which microplastics were problematized and framed such that they could be targeted with the regulatory tools of the EU, summarised in the following research question:

How did microplastics become an object to be regulated in the European context?

This question takes as a starting point that objects cannot simply be transported into the policy realm; rather, they need to be reconfigured in order that they can become targets of regulatory action. Three sub-questions follow from this main research interest.

How did microplastics emerge as an issue within the EU?

Scientific findings demonstrated the possible harms of microplastics to marine fauna as early as 1972, but it was only in 2013 that it was flagged as an issue at the EU level. This question attempts to unpack the ways in which the topic of microplastics was framed by different actors to take it from an issue concerning mainly scientists to becoming entangled in world of policy.

How are microplastics defined and categorized in order to make them regulatable?

Not only does no standard definition of microplastics currently exist (Hartmann et al., 2019), but the materiality of microplastics, due to its extreme persistence in the environment and the low dose effects of some of the additives they contain is difficult to grasp (ECHA, 2019a; Liboiron, 2016). In order to regulate them, they first must be articulated into a standardized definition. STS literature on classification and standardization provides a means of which to make sense of this process and draws attention to their consequences (Bowker & Star, 2000; Busch, 2011).

What political negotiations took place in the development of EU microplastics policy?

Technical discussions are not spaces free from political interests, but where they are articulated via different means (Barry, 2001; Hecht, 2001). This form of governance where multiple actors are involved in the technical and scientific portions of policymaking is characteristic of European governance (Barry, 1994; Laurent, 2022). Through this lens, conflicts over the minutia of microplastic regulation can be viewed as tensions between diverging interests. It is important to be sensitive to the political undercurrent of microplastics regulation in order to shed light on the actors directing the trajectory of microplastic regulation

in ways that are often invisible, shrouded as they are by the veneer of objective science, such that we can reflect on if this these are the actors and concerns regulation should really reflect.

3.2 Methodological approach

As my research interest is how microplastics are discussed in the context of EU policymaking, EU policy documents were my empirical material of choice. There is no shortage of microplastics-related EU policy documents to analyse, which made the challenge figuring out which documents to focus on. In taking a preliminary look at how microplastics are discussed in the EU, I found that microplastic regulation is often categorized by type of microplastic targeted: intentionally added, unintentionally released, and generated from macroplastic waste (more on this classification in the empirical chapter). As the first two categories regulate microplastics directly (as opposed to indirectly through regulating larger plastic components) and as both involve substantial regulatory initiatives with extensive documentation (as opposed to a smattering of unrelated pieces of regulation), they, and more specifically, the documents related to the regulatory initiatives that target them, are those that I chose to focus on. As this thesis is part of a larger research project, “Innovation Residues: Modes and infrastructures of caring for our longue-durée environmental futures”, I also had the opportunity to take part in a number of expert interviews, which supplemented the primary document work. In the following sections, I will first touch upon my early attempt at thematic analysis, before elaborating on the document analysis and interviews that I ultimately drew upon to compose my empirical section.

3.2.1 Thematic analysis

Once I had narrowed down my documents, the most obvious next step for me felt like coding them in order to analyse them in a systematic way. While a common approach here is grounded theory, I instead followed the thematic analysis approach proposed by Clarke and Braun (2017). While thematic analysis is similar to grounded theory in that it starts with the empirical material and uses codes to develop the conceptual analyses, a major difference is that it does not require the development of a wholly new theory, aiming instead to identify themes. A theme, according to thematic analysis, is understood as that which captures an idea relevant to the research question and occurs in the empirical material in a patterned manner. Due to this lower barrier, I felt thematic analysis was better suited to master’s-level research. Thematic analysis involves six stages: (1) familiarising yourself with the dataset, (2) coding, (3) generating initial themes, (4) developing and reviewing themes, (5) refining, defining and naming themes, and (6) writing up (Braun & Clarke, 2022). The first step, familiarization, involves taking a first pass through the empirical material. Early analytical thoughts may arise, and these should be noted down but should not be taken too seriously in order to prevent pre-

existing ideas or ideas based on only a small sub-set of data to dominate the analysis phase. Familiarisation is particularly important in instances where the analyst isn't also the data collector or if the data was not generated from interaction with participants, so I felt it was especially relevant when working with documents. It is only after this familiarization phase that Braun and Clarke (2022) recommend proceeding with coding. While the idea of separating these two phases was new to me and at first felt unnecessary, it ended up being very useful as I was able to get an overall picture of how the documents relate to each other before diving deep into each one and coding specific sections of text. Practically speaking, I used MAXQDA both to add notes to the documents as I was reading through them the first time as well as code the documents in the second step of thematic analysis. Ultimately, I did not proceed with thematic analysis following the coding step. This was because I had selected a large number of documents to analyse, with several of the documents being of substantial length, making the fine-grained coding that I'd done almost impossible to synthesize. Nonetheless, taking this approach was a crucial part in gaining a more intimate knowledge of the documents.

3.2.2 Document analysis

Asdal and Reinertsein (2022) take a practice-oriented approach to document analysis, which means seeing documents as parts of larger fields of practice: how they are part of everyday practice, how issues are brought into documents, and how they have world-making effects. This approach animates documents in ways contrary to the common perception of them as dull and boring. In elaborating their practice-oriented approach, Asdal and Reinertsen (2022) lay out six methodological moves through which document-related practices become visible: document sites, document tools, document work, document text, document issues, and document movements. Rather than being discrete categories, "the different elements are partly overlapping and … 'speak' to one another" (Asdal & Reinertsen, 2022, p. 146). Of these six moves, document sites, document tools, document issues, and documents movements are of particular relevance to this analysis. Using them as lenses through which to study the documents allowed me to identify and focus in on the most interesting aspects of the documents without being inundated by the sheer quantity of pages I was looking at.

The notion of document sites refers to three different ways in which documents relate to sites: documents can be part of sites, such as the documents that are part and parcel of a government bureaucracy; they can produce sites, in the way engineering plans for buildings enable the construction of a physical site; and they can be sites in themselves, such as a report where a problem is first analysed, then a resolution arrived at. Considering documents as sites in themselves and tracing the action that takes place within them Asdal and Reinertsen (2022) call document ethnography. Document ethnography is the central way the notion of document sites is deployed within this thesis. In addition to paying attention to the action that

takes place within documents, viewing documents as tools—Asdal and Reinertsen (2022) identify three types: tools of governing, tools of knowledge, and tools of the economy—highlights their crucial role in bringing about action in the real world. This is obvious in the case of documents that are large tools, such as pieces of legislation, but documents like agendas, meeting minutes, memos, and emails—little tools—are equally crucial in making things move.

'Document issues' takes as its starting point the idea that issues do not simply exist but need to be formed (a conceptual approach that will be further elaborated in the next section). Furthermore, issues are rarely a single thing: different actors problematize things in different ways. Both these properties of issues can be traced through documents, such as through comparing how an issue is framed in subsequent documents or considering whose perspective a given document is advocating. For example, Asdal (2015) observed pollution from a new industrial aluminium smelter was framed by farmers as making their sheep sick, but by engineers in the expert report they authored for the Norwegian government as a normal and acceptable part of industrial activity, turning what was originally an agricultural and environmental issue into and industrial one. Marres (2004) notes how the Internet is particularly conducive to studying issue formation as it not only captures social interactions that have previously been undocumented but also allows for tracing issues in its distributed nature—across actors and locations. These points also apply to the case at hand: the ease at which digital documents can be produced means that more social interaction is recorded than ever before and I am able to access documents produced by different actors in different parts of the world through my laptop. Documents not only record the trajectory of issues but also have the power to intervene in them, as highlighted by the idea of document tools (Asdal & Reinertsen, 2022). Lastly, issues often form around objects. In order for them to enter the discussion, however, they need to be transformed from material objects into document objects. This was the case in a whaling controversy studied by Asdal whereby "the large, fleshly blue whale itself, possibly the largest animal that has ever lived on the planet" was transformed into a "paper whale" (Asdal & Reinertsen, 2022, p. 120) in order that it could be transported into the Norwegian parliament to be discussed. The broader point her here is to question in what ways material objects are reconfigured as they enter the document space.

'Document movements' likewise pertains to several types of movement (Asdal & Reinertsen, 2022). Documents build upon those that came before it and contribute to the ones that follow. In this way, single documents are part of chains of documents and being sensitive to this broader document ecology allows the analyst to consider the context in which the document was produced and how the document exerts an effect on other documents. Thinking in terms of chains of documents is especially relevant when studying the development of an issue, as comparing subsequent documents can reveal the incremental changes in the development of

the issue and thereby isolate and identify key moments. Documents can be produced as part of pre-set procedure, and in this case, they will follow a well-trodden path. Within the EU, this is certainly the case for proposing a restriction of a substance under REACH or developing a piece of regulation. While such formal procedures ensure that issues receive due consideration (although this is also imperfect, as we will see later), they can also have the effect of slowing down how quickly documents are able to move through the bureaucratic machinery. Included in the EU regulatory process is the opportunity for external actors to comment on proposed legislation. In this instance, documents also do the work of transporting public opinion into the formal decision-making process.

3.2.3 Interviews

The primary empirical material in this thesis are policy documents. However, as an outsider to the field of EU policymaking, I am limited in my ability to contextualise the documents: I may give them more or less weight than they are afforded in practice. Collins and Evans (2007) define knowledge based on interaction with primary source material, primary source knowledge, and differentiate this from specialist tacit knowledge which involves either being part of (contributory expertise) or being in close contact with (interactional expertise) the community of experts. Interviews therefore serve as a way to contextualise my primary source knowledge and in doing so, move it closer towards interactional expertise. I drew upon four interviews for this thesis, two with scientists and two with policymakers. The profiles of the interviewees are provided in more detail in the Table 1 below. As the interviews were conducted in the context of a broader research project, they were primarily led by the project investigator. In the majority of cases (S1, S2, P2), I was present at the time of the interview and asked questions of my own whenever the interview moved towards topics more directly related to my research. Where the interview was of relevance to my research (S2, P1), I transcribed them. Meanwhile, as interviews S1 and P2 served to provide background knowledge, for these I relied on a transcription done by a colleague and my notes from the interview, respectively. In the instances where I did the transcription, I did so with the assistance of the AI transcription software, GoSpeech. GoSpeech automatically generated a transcript in a more standardized style, transcribing the main portion of the narrative omitting non-verbal elements and using conventional punctuation (Jensen & Laurie, 2016). This I then edited for accuracy and to include more of the repeated, broken off, and filler words, which also served to re-familiarize myself with the tone of the interview. In retrospect, however, the more detailed transcription was not necessary given that I was primarily interested in the context of what was said rather than in performing a discourse analysis (Mcnaghten & Myers, 2007). The interviews were largely analysed using a realist approach as they served as a

resource with which to understand what takes place behind closed doors as a complement to the document analyses rather than being the topic of research themselves (Bryne, 2018).

Table 1: Interview participants

Interview code	Profession	Interview topic	Recording method
S1	Environmental geoscientist	Environmental impact of microplastics	Transcribed by colleague
S2	Environmental psychologist	Experience with contributing to EU's science gathering	Transcribed
P1	Policymaker	EU plastic policy	Transcribed
P2	Former policymaker	Role of documents in EU policy	Note-taking only

3.3 Conceptual approach

This section introduces the sensitizing concepts employed in order to make sense of the empirical work that follows. I use the term sensitizing concept to refer to how I used these concepts for "seeing, organizing, and understanding experience" (Charmaz, 2003, p. 259, as cited in Bowen, 2006). The first section of this chapter introduces the concept of issue formation, which informed my understanding of microplastics in the policy space as a topic that was not simply taken up but transformed in the process. The second section draws heavily on Barry's work (1994, 2001) on harmonization and Laurent's (2022) book, *European Objects*, both of which explore the scientization of politics within EU policymaking and what politics looks like in this new context. In the final section, I delve deeper into one concrete example of this—classification and standardization—and explore the politics at play in this seemingly technical endeavour. A common theme across all three bodies of literature is the socio-material perspective which highlights the materiality of the objects at the centre of the processes of issue formation, harmonization, classification, and standardization.

3.3.1 Issue formation

The concept of issue formation draws analytical attention to how topics become issues and how issues become politicized. The social and political sciences view the formation of issues as a discursive process, giving priority to the role of ideas, terms, and frames, over objects in the development of social movements, political processes, and news cycles (Marres, 2012). This stance sees issues not as preexisting in the world but brought into existence through discursive practices. In the context of social movements, for example, Snow and Benford (1998) criticise "an isomorphic relationship between the nature of any particular set of conditions or events and the meanings attached to them" (p. 198), calling for a closer analysis

of how conditions are framed in specific ways in order to mobilize people. However, STS approaches point out how sociotechnical controversies often crystallise around tangible problems, such as where a dam should be built, in what instances medical procedures should be allowed, or how taxes on financial gains should be designed (Venturini & Munk, 2022). In simpler terms, “our politics are object-oriented” (Venturini & Munk, 2022, p. 55). Microplastics as an object therefore serves as an entry point into unpacking the broader issues that come to resonate with it. Furthermore, STS takes a socio-ontological view which collapses the distinction between objects and the discussions that take place around them, returning attention to “the material, physical and technical associations that are at stake in controversies” (Marres, 2007, p. 776). Viewing microplastics through this socio-ontological lens means not only thinking about how microplastics are taken up within the policy discourse, but also to how the materiality of microplastics is present in this.

Additionally, Marres (2004) demonstrates how issues are become politicized as they circulate around different sites and take on different meanings. One example of this comes from Gomart and Hajer (2002), who studied the political processes underlying the regional planning of Hoeksche Waard, a Dutch island located between near Rotterdam and Antwerp. They demonstrate how the controversy over the proposal for the island became a political object as it was circulated between the offices of local governments and a public event organised by architects, each party having a differing vision for the proposal. Similarly, in investigating the controversy surrounding Development Gateway, a portal for development information, Marres (2004) demonstrates that the tensions stem from different actors framing the relationship between the Gateway and the World Bank in contradictory ways: Gateway affiliates downplay the involvement of the World Bank, while critics of the Gateway highlight the connection, pointing out that the initiative is not as independent is it is made to appear on the surface. What both these case studies also demonstrate is that issue formation outside of traditional political institutions is part and parcel of democratic politics (Marres, 2004). Tracing the development of the issue of microplastics will likewise involve being attentive to the places from which it emerges, the spaces to which it travels, and what meanings they taken on at these various locations.

In the methods section, I briefly touched upon how the Internet and digital documents made available through it provide unprecedented access to the formation of issues. This methodological development requires treatment at the conceptual level as well since the Internet does not simply make controversies more visible to the analyst but also shapes the way in which issues develop. There are two ways of responding to this intervening power of the digital: the precautionary approach, which views digital bias as a negative feature and attempts to neutralise the effect, and the affirmative approach, which sees digital spaces as

enabling controversies to play out in new venues and brings the effect of digital devices into the scope of analysis (Marres, 2015). This extends a long-established STS sensibility “to defer to the empirical setting in answering substantive questions like Who are the protagonists? What is the topic of contention … ?" (Marres, 2015, p. 672). Studying the development of issues in digital spaces therefore requires a consideration not only of how issues are framed, but also the ways in which the digital space contributes to issue formation. In the case of the microplastics issue, this means thinking about how the availability of policy documents and digitally mediated political participation plays into the ways in which negotiations about microplastics take place.

3.3.2 Harmonization and the scientization of politics

Barry’s (1994, 2001) central argument in his writings on the European Union is that the EU as a political body exercises its power through harmonization. Harmonization refers to shared regulations that apply across the Member States and can pertain to a variety of policy areas, including telecommunications, the environment, employment, and taxation (Barry, 1994). While there was an uptick in harmonization efforts specifically with regards to the internal market as a result of the Single European Act (SEA), harmonization is not necessarily a neoliberal project (Barry, 1994). Harmonization is opposed to more traditional form of governance which involve large-scale state-supported programmes such as hospitals, schools, armies, and local-government bureaucracies (Barry, 1994; Barry, 2001), but nonetheless have a similar identity-building effect: in the case of technology, for example, the European identity is constructed around the compatibility of technologies within the European Union rather than a single large-scale technical project (Barry, 1994). In other work (2001), Barry has described the EU’s harmonization project, particularly when it concerns technology and associated practices, as the formation of a technological zone, which he defines as “a space within which difference between technical practices, procedures or forms have been reduced” or conversely, “common standards have been established” (Barry, 2006). Governance via harmonization allows for the EU delegate power to other institutions and thereby reduce their own administrative capacities; in fact, the bureaucracy of the EU is relatively small given its large geographical jurisdiction (Barry, 1994; Barry, 2001). In this way, harmonization is “an essential element in the art of European government” (Barry, 1994, p. 52).

This delegation of governance from the hands of political actors traditionally conceived to technical ones can be understood as a form the scientization of politics, defined as “the transformation of an issue requiring open political debate into a technical problem examined by restricted groups of bureaucrats and experts” (Barry, 1994, p. 50). In the process, politics is not so much removed from the debate, but rather takes on a different form (Barry, 2001). This is not simply scientific fact recruited to make a political point, but politics articulated

through technical arguments (Barry, 2001). This idea resonates closely with Hecht's (2001) notion of technopolitics, "the strategic practice of designing or using technology to constitute, embody, or enact political goals" (p. 256), which shares this distinction. An example of this is how in response to an EU directive on bathing water quality which required Member States to monitor the quality of bathing water in their countries in accordance with commons standards, scientists commented on how diverging water quality monitoring practices made comparing the results impossible (Barry, 2001). This was not just an observation, but also a criticism of the EU's regulatory initiative delivered in technical jargon. Laurent (2022) elaborates on the idea of scientization of politics within EU policymaking, identifying two mechanisms by which this proceeds: technical descriptions of market objects and scientific assessments of potentially risky entities. The regulation of market goods is governed by the New Approach, introduced in 1985, which mandates that the EU institutions first agree upon the basic guidelines before recruiting the European Standards Organisation (CEN) to hash out the details of the standard (CEN, 2019). Similarly, in the case of risky entities subject to scientific assessment, European institutions develop high-level regulations, such as REACH, and leave the execution of the regulation of expert agencies, in this case, ECHA, the European chemicals agency. Laurent (2022) uses the phrases 'dream of disentanglement' and 'dream of objectivity' to point to how despite their outwardly apolitical appearance, interests are present in these technical and scientific practices.

3.3.2.1 Dream of disentanglement

The dream of disentanglement refers to how in setting standards for market objects, EU procedures attempt to demarcate between the political task of writing regulation and the technical one of writing standards (Laurent, 2022). However, there are several ways in which this is just a dream. Firstly, there is a legal mechanism—the delegated act—which allows the European Commission to amend portions of regulation which is then only subject to a yes/no vote by the legislating bodies of the EU rather than restart the legislative process. Employing this legal tool allows the EU to intervene in the technical standard writing to ensure objects remain free market objects without having to go through the process of acquiring consensus from both the Council and the Parliament. However, EU institutions not only ensure the success of their single market project through the delegated act, but the practice of standard writing itself is in service of the European market. If using regulation to ensure the functioning of the free market is in line with the ordoliberal economic constitution, setting standards in an extension of this (Laurent, 2022).

The EU is not only interested in maintaining the integrity of its single market, but also of regulating other areas of policy, which it does in part through internal market regulation due to its extended power in this area of policymaking. This is because the Single European Act of

1985, described as the "the legal and political framework for the Single Market programme" (Barry, 2001, p. 71), introduced Article 100a (Article 95 in the Treaty of Amsterdam, Article 114 in the Treaty of Lisbon (Boetter & Blanke, 2023)), which allowed for qualified majority voting in the Council for matters pertaining to the internal market (Moravcsik, 1991; Scharpf, 1991; Barry, 2001; Dougan, 2009), making it easier to pass laws that created common standards for goods such that they could circulate freely on the European single market (Scharpf, 1991; Barry, 2001; Dougan, 2009; Berman, 1989). Prior to this, unanimity was required in order to pass regulation (Moravcsik, 1991; Scharpf, 1991) and qualified majority was only used in a limited number of fields and even then, only for specific measures (Berman, 1989). While the article was presented as secondary to the article on unanimity (Article 100) both in its naming (Article 100a) and its wording (“By way of derogation from Article 100”), in practice, it quickly became the dominant pathway to set harmonization regulations (Boettner & Blanke, 2023; Weiler, 1991). This was reflected in the Treaty of Lisbon where the order of the two articles was swapped to give the unanimity article the leading position (Boettner & Blanke, 2023). What is unique about Article 114 of the TFEU (Treaty of the Functioning of the EU) (the current iteration of Article 100a of the SEA) is that it is a provision of general competence, meaning it can apply to any policy area so long as it has a connection to the internal market (Boettner & Blanke, 2023). With regulations which are part of multiply policy areas, the centre of gravity approach is used, where what is found to be the main policy area dictates the course of legal action. However, Boettner and Blanke (2023) observe that “the ECJ [European Court of Justice] seems to regard the internal market as a high good that may prevail over other objectives” (p. 8). In this way, European institutions are able to encroach on policy areas normally outside their jurisdiction via appeals to the internal market, and it is not unusual for them to do so. Understandably, Weiler describes the act as “the single most important provision of the SEA” (Weiler, 1991, p. 2458). Under the guise of a seemingly technical undertaking—setting harmonized standards for market objects—the EU is able to advance its political goals.

Laurent (2022) provides an example of how environmental policy was done through action on a market product. In the case of cigarettes, the EU passed a directive on cigarette labelling (1989) mandating warning labels and an indication of tar and nicotine yield on all cigarette packages sold in the EU (Council Directive 89/622/EEC). While the directive takes Article 100a of the Treaty establishing the European Economic Community (EEC) as its legal basis, it also explicitly cites its concern for public health protection and links both labelling requirements to the European action programme against cancer. The UK brought the directive to court, citing that the majority vote (used for internal market policies) was used despite the directive clearly touching upon health issues (requiring unanimity voting); however, the European Court of

Justice dismissed the case, underscoring the power of the EU (Laurent, 2022). A similar legal challenge was launched against the 1998 directive to ban all tobacco advertising and while the ECJ found the EU in the wrong in this situation, Laurent (2022) describes this instance as "less a halt in the process of expansion of European power than an episode in the gradual definition of the appropriate scope of European intervention" (p. 59) and similar subsequent cases again saw the ECJ rule in the favour of the EU. As the empirical material will demonstrate, microplastic regulation also draws upon this legal foundation, prompting a reflection on the kind of policymaking that the EU is doing.

3.3.2.2 Dream of objectivity

The dream of objectivity draws upon the understanding of science as being a view from nowhere and therefore a source of political legitimacy (Laurent, 2022). However, STS scholarship has investigated how what is accepted as expertise can differ from institution from institution and in doing so have developed concepts that counter tradition ideas of objective science. Cambrosio and Keating, for example, discuss regulatory objectivity, where "objectivity is based on shared norms negotiated by a diversity of stakeholders" (Laurent, 2022, p. 96). Similarly, Jasanoff (2005) talks about civic epistemologies, or "the institutionalized practices by which members of a given society test and deploy knowledge claims used as a basis for making collective choices" (p. 225). Laurent (2022) explores subjectivity in science in the context of European regulation through the notion of European objectivity: "If conceived in terms of the view from nowhere, European objectivity remains an elusive dream. … If there is a European objectivity it can be described as an "interested objectivity," which grounds both the production of technical advice and the representation of interested parties, be they member states or concerned stakeholders" (p. 106). European objectivity is visible when, for example, political interests infuse decisions to ban or limit the use of hazardous substances and/or set thresholds for their presence in the environment. However, not all interests are equally represented in these spaces as access to them requires a familiarity with bureaucratic processes as well as the technical language in order to participate in the scientific discussions. As a result, "arcane procedures give much leeway to the most skilled lobbyists" (Laurent, 2022, p. 137). The approach of European objectivity keeps our eyes open to the ways in which seemingly apolitical technical discussions are politics by another means.

Grounding political legitimacy on the objective nature of science can backfire when events to the contrary arise (Laurent, 2022). This was the case with the European Food Safety Authority (EFSA), which was set up as an independent body to provide expertise on the safety of European food products in response to the BSE crisis, during which national interests were claimed to have interfered with a prompt response. However, the EFSA failed to be the source of trust as imagined by the EU, mired as it was in debates around the quality of the scientific

advice it provided, the transparency of its operations, and its independence from lobbying groups. While these allegations are hardly surprising to science studies scholars, it is no wonder that, against the backdrop of the promise of an independent regulatory body, these charges led to political discontent (Laurent, 2022).

3.3.2.3 European objects

In his discussions of harmonization in the EU, Barry (2001) emphasizes the need to extend the analytical scope beyond laws, markets, and regulations to include objects and practices, as it is only in doing so that we are able to delve beneath the appearance of harmonization proceeding smoothy to see the difficulties and tensions that arise as harmonization is implemented. Laurent follows this call in his 2022 book, and it is through his research on European objects that he develops the two dreams of harmonization: the dream of disentanglement and the dream of objectivity. He defines European objects as “entities that are regulated by European policies” (Laurent, 2022, p. 5). However, objects are European not simply because they are subject to European regulation, but because “manifestations of long-term objectives for European integration, such as a harmonized market or an objective expertise” (Laurent, 2022, p. 5). As such, European objects are commonly “market objects expected to circulate across Europe, objects described by scientific expertise because of the risks they entail or can be subjected to, or both at the same time” (Laurent, 2022, p. 5). As both objects prevented from entering the market and objects of scientific scrutiny as to their effects on the environment and human health, microplastics are a perfect example of a European object.

The concept of European objects is powerful not only because it provides an entry point for studying European regulation but also because they resonate with peoples’ concerns and therefore offer a means through which to envision more democratic forms of governance (Laurent, 2022). The scientization of politics reconfigures how accessible spaces of debate are. On one hand, [t]echnical practices can open up the space of political contestation” (Barry, 2001, p. 82), making it accessible to actors outside of politics traditionally conceived. At the same time, however, it remains limited in that technical discussions require a certain level of expertise (Laurent, 2022). European objects take this one step further: given that regulation via objects is how the EU knows how to operate and that objects are able to resonate with people’s concerns, European objects can be leveraged as entry points through which citizen can engage with policymaking (Laurent, 2022). Viewing objects as a source of democratic participation draws attention to ways in which microplastics regulation already invites feedback and whether these processes can be reimaged to be more democratic.

3.3.3 Classification and standardization

On their book on classification, Bowker and Star (2000) identify three properties of a classification system. Firstly, they are organised based on unique classificatory principles, such as temporality or frequency. Secondly, categories are mutually exclusive. What is labelled as belonging to one category does not also belong to another. Thirdly, the system is complete. This means that it should be able to accommodate all the items it aims to classify. However, Bowker and Star (2000) acknowledge that these properties are ideal and that in practice, these principles are not obeyed strictly. A classification scheme can be patchwork. For example, the public libraries in Toronto have a special way of classifying books that are on hold—by the last four digit of the borrower code—that is separate from the rest of the books held in the library. Objects can be ambiguous; they may not clearly belong to one category over another. Finally, there are good reasons why some classification systems are incomplete, for example, if updating the existing system is too costly. Bowker and Star (2000) differentiate between classification and standardization. They define standards as “any set of agreed-upon rules for the production of (textual and material) objects” (Bowker & Star, 2000, p. 13) which crucially have the quality of persisting over time and space. Nonetheless, they are “two sides of the same coin” (Bowker & Star, 2000, p. 15): classifications can be standardised, such as the Dewey Decimal System, which is employed in libraries the world over, while standards automatically generate categories, at the very least between things that follow the standard, and those that don’t.

Whereas Bowker and Star investigate classification, Busch (2011) is more concerned with standardization. Busch conceptualises standards as metaphors made concrete. Standards, like metaphors, involve comparison along a single metric. For example, in measuring an object with a ruler, the object being measured is being compared to the centimetre marks on the ruler, and not along any metric, for example, it’s composition or weight, but its dimensions. Standards formalize these metaphors, whether into voluntary agreements or mandatory regulations. Busch (2011) furthermore develops a typology of standards. The four types of standards he identifies are what he calls Olympic standards, filters, ranks, and divisions. Ranks involve a hierarchical order. Olympic standards and filters are special binary cases of rankings. While Olympic standards operate at the upper end of the ranking, identifying the top or the top few of a group, filters operate on the lower end, filtering out those that do not meet minimum requirements. Divisions, on the other hand, are “different categories that are unranked” (Busch, 2011, p. 46). Divisions are the kind of standards Bowker and Star (2000) have in mind when they speak of categories that are made into standards. Additionally, while Busch (2011) only describes divisions in his typology as categories, Bowker and Star (2000) would also consider Olympic thresholds and filters as forming categories of those that meet

the criteria and those that don't. The rest of the thesis will follow Busch's (2011) typology but using the term 'category' or 'classification' instead of 'division' for the sake of clarity. This thesis will investigate the multiple ways in which different types of standards were used to render microplastics into governable entities as well as to shape the scope of regulation.

The earlier discussion on the scientization of politics may have primed us to consider the ways in which categories and standards, despite their innocent appearance, have the power to order the world in specific ways. Bowker and Star (2000) describe the power of categories and standards as a 'practical politics', referring to the political negotiations and practical considerations that go into developing classification systems. While political negotiations stem from difference in opinion, such as the importance of a single case of a disease (important for a public health official but not for a statistician), practical consideration have to do with ease of use, such as granularity and/or system restrictions. An example of the latter is how the International Classification of Disease originally recorded 200 diseases as that was the number that would fit onto the original census sheets. Busch (2011) elaborates on the nature of the power of standards. First, their power is not of the explicitly coercive type but is "the ability to set the rules others must follow, or to set the range of categories from which they may choose" (p. 28). Because the power cannot be directly traced to an individual, it can be described as anonymous. Furthermore, established standards determine how things ought to be such that what does not follow the standard appears out of place. Together, these features give standards a sense of naturalness which becomes a source of power. Busch (2011) describes this with a short vignette: "If someone tries to prevent me from entering a building by standing outside blocking the door, I am likely to be angry at that person. But if I find the door unopenable because of a snowdrift, I will only be frustrated and grumble about it" (p. 32). Despite this quality of invisibility, the power of standards is evident in that conflicts arise over how to set standards or between different existing standards.

3.3.3.1 Regulatory categories

In his discussion on the European regulation of objects, Laurent (2022) introduces the notion of regulatory categories. Regulatory categories are not simply legal entities or labels assigned to existing objects, but are entities carefully crafted in order to provide "meaningful ways of regulatory action" (Laurent, 2022, p. 10). One way in which regulatory categories are employed are in order to exercise regulatory precaution. Regulatory precaution refers to the dually precautionary nature of European policymaking: precaution in acting against potentially harmful substances while also being careful of the extent of regulatory reach. They acknowledge that these harmful substances need regulating but are hesitant to restrict them too strongly. As we encountered in the literature review, despite attempts to move towards a

precautionary form of regulation, they ultimately take more risk-based approaches. The notion of regulatory precaution provides us with a framework with which to understand this practice.

The regulation of nanomaterials through REACH illustrates the way in which regulatory categories are employed with the purpose of limiting the extent of regulatory control (Laurent, 2022). Nanomaterials have unique properties that diverge from that of the same material in its bulk for due to its size. As a result, questions were raised as to whether titanium dioxide in its nano form, for example, should be registered as a separate entity from titanium dioxide more generally. The approach of the ECHA is to determine this on a case-by-case basis, i.e. consider for each material whether a new registration for its nano form is necessary based on the potential risks they pose. By creating ever smaller categories, in this instance, differentiating between bulk and nano titanium oxide, it is possible to circumvent blanket bans and approach the regulation in a more risk-based way. A similar approach of differentiation is taken in the case of asbestos where industrial actors argue that chrysotile, the most common form of asbestos, and asbestos with shorter fibres are less dangerous than other types, in order to allow for their continued use in workplaces (Boudia et al., 2022).

While regulatory categories order objects in a more obvious way, standards also create distinctions between what is and isn't regulated (Bowker & Star, 2000). Regulatory precaution can therefore also be exercised through defining objects in certain ways so as to exempt certain uses. In the same way that regulatory categories allow for certain forms of action, construing objects in specific ways, in other words, setting standards of membership, also determine the ways in which they can be regulated. The idea of a policy object draws attention to how the objects of policies are not directly imported from the real world but rather are discursively constructed. Papadaki-Anastasopoulou and Felt (2021), in their study of the EU Single-Use Plastics Directive, follow how single-use plastics are identified as a problem in the first place, then formed into an object of regulation. The plastics problem is associated with plastic litter found in the marine environment, which is further quantified based on beach counts—those pieces of marine litter that are (a) present on specific 100-meter section of selected European beaches and (b) large enough to be easily countable (microplastics would likely not be considered under this metric). The marine litter identified as a result of this process is not simply transported into the Single-Use Plastic Directive; plastics in the context of the Directive are defined not by any of its material properties, such as their size, shape, chemical composition, or colour, but based their intended use, that they will only be used once. However, even this is complicated by the fact that special use cases are further exempted, such as wet wipes used in industrial settings and food containers that package food for storage rather than food to be consumed immediately. Here we see regulatory precaution exercised not through categories, but through defining single-use plastics in ways that restrict is application. Mellard

and Van Meijl (2017) illustrate a similar point with domestic abuse. Domestic abuse regulation assumes that it is singular entity when in practice, it is an assemblage of different kinds of abuse—physical, mental, and emotional—perpetrated on different victims—children, partners, and parents. In this instance, the domestic violence traditionally conceived are protected against, while other forms of domestic violence are inadvertently excluded from the scope of regulation.

3.3.3.2 Constructed ignorance

Thus far, we have seen how categories and definitions play a central role in determining the scope of regulation. These are often the result of negotiations that take into consideration the state of scientific knowledge and the availability of data. Thus, the availability of information plays into what kinds of regulatory categories are ultimately laid down in the law. We have already seen examples in chemicals regulation where imbalances of information between industry and regulators allow for more chemicals to be registered than might otherwise be allowed as well as how the SCOEL were swayed to raise occupational exposure thresholds based on scientific papers funded by industry (Boudia et al., 2021). These moves can be conceptualised through the lens of agnotology. Proctor (2008) uses the term agnotology to describe the study of ignorance. He identifies three forms of ignorance, although there are points of overlap: ignorance as a resource, ignorance as a selective choice, and ignorance as an active construct. Ignorance is a resource when it directs people to strive for knowledge. Ignorance as a selective choice, meanwhile, is more sensitive to the political geographies of ignorance, that the spread of ignorance, and conversely, knowledge, is not uniform for reasons of circumstance. On the flip side, ignorance as an active construct involves malicious or otherwise motivated actors that create situations of ignorance, the typical example being the tobacco industry and their introduction of doubt into the otherwise robust scientific link between smoking and cancer. It is this last form of ignorance, constructed ignorance, that is of particular relevance to the present discussion. Considering constructed ignorance prompts an analysis of the availability of information and the role it plays in shaping regulation. There is, however, the danger of falling into the trap of the malicious actor narrative, which David Magnus (2008), in his contribution to Proctor and Schiebinger's anthology on agnotology, describes in the following: "This story has now become so common that we know it by heart: industry and its political conservative allies oppose science-based regulation and support the creation of uncertainty to protect their interests" (p. 251). He then goes on to nuance this story through exploring the case of genetically engineered organisms in the US, showing how NGOs cited scientific uncertainty to keep them from entering the market in much the same way that industry use scientific uncertainty to keep a risky product on the market.

4 Empirical findings

This chapter presents my empirical findings around four key moments in the trajectory of microplastics through the EU regulatory environment. It begins with tracing the emergence of microplastics as an issue of concern on the EU policy stage (section 4.1). Section 4.2 focuses on two reports that were central in how microplastics came to be conceptualised in a manner unique to the regulatory environment. Specifically, three categories of microplastics are identified. One, intentionally added microplastics, such as microbeads in face wash, are regulated via the REACH regulation, and this is examined in section 4.3. Another, unintentionally released microplastics, a more ambiguous category which includes microplastic released from macroplastic components throughout their useful lifetime as well as plastic pellets, are addressed through a separate regulation, the development of which is traced in section 4.4.

4.1 Making microplastics an issue

Reports of microplastics have been present in scientific literature since the early 1970s (Buchanan, 1971; Carpenter & Smith, 1972; Carpenter et al., 1972). In 2004, Thompson, a British marine biologist, and colleagues coined the term ‘microplastics’ and called for more research on the topic, sparking an exponential increase in scientific publications on microplastics as well as greater public awareness of the issue, earning him the nickname ‘godfather of microplastics’ (Rochman, 2020; Bryce, 2023). Despite all this, microplastics only appears as an issue on the EU stage in 2013 with the publication of a green paper titled “On a European Strategy on Plastic Waste in the Environment” (EC, 2013) and a comprehensive approach to tackle microplastics is only outlined in 2018 with the Plastics Strategy (EC, 2018). It appears, then, that scientific recognition of the polluting and potentially harmful effects of microplastics were on their own not enough to mobilize European policy. This next section explores the various factors which came together to increase the salience of microplastics on the European stage. I will argue that public efforts to raise awareness around microbeads, policy developments within the European Commission, and pressure from the Member States came together synergistically, creating a ‘window of opportunity’ within which to take regulatory action on microplastics. While the Commission were instrumental in creating an environment in which microplastic policy could be readily addressed, the Member States played an active role in keeping the issue alive and the pressure on the European Commission.

In 2009, a year after sailing through the Great Pacific Garbage Patch, Anna Cummins and Marcus Eriksen founded 5 Gyres in the US, an institution which links research on plastic pollution with advocacy efforts (Dauvergne, 2018; 5 Gyres, n.d.). In Europe, the Plastic Soup Foundation was founded in 2011 in the Netherlands, which likewise played a key role in

pressuring industry, raising awareness amongst the public, and lobbying governments (Dauvergne, 2018). Both organisations initiated campaigns against microbeads—the Plastic Soup Foundation launched its 'Beat the Microbead' campaign in 2012 and 5 Gyres followed suit with their #BeadFree campaign in 2013—which led to several multinational companies including Unilever, Colgate-Palmolive, Johnson & Johnson, and Procter & Gamble to agree to phase out microplastics in their cosmetic products (Dauvergne, 2018; South Carolina Aquarium, 2016). In the US, the work of 5 Gyres led to several microplastic bans in 2014 at the state level before the Microbead-Free Waters Act, which bans the use of microbeads in rinse-off cosmetics, was passed at the federal level the following year (Anagnosti et al., 2021; FDA, 2022). The Beat the Microbead campaign also worked to raise public awareness of the issue, framing microbeads as toxic and pointless and developing an app that allowed consumers to scan products for microplastics (Dauvergne, 2018). Their work prompted other established environmental organisations such as Greenpeace, Flora and Fauna, and the Marine Conservation Society to campaign on microplastics as well (Dauvergne, 2018).

In as early as March 2013, the European Commission brought the topic of microplastic to the table with their green paper titled "On a European Strategy on Plastic Waste in the Environment". The paper was written up in the context of a review of waste regulation more generally, prompted by the Barroso Commission's Better Regulation agenda, which aimed to streamline existing EU legislation (Ponce Del Castillo, 2020). An example provided of microplastics in the report are those in "consumer products, such as scrub creams and shower gels" (EC, 2013, p. 14), suggesting the impact of the public campaigns. In June 2013, the Netherlands placed microplastics onto the agenda of the quarterly meeting of the Environmental Council (Council of the EU, 2013), which brings together the environmental ministers from the different Member States (Consilium, 2024). In their memo, they cite the European Commission's green paper and call for policy that looks at the different sources of microplastics, although they specifically suggest a ban on microplastics in cosmetics, given that several companies had already committed to removing them from their products on a voluntary basis. In December 2014, the Netherlands, along with Belgium, Austria, and Sweden raised the issue a second time (Council of the EU, 2014). Again, the note refers to the green paper and the voluntary initiatives by cosmetics companies, even citing the website of the Beat the Microbead campaign. They also acknowledge the forthcoming revision to the Ecolabel criteria (Commission Decision 2014/893/EU) which would no longer allow rinse-off cosmetics containing microplastics to receive the label. While the documents introduced thus far framed microplastics largely as an environmental problem, this second note introduced another line of argumentation: that failing to regulate microplastics also poses a threat to economic competitiveness. The note suggests tackling microplastics through the 7th

Environmental Action Programme which encourages the designing of more sustainable products in order to “strengthen the EU’s resource-efficient, green and competitive economy” (Council of the EU, 2014, p. 3). Furthermore, the note suggests that so long as microplastic containing products remain on the market, the playing field is not level as sustainable products may be at a disadvantage. To prevent such a situation, the four Member States proposed a ban on microplastics in cosmetics and detergents. Despite several actors raising the issue of microplastics at the EU level, in their Circular Economy Action Plan published in 2015, the European Commission, while identifying plastics as a “priority area” (EC, 2015b, p. 13) and committing to preparing a strategy on plastics, does not specifically mention microplastics. In a report published in early 2016, the Swedish Chemicals Agency (KEMI) described their impression that “the European Commission has little interest in this issue” (KEMI, 2016, p. 9), given their lack of action following the notes sent to the Environmental Council.

In its response to the Circular Economy Action Plan, the Council “CALLS upon the Commission to propose robust measures to reduce discharge of macro- and micro-sized plastic debris in the marine environment …, including a proposal for a ban on micro-plastic particles in cosmetics, and proposals to address other products generating marine litter as appropriate” (Council of the EU, 2016, p. 9). Shortly thereafter, the European Commission (2016) published a communication titled “International ocean governance: an agenda for the future of our oceans”. They specifically mention microplastics, committing to reducing the volume of microplastics in the marine environment, suggesting they have taken on board the Council’s recommendations. In May 2017, an amendment was made to the Marine Strategy Framework Directive (MSFD), requiring Member States to report on the presence of microplastics in their marine environments (Commission Decision (EU) 2017/848). Two reports on microplastics were contracted by the Directorate-General for the Environment, complied by external parties (under framework contracts), and published in the following years: “Intentionally added microplastics in products” (Scudo et al., 2017) and “Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products” (Hann et al., 2018). Both reports describe the other as a parallel report, likely as their scope is complementary and because they were written on similar timelines. The Plastics Strategy, published in January 2018, marks the first time the European Commission discuses microplastics in an explicit and extended manner. In it, microplastics are problematized as both an environmental issue, posing a threat to the marine environment and potentially to human health as well, and an economic issue, threatening the single market and encouraging the development of innovative solutions. A policy officer from within the European Commission identified several of these events in his narration of the development of microplastics policy (P1, 2024). Although he only started working on the topic of plastics

with the Plastics Strategy, he recalled earlier work done on microplastics, such as the initial stages of considering the restriction of microplastics under the REACH regulation as well as research on microplastics in the marine environment. However, he emphasised how the Plastics Strategy marked the first policy efforts targeted at microplastics. As an extension of the Circular Economy Action Plan, the Plastics Strategy deals with how to recycle plastics as well as reduce plastic waste; it is within this latter objective that microplastics policy is situated.

Table 2: Timeline of early policy documents related to microplastics

Date	Document
Mar 2013	Green paper “On a European Strategy on Plastic Waste in the Environment” (EC, 2013)
Jun 2013	Note “Micro-plastic litter: a growing environmental problem” (Council of the EU, 2013)
Jul 2014	Communication “Towards a circular economy: A zero waste programme for Europe” (EC, 2014)
Dec 2014	Note “Elimination of micro-plastics in products - an urgent need” (Council of the EU, 2014)
Dec 2014	Commission Decision 2014/893/EU of 9 December 2014 establishing the ecological criteria for the award of the EU Ecolabel for rinse-off cosmetic products (Revision to Ecolabel criteria)
Dec 2015	Communication “Towards a circular economy: A zero waste programme for Europe” (Circular Economy Action Plan) (EC, 2015b)
Jan 2016	Report “Proposal for a national ban on microbeads in cosmetic products” (KEMI, 2016)
Jun 2016	Council conclusions on the Circular Economy Action Plan (Council of the EU, 2016)
Nov 2016	Communication “International ocean governance: an agenda for the future of our oceans” (EC, 2016)
May 2017	Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU (Update to MSFD)
Oct 2017	Report “Intentionally added microplastics in products” (commissioned in 2016) (Scudo et al., 2017)
Nov 2017	EC request to the ECHA to prepare REACH restriction report for microplastics (Pettinelli & Sadauskas, 2017)
Jan 2018	Communication “On a European Strategy on Plastic Waste in the Environment” (Plastics Strategy) (EC, 2018)
Feb 2018	Report “Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products” (commissioned in 2017) (Hann et al., 2018)

Multiple observations can be made from this brief history. Firstly, public concern for microbeads was instrumental in initiating action within the EU on the issue of microplastics, evident from the early focus on microplastics in cosmetic products and calls to ban them.

However, the crystallisation of microplastics as an issue cannot solely be attributed to the activists; it involved a much larger cast of actors, crucially, the European Commission and Member States, whose actions built off one another. Both notes to the Environmental Council referenced Commission documents, i.e. the green paper and the revision to the Ecolabel criteria. Likewise, Member States responded to the lack of regulatory action on microplastics on the part of the Commission by responding formally, as the Council, to the Circular Economy Action Plan. Several Member States (Finland, France, Ireland, Luxemburg, Sweden, the United Kingdom, Belgium, and Italy) publicized their intention of introducing national bans on intentionally added microplastics in 2017 (Dauvergne, 2018; Kentin & Kaarto, 2018), signalling their dissatisfaction with the pace of microplastic regulation on the EU level. On the flip side, the Commission signalled their acknowledgement of the issue by updating the Ecolabel criteria, taking up the Council's call publication with the promise in their communication on international ocean governance to include microplastics in their forthcoming Plastics Strategy, and including microplastics as a category of marine litter under the MSFD, as proposed by the Netherlands in note to the Environmental Council. Secondly, it is clear that as the topic of microplastics was taken up in EU policy, it was transformed from being an environmental issue into being an economic one as well. This is visible in the second note to the Environmental Council, where the state of microplastics policy at the time was described as harming EU competitiveness by failing to incentivize innovative solutions to microplastic pollution (Council of the EU, 2014). Indirectly as well, several Member States started introducing national level bans on microbeads, threatening the European single market. The importance of these two moves on the part of the Member States is demonstrated in the Plastics Strategy, in which the Commission, in what appears almost as a direct reply to the Member States, describes the microplastic issue as an opportunity for innovative solutions and expresses concern for "fragmentation in the single market" (EC, 2018, p. 13). Finally, while microplastics had been formally discussed within the EU since 2013, it was only when taken up in the folds of the Circular Economy Action Plan and understood as part of its broader mission that the topic of microplastics gained traction and steps were taking to develop targeted regulation around them. Prior to that, some legislative action had taken place—revisions to the Ecodesign label criteria and the specifications of marine litter in the MSFD—but both were relatively minor and neither had microplastics as its focus.

A European Commission policy officer identified similar elements in the development of plastics more generally as a policy issue, noting how "the factors come together and you have a window of opportunity" (P1, 2024). These factors he distinguished between those inside the Commission and those external to it. Within the Commission, plastics emerged as an issue within the context of marine and waste policy. In marine policy, marine litter, predominantly

plastic, was the dominant issue at the time, while in waste policy, plastics was identified as a gap that needed to be addressed. The policy officer also mentioned Janez Potočnik, the European Commissioner for Environment under the second Barroso Commission (2009-2014), who was instrumental in implementing strategies that "link[ed] economy and environment to get on the wider policy agenda, and not just only on the environmental agenda" (P1, 2024), starting with the communication "Roadmap to a Resource Efficient Europe" (EC, 2011) and followed by the Circular Economy Action Plan (EC, 2015b), which he described as "the narrative that is really working" (P1, 2024). While "plastics was already a little bit there" (P1, 2024) prior to the introduction of the notion of the circular economy, it was only when considered within its scope that it was considered "a massive problem of waste of plastics" (P1, 2024) and a commitment was made to preparing the Plastics Strategy. In terms of factors from outside of the Commission, he spoke of how the media pushed people to take grassroots action, specifically referencing pictures of marine litter on the internet and the documentary series Blue Planet[1]; how NGOs working on plastics banded together to from the Rethink Plastic Alliance; and how "in capitals these things start to move" (P1, 2024). These factors, while demarcated between those external and internal to the Commission, are nonetheless acknowledged as reinforcing one another: "so they [Member States] start sending signals to Brussels … and Brussels sent the signal already with the Plastics Strategy that we are working upon" (P1, 2024). It is this simultaneously action on the part of multiple different actors and their interaction with each other that the policy officer describes as the "window of opportunity" (P1, 2024).

Despite the fact that the policy officer is describing how plastics became an issue in the EU, similar dynamics appear to be at play as to those identified in the problematization of microplastics. Firstly, cast of actors is largely the same. The Rethink Plastic Alliance is mentioned as an actor in the problematization of plastics just as the Plastic Soup Foundation and other environmental organisations were central in initiating the conversation around microplastics. The policy officer also mentions the back-and-forth interaction between 'Brussels' and the 'capitals' that that likewise took place within the microplastic documents. Furthermore, as in the case of microplastics, while regulatory initiatives involving plastics did pre-exist the Circular Economy Action Plan, it was only within the context of the plan that plastics regulation gained traction. This the policy officer attributes to the ability of the circular

[1] The documentary series Blue Planet II, narrated by Sir David Attenborough brought widespread attention to the effects of anthropogenic pollution on the marine environment, among these, plastic pollution. It was thought to have brought about a chance in plastic consumption habits, a phenomenon which was named the 'Blue Planet effect', and while environmental knowledge was shown to have increased as a result, no significant behaviour change has been identified (Farrelly et al., 2021; Dunn et al., 2020).

economy narrative to push forward efforts on environmental issues by linking them up with economic concerns.

Echoing the words of the policy officer, Kovacic et al. (2020) argue that the concept of the circular economy, through weaving together environmental concerns with economic ones, was a way to get environmental issues back onto the political agenda in the wake of the 2008–2009 financial crisis. This connection became even more pronounced with the change in Commission President in 2014. The Juncker Commission primarily concerned itself with economic issues and therefore originally scrapped the initial circular economy policy (EC, 2014). Following backlash, it was reinstated, but in a heavily revised form (EC, 2015b) which emphasised the economic benefits to be accrued from transitioning towards a more circular economy. The first communication promised economic growth without increased resource consumption while acknowledging that significant environmental developments would negate any economic savings. With the second Communication on the circular economy, Kovacic et al. (2020) observe a shift from environmental policy being done through appeals to economic growth to economic growth achieved through ostensibly environmental policy. By framing the transition towards a circular economy as an opportunity for growth and competitiveness, the Commission is able to circumvent the "political dead end of environmental limits to growth" (Kovacic et a., 2020, p. 41). In the case of both plastics and microplastics policy, the circular economy narrative was a catalyst for regulatory action. In the process, however, they become reconfigured as more than simply environmental issues. For microplastics, they become framed as a threat to the European single market as well as an opportunity to develop new solutions. This problematization then constraints what types of regulatory actions are imaginable. As we will see, while the EU has taken steps in introducing controls for microplastics, these are never at the expense of the health of European industry.

Tracing the emergence of microplastics as an issue has demonstrated that the story is a complex one. Crucially, it was as a process that involved a diverse group of actors, including the scientists who first published on the matter, activist organisations who drew public attention to microbeads in the environment, the Member States who from early on brough the issue to the table, and the European Commission, with the power to draft policy and regulation. Regulation on microplastics only started to gain ground following the publication of the Plastics Strategy in 2016, which, in reframing microplastics as a source of innovation and threat to the single market as well as an environmental risk, transformed the microplastics issue into something worth regulating. In this way, it was the concerns of multiple actors coming together in a synergistic way that opened the 'window of opportunity' for microplastics to be taken up on the regulatory level.

4.2 Three categories of microplastics and their key sources

Once problematized, an issue still needs to be moulded in certain ways such that regulatory tools can address it. This next section looks at how microplastics were transformed from being an issue to be handled to target of regulator initiatives. One main mechanism was to organise microplastics into different categories, each with an associated form of regulation. These categories are not based on properties inherent to microplastics but emerge in conjunction with the possible regulatory pathways available to control them. Through their repetition in various documents, they have become part of the institutional language of speaking about microplastics. Furthermore, key sources came to be associated with these categories. Central in this regard were two reports requested by the European Commission in order to inform their future policymaking. The prominence given to these sources led to the preferential consideration of policies targeting them, as opposed to more overarching measures that target microplastics no matter their origin, as well as product specific policies being developed for the sources identified at the expense of others. As we will see, the key sources were arrived at through a series of steps in which filters and rankings determined which sources would receive further consideration.

4.2.1 Categories of microplastics and their emergence

In scientific literature, microplastics are considered either primary or secondary (Song et al., 2024). Primary microplastics are plastics that start as microplastics, while secondary microplastics are a result of the breakdown of larger plastics. However, in EU policy, microplastics are more commonly considered one of three types (e.g., EC DG ENG, 2023):

(1) intentionally added microplastics, or primary microplastics with the exception of plastic pellets (the raw material used to manufacture plastic components);
(2) unintentionally released microplastics, which includes secondary microplastics released during the use phase of a plastic product and plastic pellets; and
(3) microplastics due to the breakdown of plastic waste, which are also a type of secondary microplastics.

While the last two categories are similar in that they both involve secondary microplastics, their difference lies whether the microplastics were generated before or after the useful lifetime of the plastic component from which it originated. Microplastics that are released through the friction of tyres with the road would be considered unintentionally released, as the macroplastic component, the tyre, is still in its use phase. On the other hand, microplastics created from fishing gear lost at sea would be considered microplastic due to the breakdown of plastic waste as the macroplastic component, the fishing gear, is already a waste product. Figure 1 below illustrates the contribution of each category of microplastic to overall microplastic pollution,

with microplastics that are generated from plastic waste contributing the greatest amount by far, followed by unintentionally released, then intentionally added microplastics.

Figure 1: Contribution of each category to total mass of microplastics in the environment (ECHA, 2019a; Hann et al., 2018; Scudo et al., 2017)

Laurent (2022) observes how "when regulators, company directors, and expert talk about regulatory categories, … they attempt to craft an entity that could provide meaningful ways of regulatory action" (p. 10). As we will see, this is certainly also the case for the three microplastic categories presented above, as by creating these categories, it becomes possible to target each with a different regulatory mechanism in a way that using the categories of primary and secondary microplastics would not.

Attempts at classifying microplastics are present from the very first Commission document touching upon microplastics. In the green paper, two types of microplastics are identified: “virgin micro-plastics” (EC, 2013, p. 14), included in consumer products such as scrub creams and shower gels, and those that arise due to degradation and abrasion. These categories are largely similar to the distinction made in science between primary and secondary microplastics, respectively. The note from the Netherlands to the Environmental Council similarly describes two different kinds of microplastics—“micro-plastics which are increasingly being used in industry, household products and cosmetics (e.g. scrubs or toothpaste)” and “plastic waste from land- and sea-based sources that degrades into smaller particles” (Council of the EU, 2013, p. 2)—although here the descriptions do not correspond to primary and secondary microplastics, but rather the intentionally added microplastics and microplastic from macroplastic waste, respectively. The two kinds of microplastics are listed as individual bullet

points, suggesting they are distinct from each other. In the combined note from Belgium, the Netherlands, Austria, and Sweden, the categories are likewise presented in bullet points. However, this time, there are three bullet points, listing microplastics that are “intentionally added to products”, “synthetic fibres from textiles” and microplastics generated by “the break-down of larger plastic materials” (Council of the EU, 2014, p. 2). The first bullet point clearly matches up with the category of intentionally added microplastics. While the second bullet point, synthetic fibres, is more of an example than a category, it is an example of an unintentionally released microplastics (as the fibres are released while the product is in use). The final bullet point describes secondary microplastics. Thus far, there are attempts to categorise microplastics in a meaningful way, but there no schema has yet been arrived at. Nevertheless, early precursors to the regulatory categories identified early can be seen.

Prior to the publication of the Plastics Strategy, two exploratory reports were requested by the European Commission: “Intentionally added microplastics in products”, compiled by the UK-based consultancy group Amec Foster Wheeler (hereby the AMF report) (Scudo et al., 2017) and “Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products”, compiled by the similarly UK-based consulting group Eunomia (hereby the Eunomia report) (Hann et al., 2018). In demarcating their scope, both reports refine the early attempts at classification introduced in the previous documents. The AMF report identifies the three different categories of microplastics described in the second note and indicates that it only concerns itself with intentionally added microplastics:

> This report concerns microplastics that are intentionally added to products …. there are various other sources such as fragmenting from larger pieces of plastic, or generated from sources such as fibres from washing clothes. These other sources are not covered in the present study but are covered in a parallel [Eunomia] study. (Scudo et al., 2017, p. 6)

The Eunomia report, published following the AMF one, provides some more clarity. It deals with “microplastics that are created during the lifecycle of a product through wear and tear or emitted through accidental spills”, but not with intentionally added microplastics, as these are covered by the AMF study, or “microplastics that may be generated as a result of poor or non-existent waste management or as a result of the degradation of larger plastic waste” (Hann et al., 2018, p. 2). It is at this point that we are finally arrive at the three regulatory categories of microplastics.

Furthermore, in the Eunomia report, each category has been linked to a course of action, or at least an actor responsible for proposing policy recommendations. Intentionally added

microplastics are under the domain of the AMF report, which has been prepared with the intention of informing future regulatory action. This is envisioned either as a restriction under the REACH regulation or an independent regulation, although the former seems more probable, given that it performs its risk assessment in line with the standards required for the REACH restriction report and that the report is primarily concerned with assessing the technical and economic viability of banning microplastics as opposed to considering other modes of action. Unintentionally released microplastics are the responsibility of the Eunomia report, which ultimately proposes various policy actions to address them. Lastly, the microplastics due to the breakdown of plastic waste is viewed as an issue that can be tackled upstream before macroplastics break down into microplastics and therefore addressed through plastic (as opposed to microplastic) regulation. This clearly, then, is an example of how categories in the policy context arise such that regulatory action can follow (Laurent, 2022). While the green paper only identified two types of microplastics consistent with the scientific classification, the three categories explored above—intentionally added, unintentionally released, and produced through the degradation of larger plastic debris—were the dominant form of categorisation taking place in the two consultancy reports. While the terms primary and secondary were used, they appeared only seldomly. A transition can therefore be observed of microplastics as a scientific object to a regulatory one.

4.2.2 Key sources of intentionally added and unintentionally released microplastics

In both reports, one of the main exercises was identifying the key sources for each category of microplastic. In doing so, certain sources of microplastics became key exemplars for the two categories. For intentionally added microplastics, this was personal care products, detergents, paints, abrasives, and agricultural applications, while for unintentionally released microplastics, this was plastic pellets, tyre wear particles, and synthetic fibres from textiles. In this section, I will detail how this simplification took place through the use of filters and rankings. In the AMF report on intentionally added microplastics, the availability of data played a key role, while in the Eunomia report on unintentionally released microplastics, whether they contributed to marine pollution played a decisive factor. Microplastics for which information was not readily available or those which were primarily emitted to non-marine environments were therefore dropped from consideration. Furthermore, plastic pellets and the rubber filling for sports pitches being considered intentionally added, they were both considered in the Eunomia report with other unintentionally released microplastics. This was likely due to the desire to regulate them no via a ban, as with other intentionally added microplastics, but by means of product-specific measures, the impact being that several unintentionally released microplastics received less attention than they would have otherwise.

Based on a review of the existing literature at the time, the AMF report (Scudo et al., 2017) compiled a list of all identified sources of intentionally added microplastics. However, as the report progresses, some applications become more prominent while others are forgotten due to reasons of study design and data availability. In order to conduct a risk assessment of intentionally added microplastics, there is a need to first estimate the quantity of them being released. To this end, industry was consulted. As the literature review and market analysis were conducted in parallel, however, some sources were only identified only after industry had already been consulted. The effect of this study design is visible in the discrepancy in sources considered in the column 'Literature review' and 'Market analysis' in Table 3 below: microplastics arising from wastewater treatment and adhesives and sealants were not explored during industry consultation. There were also omissions of the type not visible in the table, i.e. while a certain sector was consulted, they were not asked about all sources of microplastics, e.g., microplastics used for insulation in the construction industry were considering during market analysis, but those used for concrete were not. Data on annual microplastic use was therefore complied from both industry consultation the literature review. However, figures were not obtained for all applications considered. In some cases, applications were quantified, but in a narrower way, e.g. only industrial abrasives used in sandblasting were considered and not those used in all industrial settings. In other cases, no quantitative data was available for microplastics use. This was the case for microplastics used in furniture, oil and gas, agricultural, pharmaceuticals, and water. For the latter three applications, industry claimed microplastic use was not significant. As part of the risk assessment, release volumes to various environmental compartments were calculated; for sources where pollution was considered significant but where data was incomplete or unavailable, estimates for the worst-case scenario were used. The results of this assessment then identified detergents, paints, abrasives, and agriculture as contributing the most to the presence of intentionally added microplastics in the environment. These applications were those that were further assessed for the socioeconomic feasibility of banning microplastics. Here we see how filters and rankings are used in conjunction to arrive at the final key sources. Data availability acted as a filter by eliminating several sources from the quantitative analysis due to the lack of data, while the final sources identified are those that rank the highest in terms of environmental emissions, although the ranking relied heavily on estimations. In this way, the AMF report associates intentionally added microplastics with these specific applications.

Table 3: Sources of intentionally added microplastics considered at different points in the AMF report (Scudo et al., 2017)

Literature review	Market analysis	Sources quantified	Further analysed
Cosmetics and personal care products	Personal care products	Personal care	Personal care products
Detergents	Detergents	Detergents	Detergents
Paints/coatings/inks	Paints/coatings	Paints and coatings	Paints
Industrial abrasives	Industrial abrasives	Abrasives	Abrasives
Agriculture	Agriculture	Agriculture	Agriculture
Medical applications	Dental polish	Pharmaceutical industry	
Waste water treatment		Water	
Construction	EPS in insulation*		
Furniture/soft toys	EPS in furniture		
Adhesives and sealants			
Oil and gas	Oil and gas	Oil and gas	

*The expanded polystyrene (EPS) used in construction are in the form of blocks and are therefore not considered microplastics.

Following how the key sources of intentionally added microplastics were developed throughout the report points to elements of ignorance. While a wide variety of microplastics are identified via the literature, study design features some at the expense of others. This can be understood as an example of ignorance as an elective choice, a form of ignorance that arises out of existing structures without obvious malicious intent (Proctor, 2008). Similarly, while quantities in the environment are used as a measure by which to determine which sources to focus on, this is largely reliant on data provided by industry, who aren't incentivised to provide this data freely. Why would industry admit to the scale of the microplastics problem if doing so will introduce legislative constraints on their business operations? Here we see a form of ignorance as a strategic ploy, where ignorance is employed as a tool in order to advance one's own goals (Proctor, 2008). The interviewed policy officer also mentions this line of thought in describing the role of industry in the Call for Evidence process where the European Commission requests data on policy issues from various stakeholders: "businesses can send evidence as well but on the environmental files they will rarely do because it's often against their own business" (P1, 2024). That is, "unless they have a solution for something which might happen so it's then kind of against their competitors" (P1, 2024). Here we can see how actors can both strategically withhold and release information in order to shape policy developments in the way that best suits them. Boudia et al. (2021) likewise describes the asymmetry of information when industry submits a registration application for a chemical that

is subsequently evaluated by REACH. While this may be the case when registering a new chemical, this is not necessarily the case in a REACH restriction, where it is in the interest of industry to disclose information such that exemptions from a blanket ban might be granted. This is something that the policy officer also alludes to: “Businesses do have interest to reply and to work with us because if they don’t give us the best information they have, we will still continue. We will have to base our thing on secondary best information or tertiary best information and our analysis might be wrong, or solutions might be wrong, and businesses might be much worse off than with the best information available” (P1, 2024). While the AMF report is very much oriented toward a restriction under the REACH regulation, it is still an exploratory investigation and so the balance seems still to be in favour of disclosing less information.

As in the AMF report, certain types of unintentionally released microplastics became key exemplars in the Eunomia report (Hann et al., 2018). While data (un)availability was a central force guiding which sources of intentionally added microplastics ultimately became the key exemplars, in the case of unintentionally released microplastics, filters and rankings, specifically related to the environmental compartment to which the microplastic pollution contributed, played a more prominent role. Starting from a long list of all sources identified in literature, a shortlist of nine sources was them made based on what were “thought to be the largest sources that are within scope of this project” (Hann et al., 2018, p. 10). Those were not carried over from the full list were excluded from the short list for several reasons. One was the distinction between ‘intentionally added’ and ‘created during use’. While straightforward in theory, assigning different sources of microplastics to one category or the other was not so easy. Some categories, such as agriculture, use microplastics that are both intentionally added (fertilisers) and created during use (films). Furthermore, the status of microplastics released from paints depends on whether it was released from the paint matrix before or after it has dried. Furthermore, the scope of Eunomia’s report was unintentionally released microplastics; nonetheless, there were also types of microplastics considered intentionally added, i.e. not in the Eunomia’s scope, which nonetheless were included in the short list, infill material for artificial turf and pre-production plastic pellets, the reason given being that Eunomia has expertise in those areas. While what exactly is meant by ‘Eunomia’s expertise’ is not specified, it is possible that it has less to do with expertise in specific sectors, i.e. synthetic turf and plastic pellets, and more to do with their competence in articulating problems and developing targeted policies to address them. For these applications, perhaps it was more desirable to develop product specific policy rather than subjecting them to the REACH restriction as with all other intentionally added microplastics. This is especially the case for plastic pellets, the raw ingredient for the manufacturing of plastic components, as banning them outright would put a

halt to the entire plastics industry. Additionally, sources were considered based on their environmental endpoint. The Eunomia report is titled “Investigating options for reducing release in the aquatic environment of microplastics emitted by (but to intentionally added in) products”, following the dominant framing of microplastics as a marine pollutant at the time. It is with this end point in mind that agricultural films, which primarily release microplastics to the terrestrial environment, are not given further treatment in the report, despite being considered as a possible significance source of unintentionally released microplastics. Lastly, several uses (non-clothing textiles such as cleaning cloths and carpets, kitchen utensil, shoe sole wear, building wear) were excluded due to lack of data and presumed limited contribution to microplastic pollution in the environment. The story is thus more complex in the case of unintentionally released microplastics as a number of factors—the need for product-specific policy, relevance to the marine environment, and assumed insignificance—combine together to yield the sources on the short list. EU-level estimates were then gathered for the aforementioned applications and six “problem drivers” (Hann et al., 2018, p. 47) were identified based on their contribution to microplastics emitted to surface waters. While fishing gear was quantified as being the sixth highest emitter, artificial turf was selected as the sixth problem driver, citing the projected increase in microplastic emissions over the next ten years as well as a few pitches being responsible for the majority of the microplastics released. A long list of measures was draw up for each of the six problem drivers, but followings several rounds of screening, only measures pertaining to plastic pellets, tyre wear, and synthetic clothing remained. For paints and coatings and artificial turf, lack of knowledge was cited as a barrier to proposing policy options.

While data availability was a determining factor in identifying the key sources of intentionally added microplastics in the AMF report, it was the focus of the Eunomia report on the marine environment that shaped to a significant degree the sources of unintentionally released microplastics ultimately identified. Sources were not only filtered by their contribution to marine microplastics but ranked by this criterion as well. In addition to the marine framing, the lack of data appeared again as a factor influencing the sources considered significant and the policy options that could be proposed. While the data for the Eunomia report drew on existing reports rather than industry consultation, this nonetheless prompts a consideration of why data sources of unintentionally released microplastics deemed significant is lacking. There were two sources of microplastics that were included in the Eunomia report on unintentionally released microplastics despite being intentionally added. This suggests strong interest in regulating these sources of microplastics not via restriction, as is the case for other intentionally added microplastics, but through targeted policies. On the flip side, these sources taking two of the top six positions of unintentionally released microplastics to the marine

environment also means that sources which would otherwise have been covered in the report—fishing gear and automotive brake dust—were pushed aside.

Table 4: Sources of unintentionally released microplastics considered at various points in the Eunomia report (Hann et al., 2018)

Long list	Problem definition	Problem drivers	Policy options
Artificial turf	Artificial sports turf	Artificial turf	
Vehicles	Automotive tyres Automotive brake dust	Automotive tyre wear	Automotive tyres
Synthetic textiles	Synthetic clothing	Synthetic clothing	Textiles
Pre-production plastics	Pre-production plastics	Pre-production plastic pellets	Pre-production plastics
Oil and gas			
Agriculture*			
Paints/coatings	Building paints Maine paints Road markings	Road markings Building paint	
Personal care products			
Detergents			
Marine	Fishing and aquaculture		
Industrial abrasives			
Others (shoe sole wear, kitchen utensils, buildings, indoor dust)			

*Terrestrial source, pathways to water not well established

In sum, both reports, through the use of filters and rankings, identified key sources of microplastics that emerged as exemplars for the categories to which they belong. In the case of intentionally added microplastics, lack of data, whether due to study design or industry cooperation, had a hand in deciding which sources became more prominent. In addition to the lack of data, whether a given source of microplastics contributed to marine pollution contributed to which sources of unintentionally released microplastics were the focus of the proposed policy options. This meant that sources for which information was not readily available as well as sources of unintentionally released microplastics contribution to pollution in other environmental compartments remained largely out of sight. Furthermore, the decision to include plastic pellets and artificial turf in the report on unintentionally released microplastics meant that true unintentionally released microplastics received less attention, a convenient fact considering that intentionally added microplastics are easier to regulate but contribute significantly less to pollution than unintentionally released microplastics. Which key sources

are associated with these two categories of microplastics is relevant as how issues are problematized subsequently determine the range of solutions that are considered.

I started this section with the claim that categories allow for meaningful regulatory action. How do the consultancy reports envision this? As we saw earlier, the Council, in requesting the Commission to take action on microplastics, suggested “a proposal for a ban on micro-plastic particles in cosmetics, and proposals to address other products generating marine litter as appropriate” (Council of the EU, 2016, p. 9). The two reports seem to follow this call directly. While the AMF report does not explicitly recommend a course of action, it is oriented towards a restriction proposal under the REACH regulation. Not only is the entire report is structured around assessing the technical and economic feasibility of banning intentionally added microplastics, but the risk assessment is conducted in line with how the ECHA would require it to be performed for a restriction proposal. Other regulatory pathways, i.e. filtration at wastewater treatment, is only considered briefly at the end of the report and swiftly rejected for two reasons. Firstly, filtering out microplastics at wastewater treatment plants were assessed as being only a partial solution as it would only capture microplastic that enter the environment through wastewater streams. Secondly, it would cost several to tens of billions of Euros annually and therefore not be proportional to the risk posed by microbeads. In the case of unintentionally released microplastics, while the Council proposes product-specific policy, the Eunomia report considers downstream measures (capture at roads, capture at the wastewater treatment facility) from an early point in their assessment. Interestingly, the Eunomia report, although dealing with a different sort of microplastics, arrive at the same conclusion: reduction measures at the source are both more effective in reducing microplastic emissions and cheaper than interventions downstream. As such, they propose interventions that target objects, specifically plastic pellets, tyres, and textiles: pellet supply chain accreditation, tyre abrasion threshold and labelling, and textiles threshold and certification. While supply chain accreditation is anticipated to reduce emissions to surface waters by 55%, the other two measures capture a much lower percentage of emissions, leading the report suggest complementary downstream measures, i.e. storm water drains and washing machine filters, respectively, which while being more expensive solutions, are nonetheless less costly than upgrading wastewater treatment plans to capture microplastics. This is even more so the case when considering that the implementation of upstream interventions reducing the cost effectiveness of the measure. Another concern raised for filters at the wastewater treatment plan was the possibility that the microplastics captured in the sludge will find their way back into the environment as it is applied as fertilizer to land. In this way, we see how the categories of intentionally added and unintentionally released microplastics can be considered regulatory categories as both are linked to specific course of action: restriction under the REACH

regulation in the case of the former and product-specific measures in the case of the latter. The key sources of microplastics that the Eunomia report links to the category of unintentionally released microplastic can also be considered a sort of regulatory category in that it is for the key sources identified that policy measures are drafted and proposed. Of the top three sources of evaluated, plastic pellets are not unintentionally released at all, leaving regulation on unintentionally released microplastics underdeveloped. Furthermore, the emphasis that both reports place on the sources of microplastic pollution prime them to preferentially consider piecemeal regulatory measures that target these sources while rejecting more overarching measures.

4.2.3 Refinement and rehearsal

The Plastics Strategy was the first major European Commission communication following the publication of the consultancy reports and their influence is clearly visible in the categories they use, the examples they employ, and the actions they advocate for. The Plastics Strategy differentiates between microplastics that "result from the fragmentation of larger pieces of plastic waste" (EC, 2018, p. 4) as well as those that "intentionally added to certain product categories (such as cosmetics, detergents, paints), dispersed during the production, transport and use of plastic pellets, or generated through wear and tear of products such as tyres, paints and synthetic clothes" (EC, 2018, p. 13). That plastic pellets are seen as its own category reflects how its regulatory status is ambivalent. In the quotes above, it can be seen that not only are the categories transported from the consultancy reports, but the quintessential applications are as well. The regulatory suggestions put forth in the Plastics Strategy also mirror those proposed by the consultancy reports: restriction under the REACH regulation for intentionally added microplastics as well as "measures such as labelling and specific requirements for tyres, better information and minimum requirements on the release of microfibers from textiles, as well as measures to reduce plastic pellet losses" (EC, 2018, p. 13).

As we have seen, in the consultancy reports, although plastic pellets and artificial turf were considered intentionally added, they were dealt with by the Eunomia report, which otherwise focused on microplastics created during use. Plastic pellets were identified as the top contributor to marine pollution in the report, so in order to speak about the results, the Eunomia report and the Plastics Strategy discuss this category of microplastics as those arising from abrasion and accidental spills/plastic pellet loss, pointing to the contradiction. Artificial turf is not included in these descriptions as they were not identified as a key exemplar in the Eunomia report. In the REACH restriction, both infill material and plastic pellets are considered intentionally added, but the former is included while the latter is exempt (ECHA, 2019a). Until this point, plastic pellets occupy an ambiguous territory in that while they are considered

intentionally added, they are not subject to the same regulation. This tension is resolved in the Call for Evidence for the impact assessment to explore measures to combat this category of microplastics, which introduces a new language (EC, 2021c). Microplastic pollution from pellets losses and abrasion are called 'unintentionally released', while intentionally added microplastics are described as being regulated by the REACH restriction. This allows for plastic pellets to be subsumed with microplastics that results from abrasion while categorising artificial turf as intentionally added. I argue that the reason that plastic pellets are afforded this special treatment is much the same for why they were included in the Eunomia report: treating them the same as other sources of sources of intentionally added microplastics, i.e., removing them from the market, would cause a huge upset. While artificial turf was originally also provided this privilege, assessment performed in the course of drafting up the REACH restriction showed that restricting rubber infill material with a time delay was feasible (RAC, 2020; SEAC, 2020b). Here we can see how categories are not only developed to allow for each to be regulated, but existing regulatory mechanisms and how they can or cannot be applied to specific sources of microplastics has a say in what type of microplastic they will be categorised as. It is at this point that we have arrived at the three categories introduced at the beginning of this section.

The three regulatory categories introduced above appear time and time again in various Commission documents. Each rehearsal of these categories further embeds it into the institutional language. The most recent example is a 2023 report published by the European Commission titled "EU action against microplastics" (EC DG ENV, 2023) summarising the EU's initiatives on microplastics thus far. Key sources of microplastics are identified as the "unsustainable consumption and improper disposal of plastic products" (EC DG ENV, 2023, p. 6), "products with intentionally added microplastics", and "unintentional release of microplastics" (EC DG ENV, 2023, p. 8). Interestingly, however, new sources of microplastics emissions had been identified. For intentionally added microplastics, for example, in addition to the five sources considered in the AMF report, products from the oil and gas industry were also identified as a source of concern. Similarly, for unintentionally released microplastics, paints have risen to the status of top emitter and geotextiles and detergent capsules are new sources not previously considered. As we will see in one of the following sections, this was the result of research done by the Joint Research Council (JRC) in preparation for the regulation on unintentionally released microplastics. This is promising as while the consultancy reports did have considerable influence, they did not create a complete path dependency in the sense that sources dropped by the consultancy reports do still have the chance to return in the policy documents.

In this section, we have traced the development of the three categories of microplastics, looking at the various standardization practices that are employed in order to arrive at key sources for two of these categories. As we have seen, what categories and sources of microplastics are generated have implications for the regulatory solutions envisioned and vice versa, as regulatory options have likewise, although to a lesser extent played a role in categorising certain sources of microplastics. In the process, we have observed the difficulty of applying categories in practice as well as the role ignorance in directing the course of regulation development.

4.3 Regulating intentionally added microplastics

In the previous section, we saw how there are three broad categories of microplastics, each addressed by a different set of regulatory tools. Intentionally added microplastics and unintentionally released microplastics are targeted directly, while microplastics due to the breakdown of plastic debris is targeted through regulation that deals with plastic waste more generally, the logic being that reducing plastic waste overall will also reduce the microplastics being generated from them. When I speak of microplastics regulation, then, I specifically refer to those regulations that target intentionally added and unintentionally released microplastics. A restriction under the REACH regulation was used to target the intentionally added microplastics, a regulation which was passed in September 2023 (Commission Regulation (EU) 2023/2055). Efforts to regulate unintentionally released microplastic began with the intention of regulating several different sources but culminated in a single regulation on plastic pellets (EC, 2021c). This section will deal with the restriction of intentionally added microplastics and the next section will deal with the attempt to regulate unintentionally released microplastics. It will begin by providing an overview of the REACH restriction process (section 4.3.1) before exploring how delegating the drafting of the restriction proposal to the ECHA works to separate the political decision making from the technical standard writing (section 4.3.2) despite the fact that, as will be explored in section 4.3.5, various industrial actors assert their interests by means of technical process of the regulation writing. Another key theme in the regulation of intentionally added microplastics are the ways in which definitions (section 4.3.3) and categories (section 4.3.4) are utilized in order to mould microplastics into a regulatory object. This is done through defining the lower size limit of microplastics to a value that can be enforced and excluding sources of microplastics that do not contribute towards the microplastics problem from its regulatory definition as well as by differentiating microplastics by source into smaller categories so that they can be granted transition periods before the regulation comes into force or can be exempted from the regulation entirely. This practice of regulating microplastics, but nonetheless wielding regulatory power with restraint can be understood as regulatory precaution (Laurent, 2022).

4.3.1 The REACH regulation and the restriction process

The REACH regulation is the main piece of EU legislation which protects human health and the environment against the hazards posed by chemicals (EC, 2024; ECHA, n.d.-g). In addition, it aims to enhance the innovation and competitiveness of the chemicals industry (Regulation (EC) No 1907/2006). The REACH regulation also founded the European Chemicals Agency (ECHA) in order to carry out the tasks required regulate the chemicals (NSF, 2023). This involves registration, evaluation, authorisation, and restriction (EC, 2024; NSF, 2023; ITA, n.d.). Registration is necessary for all chemicals that are manufactured in/imported into the EU in quantities over one metric ton and involves preparing a technical dossier with its various properties, potential risks, and how they are managed. Evaluation involves assessing the quality of a selection of these dossiers. Authorisation ensures substances of very high concern are replace with less dangerous substances when economically and technically feasible. Finally, restriction allows those chemicals which are deemed as posing an unacceptable risk to the health or environment are restricted in their production, placing on the market, and/or use, either partially or completely.

The restriction procedure proceeds as follows (ECHA, n.d.-d). The procedure is initiated when an EU Member State or the ECHA, at the request of the EC, submits a restriction proposal for a substance they are concern poses an unacceptable risk to human health or the environment. The request for a restriction proposal was submitted in November 2017 following the publication of the AMF report in October 2017 and requests the “ECHA to develop an Annex XV dossier concerning the use of intentionally added microplastic particles to consumer or professional use products of any kind” (Pettinelli & Sadauskas, 2017, p. 2). The restriction proposal was published in August 2019 and consists of the entry which would be added to Annex XVII of REACH as well as the justification (ECHA, 2019a). Following the publication of the restriction proposal, interested parties have six months to comment on the restriction proposal (ECHA, n.d.-e). Interested parties include “companies, organisations representing industry or civil society, individual citizens, as well as public authorities” (ECHA, n.d.-c). The Forum for Exchange of Enforcement (Forum), a body of the ECHA also has the chance to contribute insights related to the enforceability of the proposed restriction. The Dossier Submitter then updates the proposed restriction, and it is on this that the Committee for Risk Assessment (RAC) and the Committee for Socio-economic Analysis (SEAC) develop an opinion. Within the restrictions process, the RAC is responsible for assessing whether a given proposal is appropriate for reducing the risk to human health and the environment (ECHA, n.d.-a). As its name suggests, the SEAC is responsible for evaluating the socio-economic impact of the proposed restriction (ECHA, n.d.-b). Interested parties then have a second chance to comment on the SEAC’s opinion before the two opinions are compiled and

submitted to the European Commission. Given that new revisions are suggested in the final SEAC opinion after the RAC opinion has already submitted, there are also provisions for an additional RAC assessment which is submitted to the European Commission with a delay. At the European Commission, the REACH committee discusses the proposal over a number of meetings before submitting their final proposal for legislative approval from the European Parliament and the Council. It is through this process that the proposed restriction is negotiated and transformed. Intentionally added microplastics were restricted under the REACH regulation in September 2023 (Commission Regulation (EU) 2023/2055).

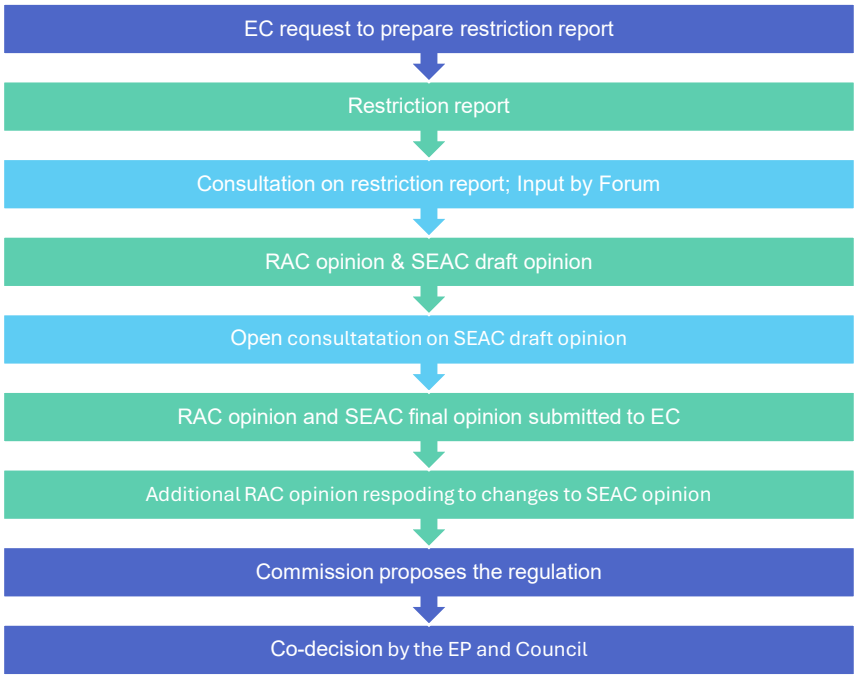

Figure 2: Flowchart of the REACH restriction process (ECHA, n.d.-e)

4.3.2 Protecting the European single market

Following the problematization of microplastics as an issue within the EU illustrated how what was primarily an environmental issue of pollution and toxicity was transformed into an economic threat. Having regulation that target individual sectors can create an uneven playing field and disincentivize sustainable innovation. Preventing microplastic leakage along the value chain and developing new solutions for preventing microplastic pollution both find a place within the notion of the circular economy. I have also argued that a major driver for the European Commission to take up the issue of microplastics was the possible threat to the European single market posed by national level bans on microplastics. This is increasingly clear in the request that the European Commission put in with the ECHA to prepare a restriction dossier on intentionally added microplastics, the initiating step of the restrictions process.

This potential fragmentation of the European single market is first raised expressed as a threat in the Commission's request to the ECHA to prepare the restriction proposal (Pettinelli & Sadauskas, 2017). While they lead their request with concerns about microplastics' risk to the marine environment, there is explicit mention of national bans posing a restriction to the free movement of chemicals. By restricting microplastics through REACH, all Member States would need to comply with the restriction, securing the free movement of goods. That such a statement is included in the request is not surprising as the aim of REACH is twofold: "The purpose of this Regulation is to ensure a high level of protection of human health and the environment … as well as the free circulation of substances on the internal market while enhancing competitiveness and innovation" (Regulation (EC) No 1907/2006). Even more strikingly, the citation, the section of EU legal text that states the legal basis for the piece of legislation (Publications Office, 2024), refers to Article 95 of the Treaty establishing the European Community (1992)[2], which deals with matters relating to the internal market. The economic aims behind REACH are therefore not only a goal in the abstract, but institutionalised through the legal provisions it draws upon. The presence of the motivation of harmonization behind the request is further present not only in the text of the document, but in the visual elements as well, specifically, the header and signature of the document. Both the header and signatures indicate the Commission Directorate-Generals involved in initiating the restriction of intentionally added microplastics under the REACH regulation: the Directorate-General for the Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) and the Directorate General for the Environment (DG ENV). This reflects the broader Commission structure as it relates to the REACH regulation. While the Directorate-General of the Environment has a 'Safe & Sustainable Chemicals' unit that concerns itself with the regulation of chemicals, the organisation unit responsible for the REACH regulation is located within the Directorate-General for the Internal Market, Industry, Entrepreneurship and SMEs (EU, n.d.-a ; EU, n.d.-b). Furthermore, the Safe & Sustainable Chemicals unit is located with the branch of the DG ENV responsible for the circular economy strategy, suggesting that their concerns are likewise intertwined with the health of the European economy (EU, n.d.-a; Kovacic et al., 2020).

That the European Commission delegates the work of drafting the restriction proposal to the ECHA is an example of what Barry (1994) calls 'the art of European government'—European institutions make the high-level decisions, then outsources them to various technical agencies. In the process, politics is scientized as political decision-making is translated into technical jargon, giving it the allure of objectivity (Barry, 1994). This transition can be witnessed in the

[2] Previously Article 100a in the Single European Act (1986); subsequently Article 114 in the Treat of the Functioning of the European Union (2007) (Boettner & Blanke, 2023)

documents as while the request makes explicit reference to the need to keep the internal market harmonized, the restriction proposal only does so once in order to justify the EU wide nature of the restriction, and even then, only as the additional point, the primary one being the cross-boundary nature of microplastics, both in terms of European supply chains as well as microplastic pollution (ECHA, 2019a). The bulk of the report is concerned with assessing the risk posed by microplastics and the social and economic impacts of their ban. However, this division obscures not only the central role that the restriction plays in bringing into being a technological zone (Barry, 2006) which, by creating uniform market conditions across the Member States, protects the European single market, but also the negotiations that take place as the details of the restrictions are fine-tuned.

4.3.3 Defining intentionally added microplastics

Section 4.2 explored the formation of three categories of microplastics such that each could be assigned a different form of regulatory action. Similarly, intentionally added microplastics are defined in such a way that they can be regulated. This is acknowledged from the earliest attempts to define intentionally added microplastics, with the AMF report and the restriction proposal speaking of needing to develop a “working definition” (Scudo et al., 2017, p. 12) and a “regulatory definition” (ECHA, 2019a, p. 27), respectively. In studying the definition of intentionally added microplastics as adopted in their restriction under the REACH regulation, two ways in which it takes on regulatory qualities becomes apparent: the first is how a lower limit for microplastics are adopted such that the regulation can be enforced, and the second is how certain types of microplastics are expected based on the fact that they are not envisioned as contributing to the so-called microplastic concern that the regulation is aimed at addressing.

The struggle to pin down an exact definition of intentionally added microplastics begins with the AMF report (Scudo et al., 2017). Having identified the need to produce a “reasonable definition” (Scudo et al., 2017, p. 2) in light of the fact that a standard one does not already exist, they adopt a “working definition” (Scudo et al., 2017, p. 12). Describing the definition as working implies it is open for change. This change can be a result of new scientific evidence that comes to light, but it could also be for more practical reasons. Throughout the report it is acknowledged at least on two occasions that this definition may need to be modified in order to make it operable. In the first instance, several organisations who had been asked to provide figures based on the working definition of microplastics deemed it as being “too broad to be workable” (Scudo et al., 2017, p. 41). The figures included in the report were therefore of microplastics in a more general sense than in accordance with the working definition. The report reflects on the need to develop a narrower definition if it is to become a basis for decision making. Another consideration that was raised was that adopting a definition that diverges

significantly from other national authorities could lead to additional costs and challenges with compliance, enforcement, and monitorability. This first attempt to define intentionally added microplastics provides a preview into how defining microplastics is not a strictly scientific endeavour, but a practical one as well.

The proposed REACH restriction defines microplastics as “a material consisting of solid polymer containing particles, to which additives or other substances may have been added, and where ≥ 1% w/w of particles have (i) all dimensions 1nm ≤ x ≤ 5mm, or (ii), for fibres, a length of 3nm ≤ x ≤ 15mm and length to diameter ratio of >3” (ECHA, 2019a, p. 16). The report acknowledges that this description is a "regulatory definition of a microplastic developed for the purposes of this restriction” (ECHA, 2019a, p. 30). This acknowledgement stems from the observation that there is no fixed definition of microplastics and that where for regulatory purposes one becomes necessary, microplastics are defined with reference to the regulation in question. In the case of the definition proposed by the ECHA, the regulatory definition not only considered the scope of the intended restriction, but stakeholder input gathered through a Call for Evidence as well. In a similar way to the AMF report, then, the restriction proposal also considers the extra-scientific nature of the definition they are suggesting.

In defining microplastics, one key characteristic is its size. While all parties agreed on an upper limit of 5 mm, determining the lower limit was not as straightforward. During the consultation on the draft proposal, respondents commented that analytical techniques are not sufficiently developed to work on nanoscale microplastics (ECHA, 2020). The Forum likewise advocated for a lower limit based on feasibility, which they assess to be 100 nm (RAC, 2020). Taking this into account, the ECHA updated “the conditions of the restriction (and not the definition of a microplastic)” (RAC & SEAC, 2020, p. 92) from 1 nm to 100 nm, bringing it up from the lower limit of the REACH definition of nanomaterials to the upper limit, thereby excluding nanoplastics from the scope of the application. Commenting on the proposal, the RAC argued that on the basis that there is not enough data to determine a lower limit beyond which microplastics would not be considered a hazard, no lower limit should exist (RAC, 2020). However, considering enforceability, they condone a lower limit for enforceability, which they claims should be set at the smallest size that can be measured (RAC & SEAC, 2020). While in their draft opinion, the SEAC (2020a) agree with both RAC (no limit) and the proposal (100 nm functional limit), in their final opinion (SEAC, 2020b), they take an intermediary stance of a lower limit on the definition of microplastics of 1 nm. This was reasoned on the basis having no lower limit at all “would not provide a fully fit-for-purpose delineation of the group of substances that need to be regulated” (SEAC, 2020b, p. 94). In the final regulation (Commission Regulation (EU) 2023/2055), the European Commission defines microplastics without a lower limit but considers a functional lower limit 100 nm. Here we can see how

considerations of monitorability and enforcement introduced by interested parties and the Forum led to a split between how microplastics are defined and how they are defined within the scope of the restriction. This allows for microplastics to be regulated even though they escape scientific capacities to monitor them in practice.

Table 5: Changes to lower limit of microplastics

Actor	Definition of microplastic	Scope of restriction
ECHA initial	1 nm	
Interested parties	100 nm	
Forum	100 nm	
ECHA revised	1 nm	100 nm
RAC	No lower limit	Small as can be detected
SEAC draft	No lower limit	100 nm
SEAC final	1 nm	100 nm
EC	No lower limit	100 nm

The distinction between the two is formalised in the structure of the regulation. An entry in the Annex XV has two columns, one stating the substance to be restricted and the other, the conditions of the restriction. All versions of the restriction prior to the European Commission regulation considered polymers the substance and restricted them when placed on the market as a microplastic. This meant that the definition of microplastic decided was simultaneously the substance definition and the functional definition. However, the European Commission regulation changed the structure of the restriction such that microplastic, defined in a certain way, was the substance to be restricted, and the size range of microplastics to which the regulation would apply could be specified under the conditions of restriction (Commission Regulation (EU) 2023/2055). In other words, they noted the size limits of microplastics generally under the ‘substance’ column and included an additional provision stating the practical limits of monitoring technology under the ‘conditions of restriction’ column.

Another way in which microplastics are defined in a regulatory manner relates to how they are problematized in the first place. The first section of the restriction report (‘problem analysis’) deals with defining the “microplastic concern”, or, more precisely, “the potential environmental and human health risks that could be posed by the presence of solid particles of polymer-based materials in the environment” (ECHA, 2019a, p. 20). The risk assessment first concluded that there was insufficient data to derive a predicted no effect concentration (PNEC). Given its extreme persistence in the environment with a half-life of over hundreds of years, a figure which vastly exceeds the minimum criteria for a ‘very persistent’ substance, which would lead to the accumulation of microplastics in the environment such that it exceeds the PNEC, microplastics were then labelled a non-threshold substance with “any release to the

environment assumed to result in a risk" (ECHA, 2019a, p. 73). Returning to the regulation, we can see that certain types of microplastics, despite fulfilling the size requirements outlined above, are nevertheless exempted on the basis that they do not contribute to the microplastic concern (Commission Regulation (EU) 2023/2055). These can be categorized into microplastic with certain properties and certain uses of microplastics. The exempted properties were naturally occurring (inherently biodegradable), degradable, soluble (do not retain form in water), or not containing carbon atoms in the chemical structure (degrade more readily compared to common microplastics). The exempted uses are those in which where microplastics are not foreseen to be released to the environment, i.e. microplastics that are contained throughout their lifetime and disposal, microplastics that change form during use such that they no longer are microplastics, and microplastics where they are permanently incorporated into a solid matrix. While the microplastics derogated on the basis of their properties do not pose a hazard even when in the environment, the microplastics derogated by use are not an issue as they do not enter the environment in the first place. Here again we can see how are defined with respect to the regulation in question. Where microplastic do not contribute to the microplastics concern, which the restriction aims to address, they are not considered microplastics in the regulation.

4.3.4 Applying the restriction cautiously

In addition to defining intentionally added microplastics as well as removing microplastics that do not contribute to the microplastics concern from the scope of the regulation, the restriction specifies the applications to be exempted as well as those for which transition periods apply from when the regulation comes into force. Differentiating microplastics by application is another form of categorization which allows each to be regulated in a slightly different way. The exemptions and transition periods serve to weaken the restriction, taking it from a hazard-based approach, which views any release to be a risk, to a risk-based one, which allows room for exposure. That intentionally added microplastics are being regulated despite their full effects not being fully understood points to a commitment to the precautionary principle; yet at the same time the regulatory tools at the EU's disposal are being carefully employed so as not to overregulate the chemicals market. In this way, the restriction of intentionally added microplastics can be understood as a form of regulatory precaution (Laurent, 2022).

In the original restriction proposal, three sources of microplastics are identified for exemption: microplastics used at industrial sites, as well as those in medicinal and fertilising products, as these are considered as already being covered by other regulation (ECHA, 2019a). Following stakeholder consultation, several exemptions are added to the original list: food additives in order to avoid double regulation and market distortion; in vitro devices due to cost effectiveness and socioeconomic considerations; as well as sewage sludge, food, feed as

microplastics in these sources were considered unintentionally present (RAC, 2020). All but one—sewage sludge—were included in the final regulation adopted by the Parliament and Council, with sewage sludge being removed on the basis that microplastics in sewage sludge not being intentionally added, it did not fall under the scope of the regulation in the first place (Commission Regulation (EU) 2023/2055). Food and feed were not subject to the same treatment as they were viewed as being exempted due to being covered by another regulation. Interestingly, no justification is ever given for the derogation of microplastics used at industrial sites, a category which includes plastic pellets (RAC, 2020). The SEAC claims this is because industrial uses were not included in the original mandate from the European Commission (SEAC, 2020a), which only included professional and consumer uses. While this is true, the ECHA as a first step in preparing the restriction report clarified with the Commission that it should include expand the original scope to include industrial uses, based on the findings of the AMF report that identified abrasive blasting media and sources in oil and gas (i.e., industrial sources) as contributing to microplastics pollution (ECHA, 2019a). While both the SEAC and RAC make note of the significant contribution of plastic pellet loss as a source of microplastic pollution and that further action is necessary in order to mitigate it, neither demands a revision to the derogation (RAC, 2020; SEAC, 2020b). The exclusion of plastic pellets from the REACH restriction is similar to the consideration of plastic pellets and synthetic infill in the Eunomia report rather than the AMF one which covered all other sources of intentionally added microplastics. In the same way, the exemption of plastic pellets can be understood in terms of the impossibility of removing plastic pellets from the market.

For some applications, transition periods were granted in order to allow producers time to comply with the regulation. The original restriction proposal suggests transition periods for medical devices, rinse off and leave on cosmetics, detergents, and fertilisers and other agricultural products (ECHA, 2019a). Following the stakeholder consultation, several transition periods were extended (RAC, 2020). While the transition period for medical devices was simply extended from two years to six years, in the case of detergents and fertilizers, new sub-categories were introduced. While the transition period for detergents was to remain at 5 years, that for the fragrances in detergents was suggested to be extended to 8 years. Similarly, the transition period for fertilizers and other agricultural products remained the same (5 years), while plant protection products were allowed an extended transition period of 8 years. Transition period extension also occurred at the European Commission level (Commission Regulation (EU) 2023/2055), where the transition period for granular infill was extended from the proposed 6 years to 8 years and lip, nail, and makeup products were differentiated from other rinse of cosmetics in order to assign then a transition period of 12 years (formerly 4 years). For the majority of applications exempt from the ban (with the exception of fertilizing

products, food, and feed), labelling and reporting requirements applied and kicked in also with a transition period. While the original transition period was 18 months for labelling and 12 months for reporting (ECHA, 2019a), these time frames were increased following the consultation to 24 months and 36 months, respectively (RAC, 2020). Labelling requirements for medicinal products and in vitro devices were further relaxed by the EC (Commission Regulation (EU) 2023/2055). There were two instances, however, where the transition periods were shortened, and both cases followed the same pattern. The SEAC would propose a shorter time frame than the revised proposal by the ECHA and the European Commission would take this into consideration, issuing a time delay that was longer that than proposed by the SEAC but shorter than the ECHA revised proposal (SEAC, 2020b; (Commission Regulation (EU) 2023/2055)). This was the case for the transition period for the ban on fragrances in detergents as well as the reporting requirement for microplastics created at industrial sites. The general trend was an increase of transition periods, which took place at the level of the consultation and the EC.

Laurent (2022) observed how time and time again, “the attempts at banning substances (and at following a line resembling the hazard-based approach) are rarely successful. Instead, various exemptions are drawn, and the eventual regulatory choices are closer to a risk-based approach" (p. 126). What this discussion of the details of the REACH regulation illustrates is that this transition can also be seen in the case of intentionally added microplastics. Despite determining that any release of microplastics is not safe, which indicates a hazard-based approach, the ECHA restriction process takes a risk-based approach as it opens up space time and time again for the restriction to be scrutinized and allowances to be made. This is reflected in the restriction as while it is in theory a blanket ban, multiple transition periods and exemptions are identified, which upon consultation, are extended and increased, the resulting regulation taking more of a risk management approach. This is done through introducing ever new types of microplastics based on their source, the most extreme case of this being when categories are split into two so that certain components can be afforded even longer transition period.

4.3.5 The influence of interested parties

Thus far we have already seen how the lower limit of microplastics, exemptions of certain uses of intentionally added microplastics, and transition periods have been revised based on input from various stakeholders. This next section explores the roles of these ‘interested parties’ in more detail, looking at how they are involved in the restriction procedure, what kind of actors make up this group, and another example of how they have vied for change in the restriction proposal. The picture that emerges in doing so is that, unsurprisingly, while these engagement opportunities are in theory open to all to participate, those who write in are largely industry and

trade associations. The kinds of modifications to the proposal they request are therefore more in line with their business interests than they are with environmental safety and human health.

The process of the REACH restriction is a standardized one and includes stakeholders at different stages. These can be differentiated between involvement prior to and following the publication of the restriction proposal. Prior to the publication of the restriction proposal, several forms of the stakeholder involvement were carried out (ECHA, 2019b). The first and most significant was the Call for Evidence which gathered data on the working definition of microplastics, the products in which microplastics are used, their technical function, and possible alternatives, possible socio-economic impacts of the restriction, and analytical methods. Notification of the call was sent out to all those actors who had previously registered a substance as a monomer or a polymer. Of the 122 total responses received, an overwhelming majority were submitted by companies (46 responses, 38%) and industries and trade organisations (36 responses, 30%), while the remaining responses were submitted by international organisations (15 responses, 12%), NGOs (14 responses, 11%), individual (4 responses, 3%), Member States (4 responses, 3%), an academic institution (1%), and a regional authority (1%). A stakeholder workshop was subsequently organised to further the information gathered during the Call for Evidence (ECHA, n.d.-f). Sessions were organised around affected industries, and interestingly featured presentations from both companies/trade organisations and environmental organisations/research institutions. The Plastic Soup Foundation, earlier identified as a key actor in initiating the debate on microplastics, were one such environmental organisation. Stakeholder engagement throughout the writing of the proposal include targeted stakeholder consultation with companies and trade associations which yielded 33 additional responses, an invitation only presentation at the MICRO 2018 conference to elicit feedback from academics on the early risk assessment, and a consultation with the ECHA's PBT expert group (composed of Member States, industry groups, and environmental associations) (ECHA, 2019b).

While the different forms of stakeholder engagement pursued are outlined in the appendix of the restriction proposal (ECHA, 2019b), there is little documentation that reveals how they influenced the initial restriction proposal. A note published following the stakeholder workshop however provides a glimpse at how responses to the Call for Evidence altered the ECHA's definition of microplastics (ECHA, 2018c). The working definition proposed in the Call for Evidence had been "any polymer, or polymer-containing, solid or semi-solid particle having a size of 5mm or less in at least one external dimension" (ECHA, 2018c, p. 3). That the basis of the definition of microplastics was based on polymers, rather than plastics more specifically was criticised on the basis that it would bring many more microplastics into the scope of the regulation, but the ECHA maintained its position, citing that there was no reason to believe

that there was no reason to believe that synthetic polymers not considered plastic would not contribute to the potential hazards associated with microplastics. Respondents were critical of the upper limit being in only one dimension as well as the lack of a lower limit, both of which were addressed in the ECHA's initial proposal. They also called for the exemption of microplastics that are naturally occurring, biodegradable, water soluble, and that do not contribute to marine litter. While the ECHA integrated exempted the first two qualities in their proposal, the latter two were not. These suggestions point to early attempts on the part of respondents, mainly companies and industry/trade associations, to restrict the scope of the regulation as well as how the ECHA is responsive to these suggestions.

Following the publication of the restriction proposal, interested parties have the chance to provide feedback. Interested parties include "companies, organisations representing industry or civil society, individual citizens, as well as public authorities" (ECHA, n.d.-c). This feedback is then incorporated into a revised proposal, which is commented on by the SEAC and RAC. Interested parties then have a second opportunity to provide feedback, this time of the SEAC opinion before the opinion reports are finalised, attached to the restriction proposal, and sent to the European Commission for further action. While these opportunities for participation may appear to be a box ticking exercise, a closer look at how the proposal changed between the documents reveals that these interested parties made significant contributions to the final proposal. Already discussed in the above sections are how interested parties successfully introduced a lower limit of 100 nm to the scope of the restriction, included additional exemptions for specific uses of intentionally added microplastics, and extended the transition periods both for delays to the restriction and the labelling and reporting requirement. There are several other areas in which the interested parties shifted the exemptions in their favour. Earlier I discussed exemptions on the basis of polymer properties: naturally occurring, biodegradable, soluble, and non-carbon containing. Of these, the exemption on the basis of biodegradability was modified and those on the basis of solubility and the lack of carbon were introduced by interested parties in such a way as to relax the strength of the restriction.

In response to industry comments that the biodegradability criteria were too conservative as even natural polymers would fail to degrade in the prescribed timeframe, the ECHA updated their biodegradability criteria in order to account for their more stringent criteria (ECHA, 2019b). Not only were there adjustments to the criteria of preexisting exemptions, but exemptions were added as well on the basis that these types of microplastics do not contribute to the microplastic concern. Interested parties argued that soluble microplastics, i.e. those that dissolve in water, should be exempted and the ECHA took up this exemption, setting the limit at a solubility greater than 2 g/L (ECHA, 2019b). Interestingly, this threshold was determined not based on agreed upon definitions of polymer (in)solubility, since as noted the ECHA, while

“on a conceptual level ‘water insoluble’ seems to be clear but, on a practical and empirical level it is open to interpretation” (RAC, 2020, p. 39). Rather, the solubility limit was selected as it was the upper test material concentration for the biodegradability tests, meaning that non-soluble microplastics would be subjected to the biodegradation tests, which speaks to the relational nature of these properties (RAC & SEAC, 2020). The SEAC additionally argues for the exclusion of polymers without carbon atoms in their chemical structure as this difference makes their physical properties are significantly different compared to other polymers (SEAC, 2020b). That this element only comes in at the final SEAC opinion suggests that this was brought in following the consultation with interested parties on the draft SEAC opinion. On this last point, the RAC presented that while such polymers do not fulfil the criteria for being persistent, they can remain in the environment for extended periods of time and that there is insufficient ecotoxicity data to claim that they do not pose the same risks as other microplastics (RAC, 2021). Based on the inputs of the various actor groups, the European Commission accepted the relaxation of the biodegradability criteria as well as the exemptions of soluble microplastics and those without carbon in their chemical structure, citing the lack of evidence proving they pose the same risk as extremely persistent microplastics (Commission Regulation (EU) 2023/2055).

What becomes evident when studying the process of drafting the restriction process is that despite the technical nature of the task, the restriction procedure has built into it mechanisms by which interested parties, by definition, parties with interests, are allowed to intervene. Their contributions contribute practical expertise and shape the final regulation in definitive ways. Crucially, these spaces are not equally accessible to all. On one hand, this was the result of the structure by which stakeholder opinions were elicited: the Call for Evidence was only advertised to industries which had previously registered their chemicals with the ECHA, while the audience at the stakeholder workshop, presentation at the MICRO 2018 conference, and bilateral consultations were carefully curated (ECHA, 2019b). Furthermore, while the Call for Evidence and open consultations were in theory open to the broader public, contributing in a meaningful way requires a thorough understanding of the technicalities of materials science and ecotoxicology as well as the minutia of the REACH procedures in order to recognize that opportunities to contribute expertise to the drafting regulation is available in the first place. These empirical observations provide further texture to Laurent’s (2022) claim that complexity of the EU’s regulatory machinery privileges the most skilled lobbyist. While some may see the heavy head of interested parties it the regulatory process as tainting its legitimacy, Laurent (2022) argues that such involvement, what he calls ‘interested objectivity’, is the norm in European institutions and that acknowledging this stake of being is the first step towards imaging a more democratic EU.

4.4 Regulating unintentionally released microplastics

While regulatory action on intentionally added microplastics was initiated in 2017, similar steps for unintentionally released microplastics took place only in 2020. As the initiative progressed, what was imagined as legislative action on unintentionally released microplastics more generally turned into that specifically focused on plastic pellets. As a first step, an Inception Impact Assessment Roadmap was published to the Have Your Say website (EC, 2023b), which publicized the Commission's intention to take action on the topic of unintentionally released microplastics (EC, 2019a). In July 2021, a call for participation in stakeholder workshops was put out (EC DG ENV, 2021), with the first round of stakeholder workshops on textiles, tyres, and pellets held in September and November 2021 (EC, 2023b). A Call for Evidence was published in November 2021 (EC, 2021c), replacing the earlier Inception Impact Assessment Roadmap in adherence with the newly published Better Regulation guidelines (Thompson Reuters, n.d.). The Call for Evidence communicated the intention of the Commission to develop a legislative initiative on unintentionally released microplastics, specifically on tyres, textiles, and plastic pellets, and outlined their plan to solicit feedback from stakeholders (EC, 2019a). Citizens had the opportunity to publish feedback on the Call for Evidence between November 2021 and January 2022 (EC, 2023b). Following research done by the JRC (Interview P1), paints, geotextiles, and laundry capsules were added to the scope of the initiative (EC, 2023b). Further workshops were carried out on these additional sources and the Open Public Consultation, a survey to which various stakeholders could respond, also dealt with all six sources. However, in October 2022, a draft of the Impact Assessment was submitted to the Regulatory Scrutiny Board, who recommending the scope of the measure be focused only on plastic pellets. Subsequent stakeholder engagement initiatives reflect this change, with the final stakeholder workshop focusing exclusively on pellets and a targeted consultation opened to SMEs given their role in the pellet supply chain. In May 2023, a revised version of the Impact Assessment was again submitted to the Regulatory Scrutiny Board and was accepted (EC, 2023b). The proposal for the plastic pellet regulation was published on the Have Your Say platform in October 2023 (EC, 2023c). As of writing, the European Parliament and the Council of the Europe Union, the two executive bodies of the EU, have published their positions on the draft regulation and are in trilogue negotiations in order to come to an agreement on the final form of the regulation (EP, 2025).

This section will delve into several aspects of this process. Section 4.4.1 examines the Call for Evidence that initiates regulatory action on unintentionally released microplastics. Section 4.4.2 investigates the different participatory elements that are present throughout the development of the plastic pellet regulation and compares this to how participation appears in the REACH restriction process. Section 4.4.3 focuses on the analyses performed in order to

inform the regulation writing, specifically on how what began as a general regulation on unintentionally released microplastics transformed into one specifically targeting plastic pellet. The final section (4.4.4) then considers how plastic pellets are portrayed within the regulation and the specific measures proposed in order to reduce their emissions to the environment.

4.4.1 An environmental and economic issue

The beginning of this empirical chapter delved into how microplastics gained momentum in EU policy when it was taken up in the context of the circular economy discourse. The previous section also explored how the restriction of microplastics under the REACH regulation is concerned with the threat of unevenly developed regulation on the European single market as much as with the negative environmental and health effects of microplastics and works to balance environmental protection and economic growth. In the Call for Evidence announcing the Commission's intention to develop legislation on unintentionally released microplastics, references to the circular economy are more present than before in more and less explicit ways, further supporting the argument that problematizing microplastics as an environmental issue is a key component in driving policy on the topic forward.

Most evidently, the initiative is contextualised as emerging from the new Circular Economy Action Plan and the Plastics Strategy, both of which commit to tackling pollution due to unintentionally released microplastics (EC, 2021c). Furthermore, four units listed as being responsible for the initiative: one unit from DG ENV (Sustainable Production, Products & Consumption, under the Directorate Circular Economy and Green Growth) and three from DG GROW (Tourism, Textiles; Mobility; and Green and Circular Economy). What is interesting to observe is how the responsibility for implementing the circular economy strategy falls across both Directorate-Generals. This is in line with Kovacic et al. (2020), who observed that while the circular economy entered the EU with DG ENV, with the second communication on circular economy published in 2018, "the circular economy narrative found allies in the Directorate General for Growth" (p. 40). This dual nature of the planned regulation is reflected in how its legal basis is envisioned as either being Article 192 of the TFEU, which outlines the procedure for passing environmental regulation, or Article 114, which does the same but for internal market matters (EC, 2021c).

The Call for Evidence additionally frames unintentionally released microplastics as both an environmental risk and an economic threat, which in turns feeds into the potential solutions and impacts imagined. On one hand, microplastics is described as an environmental issue: its presence in the environment is a "cause of growing concerns", they exert "negative effects on vulnerable eco-systems … and biodiversity" and pose "potential risks to human health" (EC, 2021c, p. 2). On the other, it is also an economic problem, and the language used to describe

this element of the issue is much more drastic: "*devastating* economic consequences" and "the economic impact on activities such as fishing and tourism is *vast*" (EC, 2021c, p. 2, my emphasis). More specifically, five market and regulatory failures are identified: (1) lack of market incentives for producers to implement measures that reduce the emissions of unintentionally released microplastics, (2) lack of a comprehensive policy, (3) knowledge gaps on the occurrence of microplastics in the environment, food and drinking water as well as their risks due to the lack of harmonised methods, (4) insufficient information for consumers and actors along the supply chain to make sustainable choices, and (5) market fragmentation due to certain Member States introducing regulatory measures targeting unintentionally released microplastics (EC, 2021c). Of these five, three can (points one, four, and five) are market failures.

Problematizing the issue in this way simultaneously proposes a certain solution: addressing these failures through market instruments. These solutions are viewed as bringing about both positive environmental impacts—the reduction of unintentionally released microplastics in the environment—as well as economic ones—a more efficient single market, innovation in the sustainability space, and a level playing field for sustainable products (EC, 2021c). While it is acknowledged that changes to the current mode of production comes with associated costs, any fears are assuaged by the claim that these costs will fall over time. Here again, is less explicit terms, we have the repetition of the argument that what is good for the environment is also good for the economy, and vice versa, a departure from the view of planetary limits that constrain economic growth (Kovacic et al., 2020). This presentation of economic instruments alongside environmental policy is another feature of the second-generation circular economy strategy (Kovacic et al., 2020). Whereas the first generation of circular economy followed ecology and environmental studies, approaches which prefer the regulation of the environment with targeted policies such as improving material and energy efficiency, supporting environmental legislation, and backing conservation efforts, and criticised the environmental economics approach, which advocates for market measures, this criticism largely abated with the second communication on circular economy (Kovacic et al., 2020). On the contrary, market incentives were framed as opportunities for innovation, framing environmental as a win-win situation and thereby circumventing the concern of the limits to growth posed by planetary boundaries (Kovacic et al., 2020).

4.4.2 Better Regulation, better engagement?

As in the case of developing the restriction of intentionally added microplastics under the REACH regulation, diverse publics were included in the process of developing the regulation on unintentionally released microplastics. In comparison to the opportunities for stakeholder engagement provided within the REACH restriction process, that in the development of

unintentionally released microplastic regulation was much more accessible, which is reflected in the type of participants who took part in the consultation processes. This can largely be attributed to the status of the regulation. There have been efforts within the EU to increase citizen participation in policy making, but this applies to the development of new regulatory initiatives and the revision of existing ones rather than in the implementation of existing regulations, as in the case of the REACH regulation.

The Junker Commission outlined its idea for its Better Regulation in a Communication titled "Better Regulation for better results – An EU agenda" (EC, 2015a). A key element of this agenda was increasing public involvement in the policymaking process. The concrete actions in this respect were to establish a web portal where each policy initiative would be published and through which engagement efforts would be conducted (EC, 2015a). The 'Have Your Say' portal was finalised in 2017 and relaunched in its current from in 2020 (EC, 2021a). The 2021 Better Regulation guidelines requires that an initiative be accompanied by a Call for Evidence, a document which describes the intended activities and on which people can provide written feedback, and a Public Consultation, which takes the form of a questionnaire (EC, 2021b). Where deemed necessary and appropriate, targeted consultations are also conducted with specific stakeholder groups. Once the regulation is drafted, this published on the portal alongside the impact assessment, and the public are also able to comment on these, opinions which are then collected and presented to the European Parliament (EP) and the Council when deciding whether to amend and/or pass the regulation.

The case of unintentionally released microplastics was published on the Have Your Say portal as "Microplastics pollution – measures to reduce its impact on the environment" (EC, 2022). The Call for Evidence was published in November 2021 and the feedback period ran until January 2022. The public consultation followed, open between February and May 2022. In both the Call for Evidence and Open Public Consultation, the greatest number of responses were submitted by EU citizens (22%, 30%), closely followed by contributions from companies, NGOs, and business associations (10-20%). Academic/research institutions contributed slightly less (7-10%), and environmental organisations, public authorities, and non-EU citizens (1-5%) (Figure 3, Figure 4). The feedback period on the proposed regulation ran from October 2023 to January 2024. Participation was lower (47 responses compared to the 186 received in the Call for Evidence and 411 in the Open Public Consultation) and business associations (45%) and companies (21%) were more represented than EU citizens (17%), NGOs (9%), public authorities (4%), consumer organisations (2%), and academic/research institutions (2%) (Figure 5).

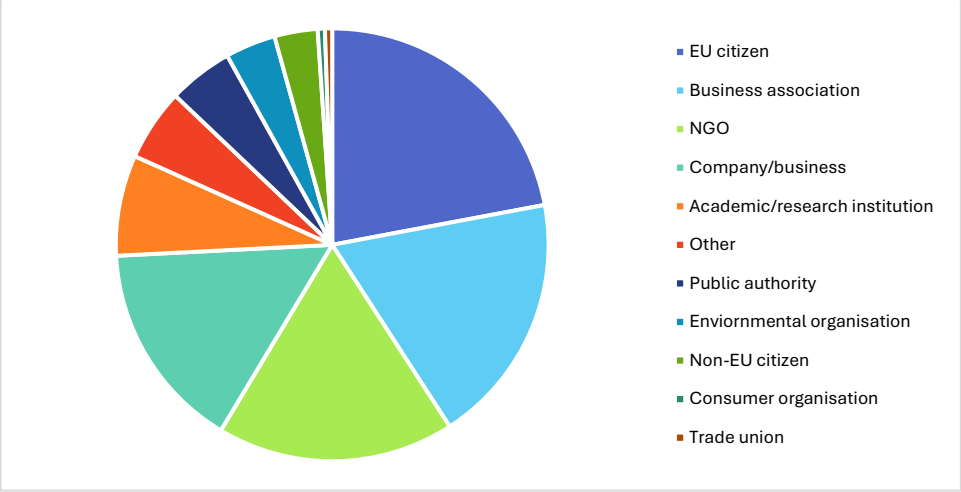

Figure 3: Participants responding to the Call for Evidence (EC, 2022)

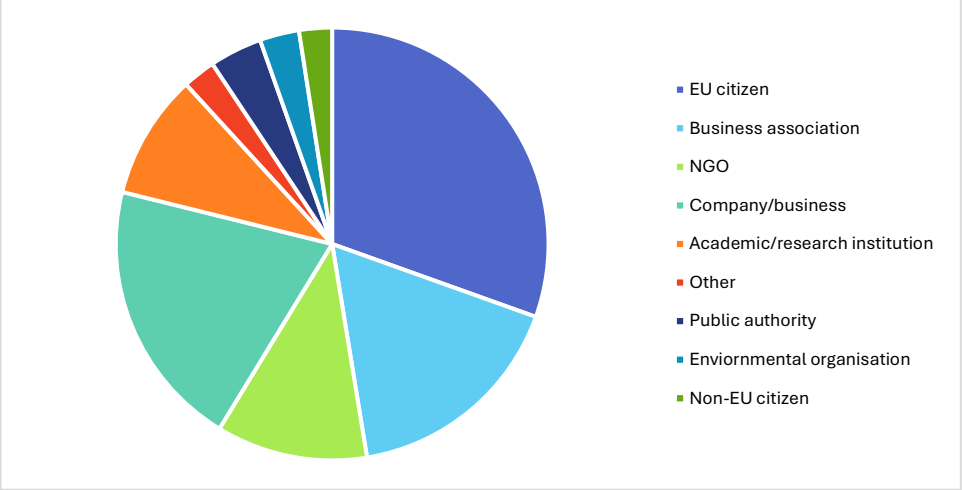

Figure 4: Participants participating in the Open Public Consultation (EC, 2022)

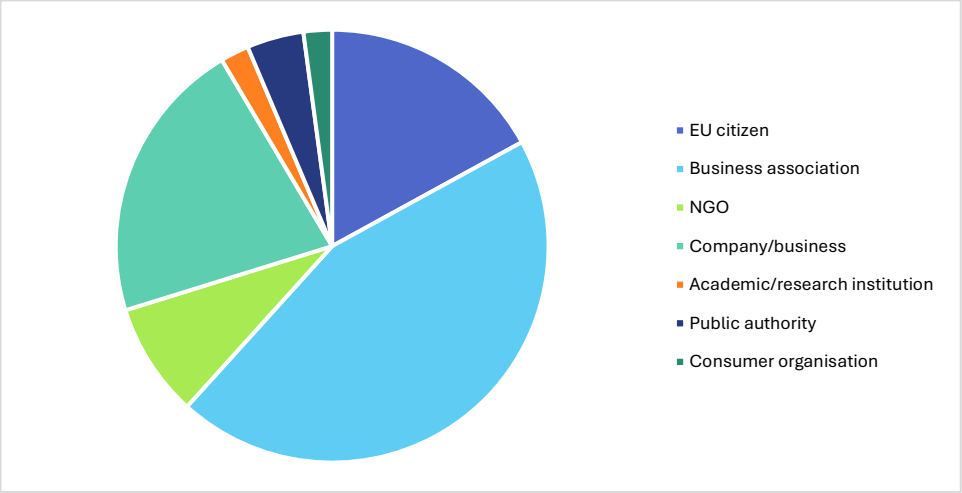

Figure 5: Participants providing feedback on the proposed plastic pellet regulation (EC, 2022)

These mandatory consultation activities were complemented by a series of workshops, a targeted consultation, and several interviews (EC, 2023b). Seven workshops were conducted in total. A call for participants in the workshops were published as a news announcement on the DG ENV website, and a variety of participants were recruited, including industry, NGOs, Member States, and researchers. These workshops featured presentations to introduce the issue at hand and for the sessions where policy options were actively brainstormed, background reports were sent around in advance in order to facilitate discussion during the sessions. One workshop was specifically targeted at Member States and dedicated to eliciting their responses to the different policy options. As a large volume of pellets are handled by SMEs and potential measures can affect them disproportionately, a targeted consultation was carried out with this group of actors. Throughout, meetings were also conducted with a number of other groups—industry representatives, NGOs, Commission services, EU organisations—although little more is known about these engagements.

When compared to the participatory elements in the REACH restriction processes presented, it is clear that the public engagement in the development of the regulation on unintentionally released microplastics is significantly greater. The Call for Evidence in both processes is the first point of contact with the respective regulations for non-EU actors. In the case of unintentionally released microplastics, this is published on the Have Your Say platform and therefore accessible to any engaged citizen regardless of whether they are specifically following the development of microplastics or not. There are also active efforts to promote engagement through this channel, for example, through social media and encouraging the scientific community to contribute (EC, 2021b). On the other hand, the Call for Evidence in the REACH restriction is only promoted to actors in the chemical industry and, being published on the ECHA site, only publicized to those who are following developments in the chemical sphere (ECHA, 2019b; ECHA, 2018b). Furthermore, there are a greater number of opportunities for involvement in providing input to the regulation of unintentionally released microplastics and they are also presented in a more accessible language. The Call for Evidence and public consultation remained at a very general level and the workshops, which aimed to brainstorm possible policy options, were prefaced with introductory materials so that participants could better engage in discussions. This was an explicit goal for the EC, who in their revision of the Better Regulation guidelines recognise past questionnaires were viewed as too long and technical and aim to address these concerns (EC, 2021b). For REACH, the Call for Evidence was more technical in nature, soliciting information and data on microplastics only available to those dealing with microplastics in a business setting (ECHA, 2018a) and the consultations requested feedback on the restriction proposal and the SEAC opinion, both lengthy reports filled with technical analyses.

However, these differences can be attributed to the fact that the two regulations are at different stages of development and therefore different processes for garnering stakeholder input apply. While the regulation on unintentionally released microplastics is not yet in force and therefore subject to multiple rounds of stakeholder input, the restriction of substance under the REACH regulation takes the form of an implementing act that simply ensures that the regulation is implemented in a uniform manner (EU, n.d.-c). In this instance, the participatory procedures to be included in the drafting of the regulation are outlined in the REACH regulation (Regulation (EC) No 1907/2006) and are described in broad strokes, only specifying that feedback be provided by interested parties on the initial proposal and the opinion of the SEAC. For implementing decisions more generally, Better Regulation requires that feedback be collected only on the final proposal and waives this requirement if sufficient stakeholder input has been considered while drafting the implementing act (EC, 2023a), as appears to be the case in the implementing decision introducing microplastics to the list of substances to be restricted. Better Regulation also outlines a mechanism by which evaluations of existing regulations can be carried out in a similar process to gathering input of new policy initiatives (EC, 2021b). An evaluation of the REACH regulation is currently underway, with feedback on the Inception Impact Assessment[3], although it deals more generally with the chemical registration, evaluation, authorisation, and restriction processes and not with intentionally added microplastics (EC, 2021a). In sum, opportunities for feedback are more restricted in the case of the restriction of intentionally added microplastics compared to for the regulation of intentionally added microplastics, although this can be attributed to the fact that the former is an implementing decision and therefore an application of an existing regulation while the latter is a regulation in the making.

This trend of more restricted avenues for consultation as a regulation develops is also present when comparing the profile of participants across the various opportunities for feedback on the regulation on unintentionally released microplastics. While early calls for participation were open to all stakeholders, the second consultation and bilateral meetings held later in the development were targeted towards specialist groups such as SMEs, industry representatives, NGOs, other services within the Commission, and EU institutions (EC, 2023b). This is an active decision on the part of the Commission, which aims to “avoid public consultations on very technical issues of little interest for the general public, where a targeted consultation of stakeholders is a better means of collecting the necessary evidence” (EC, 2021b, p. 5). Furthermore, the proposal for the plastic pellet regulation, environmental NGOs are considered one group, while various actors along the plastic pellet supply chain—plastic pellet producers (PlasticsEurope), plastic recyclers (Plastics Recyclers Europe), and plastic

[3]Prior version of Call for Evidence

converters[4] (European Plastics Converters)—are all given a unique voice, suggesting that some experts exert more of an influence than others (EC, 2023b). Looking at the responses to the proposed plastic pellet regulation, there is a significant drop in citizen feedback compared to earlier opportunities for feedback, while business associations and companies have increased in terms of percentage of overall contributions (EC, 2022). This points to the technical and legal language of the regulation posing a barrier to comprehension for citizens unfamiliar with the plastic pellet industry and/or EU law. Although to a lesser degree than in the case of the restriction of intentionally added microplastics under the REACH regulation, the regulation of unintentionally released microplastics is most informed by industry perspectives, despite the fact that the plastic pellet pollution is of concern to a broader range of communities. This can be understood as the transformation of an environmental issue concerning all those at risk to an industrial issue relevant to the producers of the public pellets as was also observed by Asdal (2015) in the case of emissions from an aluminium smelter in the west of Norway.

4.4.3 From unintentionally released microplastics to plastic pellets

While European Green Deal, reiterating the commitments first laid down in the Plastics Strategy, call for measures on unintentionally released microplastics more generally (EC, 2019b), the Call for Evidence is specifically concerned with preventing the release of plastic pellets and microplastics form tyres and textiles (EC, 2021c). Throughout the course of the development of the regulation on unintentionally released microplastics, however, the scope of the regulation was first expanded to include microplastic emissions from paints, geotextiles, and detergent capsules, before being reduced down to addressing plastic pellets only. This process can be understood as an instance of regulatory precaution in action, as despite best intentions, the actions ultimately taken are limited in scope.

The Eunomia report (Hann et al., 2018) was a precursor to the legislative action on unintentionally released microplastics, and this is visible in one of the earliest documents published with respect to this legislative procedure, the Call for Evidence (EC, 2021c). In it, the European Commission publicised their intention to introduce legislative action on unintentionally released microplastics and specifically focus on the tyres, textiles, and plastic pellets, the threes sources that the Eunomia report ultimately provide policy recommendations on. This link is spelled out clearly in the Impact Assessment Report where the three sources are described as having been identified as the top emitters in multiple reports, with the Eunomia report being cited among several others (EC, 2023b). The Impact Assessment Report does not take the results of the Eunomia report for granted, however, and conducts its

[4]Converters produce plastic components from plastic pellets.

own analysis to come to the sources of microplastics it deems relevant. Interestingly, in a similar manner to the Eunomia report, the Impact Assessment Report first identifies all sources of microplastics, then shortlisted six sources. However, the six sources identified by each report are not the same. The Eunomia report focuses on tyre wear, plastic pellets, synthetic clothing, road markings, building paint, and artificial turf, while the Impact Assessment Report considered paints, tyres, pellets, textiles, geotextiles, and detergent capsules.

Table 6: Top six sources of unintentionally released microplatics identified by the Eunomia report and Impact Asessment Report

Eunomia report	Impact Assessment Report
1. Automotive tyre wear 2. Pre-production plastics 3. Synthetic clothing 4. Road markings 5. Building paint 6. Artificial turf	1. Paints 2. Tyres 3. Pellets 4. Textiles 5. Geotextiles 6. Detergent capsules

Comparing the process by which these six were arrived at in the respective reports provides insight into the different filters at play and how the filters used can influence policy outcomes. In a process very similar to that carried out for the Eunomia report, the Impact Assessment Report first identifies all sources of microplastics, quantifies their emissions where possible through a combination of literature review and stakeholder interactions, and ranks them. Of the 24 sources identified, six were selected for further consideration: paints, tyres, pellets, textiles, geotextiles, and detergent capsules. The rest were excluded due to their unintentionally released microplastics or the lack of data on their emissions. Again, we see how the categories of intentionally added and unintentionally released microplastics are not so clear cut with the example of artificial turf. While the granular infill in artificial turf is considered a form of intentionally added microplastic, the microplastics released form the wear and tear of the plastic grass and granulates are considered unintentionally released. While for some sources for which emission data was limited, the decision to exclude them from analysis was supported by estimated low quantities, low toxicity, and/or the presence of existing regulatory initiatives that address the issue, in several cases the lack of data was reason enough for its exclusion from further consideration. This is concerning as information being unavailable does not mean microplastics are not being emitted and furthermore incentivises active ignorance. Comparing the filters employed by the two reports in the process of cutting down their master list of all microplastic sources demonstrates that common to both was the lack of emission data. However, the Impact Assessment Report retained sources of microplastics. However, unlike the Eunomia report, the Impact Assessment Report did not filter out sources contributing to pollution in environmental compartments other than marine.

Additionally, while the Eunomia report included artificial turf in its analysis due the potential need to regulate it through specific measures (rather than under the restriction), by the time the Impact Assessment Report was released, infill material had been included in the REACH restriction and thereby firmly fixed as belonging to the category ‘intentionally added’. As we will see, these filters played a role in which sources of unintentionally released microplastics were identified as in need of further consideration.

The differences in the short list of sources identified by the Impact Assessment Report and the Eunomia report are that the former includes geotextiles and detergent capsules, while collapsing the different types of paints into one category and excluding artificial turf. While geotextiles were not identified by the Eunomia report as a potential source in the first place, had it been on the long list, it likely would not have been selected as a problem driver due to its microplastic emissions being largely to the terrestrial environment, as was the case with the agricultural films. Detergents, on the other hand, were considered in the Eunomia report, but were excluded early on, having been categorised as being intentionally added. This coarse grouping failed to consider that while microbeads in detergents are certainly intentionally added, other sources of microplastics are also present in detergents, i.e. the films that are used in detergent capsules to contain the liquid detergent. Grouping various types of paints into one meant that their collective emissions earned them the spot of being top source of unintentionally released microplastics. The grouping of the paints is likely largely the result of one key report published by the environmental consultancy Earth Action in January 2022 titled “Plastic Paint the Environment”, cited in the report, which evaluates the contribution of multiple types of paints to plastic pollution, but presents them in a unified manner as a single source. An environmental policy officer also referenced the report: “we came across a study … because the people contacted us … to say that paints was most probably the first emitter of direct microplastic emissions” (P1, 2024). Here again is an example of how the coarseness of categorization shapes which issues gain prominence. That an environmental consultancy was able to make a significant contribution to policy development also echoes the way in which environmental NGOs were able to raise bring the topic microplastic pollution to the attention of EU policymakers in the first place. Scholars have argued that the current political climate is one that favours the anti-business position, as since the near completion of the single market in the 1990s, the EU has shifted form removing trade barriers to regulating the markets it has opened up (Zimmermann and Dür, 2021).

Comparing the sources of unintentionally released microplastics identified by the Eunomia report and the Impact Assessment Report and how they were arrived at has demonstrated how differences in categorisation, whether that be categorising a source as intentionally added or unintentionally released or using coarser of finer categories, and filters employed, i.e.

contribution to marine pollution vs pollution in the overall environment, lead to different policy priorities, which in turn have an impact on what kind of regulations are imagined and enter the realm of possibilities. This exercise not only reiterates the need for critical reflection on technical decision-making but also prompts the analyst to consider the dangers of “the blind leading the blind” (Bowker & Star, 2000, p. 48), in other words, how following categorisation work empirically can leave the analyst blind to the possibilities that did not materialise. In this case, considering the sources of unintentionally released microplastics identified by the Eunomia report would have left the analyst unable excluded from their analysis, which only comparison with the results of the Impact Assessment Report brought into purview.

Despite the original mandate from the Commission being to consider all major sources of unintentionally released microplastics and six sources being shortlisted in the preliminary analysis, the proposed regulation only concerns itself with plastic pellets (EC, 2023c). Two reasons were put forward justifying this change: firstly, the presence of existing product regulation which would be better suited to regulating microplastic releases form these sources (Table 7) and secondly, the lack of data to inform what kind of measures would be effective (EC, 2023b). On the flip side, regulations specifically targeting plastic pellets do not exist (the restriction on intentionally added microplastics exempt them, mandating only labelling and reporting) and enough evidence was available to draft targeted measures that are straightforward to implement, cost-effective, and ‘no regret’, i.e. not constraining future action. Returning to the refrain that “regulatory categories … provide meaningful ways of regulatory action" (Laurent, 2022, p. 10), we can see that in breaking down the larger category of unintentionally released microplastics into six sub-categories, it becomes possible to address each via a different regulatory instrument. This is another example of regulatory precaution while there is a recognition that unintentionally released microplastics are an issue that require addressing, regulatory tools are only employed where necessary, in this case, where existing measures cannot be drawn upon to address the problem. Taking this approach serves to prolong the time it takes for the microplastic emission reducing measures to come into force by postponing action from the present to when the relevant regulations are next due for revision, which is only extended if insufficient data is not available at that point to adequately inform policymaking.

Table 7: Existing regulation addressing sources of unintentionally released microplastics (EC, 2023b)

Microplastic source	Regulation
Paints	Regulation of the European Parliament and of the Council COM/2022/142 final establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC
Tyres	Regulation of the European Parliament and of the Council COM/2022/586 final on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7) and repealing Regulations (EC) No 715/2007 and (EC) No 595/2009
	Regulation (EU) 2020/740 on the labelling of tyres with respect to fuel efficiency and other parameters, amending Regulation (EU) 2017/1369 and repealing Regulation (EC) No 1222/2009
Synthetic textiles	Regulation of the European Parliament and of the Council COM/2022/142 final establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC (same as for paints)
Detergent capsules	Regulation (EC) No 648/2004 of the European Parliament and of the Council of 31 March 2004 on detergents
Geotextiles	Regulation (EU) No 305/2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

4.4.4 Regulating plastic pellets

The plastic pellet regulation is first and foremost an environmental regulation. This is reflected in fact that the legal basis for the plastic pellet regulation is Article 192 of the TFEU, which outlines the political process by which environmental legislation is passed in the EU (EC, 2023c). However, a more detailed reading of the proposed regulation and the accompanying Impact Assessment Report reveals the ways in which environmental goals are tightly intertwined with economic ones. Not only is the reduction of plastic pellets framed as conferring economic benefits in addition to environmental ones, but regulations are also applied cautiously so as not overburden the plastics industry.

Within the plastic pellet regulation, plastic pellets are characterised as bringing about adverse effects to the environment, on the climate, potentially on human health, and on the economy (EC, 2023c). The economic costs associated with plastic pellet pollution are identified as economic losses for the plastic pellet industry in the amount of €52–184 million, indirect consequences for the fishing and agriculture industries due to reduced yield as well as the tourism and recreation industries due to the pollution of natural areas, and the costs

associated with clean-up and monitoring efforts (EC, 2023b; EC, 2023c). Accordingly, the general objective for the regulation is described as being “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” (EC, 2023c, p. 24-25, emphasis added). In this way, efforts to reduce plastic pellet leakage are simultaneously framed as conferring both environmental and economic benefits.

An additional benefit of the regulation is that it allows for the harmonization of approaches towards plastic pellet regulation, reducing the danger that measures implemented at the national level would threaten the single market (EC, 2023b). This danger is not only an abstract one: at the time of the publication of the proposal (October 2023), legislation governing plastic pellet emissions was in place in France and Austria and forthcoming in Belgium (EC, 2023b). More specifically, France had introduced various equipment and procedural obligations, such as identifying key sites of pellet spillage, designing packaging to minimize pellet losses, and training staff members (EC, 2023b). While plastic pellets are covered under Austria’s General Waste General Wastewater Emission Ordinance, the threshold is set such that such that plastic pellet emissions equivalent to 2.7 million PET bottles (94.5 metric tons per year) are allowed under the regulation (Lechner & Ramler, 2015). Belgium aims to control plastic pellet losses through introducing requirements for BATs in order to obtain an environmental permit (Prins, 2023). Evidently, the regulatory landscape had been fragmented not only in terms of the degree of allowable pellet release, but also with regards to the means of regulatory action. A European-level regulation would allow for these differences to be smoothed out and create an event playing field for actors in the plastics industry (EC, 2023b). By framing the reduction of plastic pellets as a route to environmental protection and economic growth as well by viewing it as an environmental regulation which works double duty to harmonize the European plastics industry, the report taps into the narratives of win-win solutionism characteristic of circular economy initiatives (of which the plastic pellet regulation is one) in order to mobilize support behind them (Kovacic et al., 2020).

Nevertheless, the Impact Assessment Report acknowledges that implementing actions to prevent pellet losses are associated with costs and that the reduction and prevention of pellet losses should be carried out in an “economically proportionate manner” (EC, 2023c, p. 25). When evaluating different policy options, the increase in administrative and adjustment costs incurred as a result of the change in policy was awarded the same significance rating (‘+++’, the highest possible) as improvements in ecosystems and biodiversity, illustrating how these two considerations are on equal footing (EC, 2023b). Two measures are suggested in the

regulation proposal, both of which demonstrate features that speak to this balancing act (EC, 2023c). The first is the development of a standardised methodology to quantify pellet losses, which would allow for reporting quantities of pellet losses as mandated by the REACH restriction as well as for monitoring pellet reduction measures and informing future actions (EC, 2023b; EC, 2023c). Efforts to develop a standardised methodology was already underway as a part of the OCS (Operation Clean Sweep) certification scheme and this was envisioned as being the starting point for the EU's harmonized methodology (EC, 2023b). Nevertheless, the European Commission estimates that it would require three to four years for the CEN to finalize such a procedure. The second measure is the implementation of best practices in order minimize pellet loss, audited and certified by a third party (EC, 2023c). Small and micro-sized businesses would be subject to lighter requirements (delayed entry into force, longer periods between recertification, exemption from costly interventions such as sewage treatment) due to the costs associated with compliance being a bigger burden than for larger operators, while companies working with less than 5 metric tons of plastic pellets would be exempted altogether in order to prevent costly interventions that have minimal effect (EC, 2023b). Again, this measure was based on already existing best practices: the OCS certification scheme and the French plastic pellet regulation. The OCS certification scheme was launched in January 2023, but members of the European plastics industry have been signatories of the pledge to work towards zero plastic pellet loss since 2015. Given that efforts to reduce pellet losses have been underway for the past decade, this second measure is viewed by major European plastics companies as "relatively straightforward and quick to implement" (EC, 2023b, p. 34). The French plastic pellet regulation, meanwhile, is the source of the 5 metric ton limit for exemption, a figure which comes from public consultation (EC, 2023b). By drawing on existing efforts, the plastic pellet regulation minimises the costs incurred by industry by introducing few novel requirements. Furthermore, the separation of industrial actors into three categories by size—producing/handling under 5 metric tonnes, small and micro-sized businesses, and larger businesses—allows for the regulation to apply to each in differentiated ways in another instance of regulatory categories at work. Together, building the plastic pellet regulation around new initiatives and employing categories to reduce the strength of the regulation further demonstrate how the Commission, while eager to put the precautionary principle into action is cautious in the use of their regulatory powers (Laurent, 2022).

5 Discussion and conclusions

Studying the EU documents in detail has revealed the tremendous amount of work that goes into turning something as unruly as microplastics into a matter of concern for the EU and into an object that can be governed. This last section draws together the empirical observations presented in the previous sections into four overarching themes.

5.1 Linking together environmental and economic concerns

One trend that was observed time and time again in the regulation of microplastics was the strength of arguments appealing to the European economy in driving forward policymaking within the EU. This is not only restricted to microplastics policy, but takes place across environmental regulation broadly, as discussed in the interview with the policy officer as well as in social science literature on EU circular economy policy (Interview P1; Kovacic et al., 2020). In the present case study, economic arguments were instrumental in raising microplastics as an issue within the EU as well as driving forward regulation on intentionally added and unintentionally released microplastics.

Following Marres' (2004) conceptual approach of issue formation which emphasises how issues do not simply exist, but must be brought into being, the empirical section began with an exploration of how microplastics emerged as a matter of concern within EU policymaking. I identified traces of microplastic activism in the early policy documents and pointed to early efforts to integrate microplastics into the policy discussion but found that it only really got taken up within the context of the circular economy discourse. More specifically, it was only through framing microplastics as a barrier to innovation and a threat to the single market as well as positioning it in the context of the Circular Economy Action Plan that it got taken up as a policy issue in its own right. In other words, it was only in framing microplastics as more than an environmental issue that it gained traction as a matter of concern.

In looking at the regulation of intentionally added microplastics, the fragmentation of the single market was again raised as a driver in addition to the environmental and health concerns for introducing a restriction on the substance under the REACH regulation. This dual motivation is not only present as a written justification but is also ingrained in the legal structure of the REACH regulation. The regulation states in Article 1 that its purpose is "to ensure a high level of protection of human health and the environment … as well as the free circulation of substances on the internal market while enhancing competitiveness and innovation" (Regulation (EC) No 1907/2006). The centrality of the appeals to the single market is reiterated through the legal basis of the REACH regulation, Article 95 of the Treaty establishing the European Community, which governs internal market matters. Laurent (2022) recognizes this feature of the REACH regulation, describing it as "a device meant to organize the market

primarily by stating the characteristics that all chemicals need to follow to be granted the ability to circulate throughout Europe" (p. 118). In the case of restricting intentionally added microplastics, we can invert this observation, as the restriction defines exactly what kinds of microplastics cannot be placed on the market. That this dual framing is unique to the EU is apparent when contrasting it with how environmental NGOs frame microplastics. They view intentionally added microplastics as a substance that must be banned no matter the cost to industry, a position illustrated by the response of the Beat the Microbead campaign to the scope of the REACH restriction. While the ECHA allowed for exemptions of certain classes of intentionally added microplastics and introduced transition periods for various applications, the campaign called for tighter restrictions based on the arguments that the restriction would only cover 4% of microplastics currently being used and that transition periods are allowing microplastics to continue to enter the environment for years in instances where they are restricted (Bouwens, 2022).

The regulation of unintentionally released microplastics similarly problematized them as being detrimental to ecosystems, biodiversity, and human health on one hand, and bringing about devastating economic on the other, which in turn shapes the kinds of interventions envisioned for this class of microplastics. This was the case both early in the regulatory process where the scope of the regulation included all sources of unintentionally released microplastics as well as once it had been narrowed down to focus on plastic pellets. In the former case, market instruments, which would encourage the reduction of unintentionally released microplastics to the environment while maintaining the integrity of the single market and promoting sustainable innovations, were suggested. The proposal for the plastic pellet regulation also developed measures that would bring about a reduction in the leakage of plastic pellets at minimal cost to the actors along the plastics supply chain. Evidently, bringing economic concerns to resonate with microplastics as well as environmental ones was central in driving policymaking. Resulting regulatory measures then reflected this problematization by repeatedly moderating measures in order to respect the interests of European industry.

5.2 Technopolitical practices

Barry (1994) has observed a scientization of politics within the EU institutions, whereby issues requiring political discussion are recast as technical problems to be addressed by a specialised group of bureaucrats and experts. This articulation between scientific knowledge and political negotiations is so commonplace in the EU that Laurent (2022) gives it a name: European objectivity. European objectivity is visible in the two reports that first imagined possible policy options for microplastics, where consultants drew upon their expertise in order to make recommendation; in the REACH restriction report (ECHA, 2019a), the writing of which

was delegated entirely to the ECHA; and in the Impact Assessment Report (EC, 2023b) developing the regulation on unintentionally released microplastics, which while authored by the DG ENV, undertook an analytical process similar to the consultancy and restriction reports in identifying possible sources of unintentionally released microplastics. While basing regulation in these technical analyses provides regulatory decisions with legitimacy, it simultaneously hides from view the interests that are being woven into the fabric of these regulations (Laurent, 2022). Being attentive to these technopolitical practices is therefore a necessary starting point for considering how these processes might be reimagined in a more democratic way. In the regulation of microplastics, technopolitical practices manifested in the various ways in which categories, filters, and data availability were employed to direct the course of regulation development.

5.2.1 Regulatory categories

Firstly, we traced the emerge of the three categories of microplastics now commonly found in regulation: intentionally added, unintentionally released, and created from the degradation of plastic waste. These can be understood as regulatory categories not just because they are present in regulatory texts (as opposed to the classification of primary and secondary in scientific papers), but because they allow for regulatory action (Laurent, 2022). Intentionally added microplastics are to be addressed via the REACH restriction; unintentionally released microplastics, through product-specific regulation; and those generated from plastic waste, through plastic regulation more generally. In a similar way, intentionally added microplastics were given a ‘regulatory definition’ within the REACH restriction such that the restriction could be applied specifically to those intentionally added microplastics the restriction viewed as harmful, i.e. released to the environment and persisting for long periods of time, as well as those for which compliance with the ban could be monitored, i.e. within the size range detectable by current monitoring techniques.

In addition to categorizing and defining microplastics such that regulation could be applied to them, categorization was also used in order to apply the regulation in a differentiated manner with the aim of reducing the scope of regulation. The notion of regulatory precaution describes the ways in which EU institutions are tentative in their use of their regulatory power (Laurent, 2022). Regulatory precaution was present in the development of the both the REACH restriction on intentionally added microplastics as well as the regulation on unintentionally released microplastics. In the REACH restriction, different applications were specified in order to extend transition times or exempt them from the regulation altogether. For example, microplastics which provide detergents with fragrances were differentiated from microplastics in detergents in order to grant three more years to their transition period and microplastics used in in vitro devices were exempted. An analysis of unintentionally released microplastics

likewise demonstrates how they were differentiated by source with only one—plastic pellets—being the focus on the final regulation. Within the plastic pellet regulation as well, companies in the plastic supply chain were categorised by size so that lighter requirements could be set for micro and small enterprises and companies producing or handling less than 5000 metric tons could be exempted altogether.

5.2.2 Filters

In addition to categories and definitions, filters were employed in order to arrive at key sources of intentionally added and unintentionally released microplastics. For intentionally added microplastics, the key sources were those contributing significant emissions based on the available data. Data availability, then, was a filter by which what sources of intentionally added microplastics were assessed in the report. Key sources of unintentionally released microplastics were identified in a similar process of elimination. In this case, however, whether a given source contributed to marine pollution was a more decisive factor. Not only would sources contributing to microplastic pollution elsewhere be excluded from the analysis, but the top six sources were selected based on emissions to surface waters, rather than total environmental emissions. Additionally, plastic pellets and artificial turf, despite better suiting the category of intentionally added microplastics, were included in the Eunomia report. When the Impact Assessment Report revisited this topic during the development of the regulation on microplastics, they considered overall emissions, altering which sources were considered top six. Furthermore, certain categories were merged while others were divided. Together, filters and categories render some sources of microplastics more visible than others, which is of significance in the policy context as they are the ones which will receive more regulatory attention. Additionally, by highlighting individual sources, less attention is paid to solutions which could potentially mitigate pollution from multiple sources at once, such as implementing filtration systems at wastewater treatment facilities. In this way, the notion of regulatory categories can be expanded to encompass other kinds of standards which equally transform objects into regulatable entities.

5.2.3 Ignorance

While the case of microplastics reiterates the traditional narrative of agnotology in policy making, it serves to add texture to an otherwise simplified narrative. A refrain that emerged from the documents again and again was the lack of data. In the consultancy reports as well as in the Impact Assessment Report, the lack of publicly available data meant that certain sources of microplastics could not be quantified, which in turn excluded them from the final analysis. Even in instances where high-level estimates were available, the lack of more detailed release patterns was cited as an obstacle to designing effective regulatory

interventions. It was for this reason that the initiative to develop regulation around unintentionally released microplastics was toned down to target plastic pellets only. In both these scenarios, it is easy to imagine industrial actors strategically withholding information in order to prevent or delay regulation in their fields. Interviewee P1 alluded to as much, when in describing the Call to Evidence process, he noted how “businesses can send evidence as well but on the environmental files they … rarely do because it’s often against their own business” (P1, 2024).

Taking a closer look at the case of microplastics policy, however, reveals instances which diverge from the traditional narrative. Boudia et al. (2021) have written about the asymmetry of information between industry and regulators when new chemicals are registered and how it plays in the favour of industry as in the face of insufficient data, regulators tend to default to economic considerations. However, the REACH restriction process has as its starting point a blanket ban from which exemptions are carved out. Consequently, not providing the requested data may lead to possible exemptions not being granted. In this instance, then, generating ignorance does not favour industry. Similarly, taking a closer look at the plastic pellet regulation reveals that the measures proposed largely followed the voluntary initiatives put in place by industry. Where future regulation is likely, then, setting up your own infrastructure for data handling appears to be a method by which industrial actors can structure regulation in advantageous ways.

5.3 Rethinking democratic participation

While the scientization of politics allows for new kinds of actors—technical experts—to join the political discussion (Barry, 2001), these discussions take place in domains that are not only conventionally not perceived as spaces of political decision-making, but also in places that are more advantageous to some (industrial actors) more than others. In the case of the REACH restriction, input was primarily solicited from companies producing products with intentionally added microplastics prior to and during the writing of the report, with more limited contribution from scientists and environmental organisations. Once the restriction report was made publicly available on the ECHA website, the chance to provide feedback was in theory open to all. In practice, however, articulating responses required well-versed in the specialised language of the report as well as being well enough acquainted with the restriction process to know that such opportunities exist in the first place, resulting in a participatory environment hostile to citizens not well versed in the issue. While the restriction of intentionally added microplastics took the form of an implementing act, specifying how the REACH regulations should be implemented, the regulation on unintentionally released microplastics was an entirely new one and therefore subject to participatory processes as outlined in the Commission’s Better

Regulation guidelines. To this end, the Call for Evidence, Open Public Consultation, and stakeholder workshops, were advertised in a much more accessible way on the European Commission website. Nonetheless, as the regulation took more concrete from, consultations were narrowed to focus on industry actors as they were viewed as holding the expertise on the matter and business associations were the primary respondents in feedback provided on the regulation proposal. The greater opportunities for participation available to industrial actors is reflected in both the REACH restriction and the plastic pellet regulation, both of which take a risk-based approach, that allow for the continued released of microplastics so that business can continue as (more or less) usual, rather than a precautionary approach that refuses to gamble with substances that are potentially hazardous to human health (Laurent, 2022). These instances of unequal participation in shaping regulation proliferate when, as argued in the previous section, regulatory precaution leads to a preference for a piece-meal approach to regulation over overarching measures (Laurent, 2022).

Despite this uneven balance of power, Laurent (2022) argues that the interested nature of European objectivity should not be reduced but accepted as commonplace and even cultivated as an opportunity to open regulatory processes up to more democratic forms of participation. Scholars (Venturini & Munk, 2022; Laurent, 2022) have demonstrated how objects have the ability to resonate with peoples' concerns and therefore provides a pathway for a more democratic form of politics. Tarpgaard (2021) has shown that this is also the case for microplastics: Danish citizens mobilized the issue of microplastics after realising that the plastic kitchen cloths they use daily release microplastic fibres down the drain. We have also seen how public campaigns against microbeads in cosmetic products were successful in brining public awareness to the issue as well as mobilizing regulatory action on microplastics more generally. Linking microplastics back up to the sources from which they are emitted maybe therefore be an effective first step in better integrating European publics and their concerns into political decision-making.

5.4 Politics of time

Another cross-cutting theme present across the documents studied is the regulatory temporalities that by and large serve to delay the implementation of controls on microplastics. This manifested in three different ways. Firstly, institutional temporalities largely dictated when it was possible for microplastics to emerge as an issue. While the issue of microplastics gained prominence in the scientific field in the 2000s, it was only referenced in EU policy documents in 2013 in the context of an overhaul to waste regulation more generally. Furthermore, it was only in 2016 when taken up within the circular economy agenda that it gained traction, with the Plastics Strategy committing to addressing both intentionally added and unintentionally

released microplastics in early 2018. While microplastics were included in some policy revisions between 2013 and 2016—specifically to the Ecodesign regulation outlining the criteria for products to receive the Ecodesign label and the Marine Strategy Framework Directive requiring Member States to monitor the amounts of pollutants present in their ocean waters—these did not address microplastics directly. Microplastics were therefore integrated into EU policymaking regulations and narratives receptive to them emerged from within the EU.

Once direct action commenced on the regulation of microplastics, one of the first steps was the development of the restriction of intentionally added microplastics under REACH. The policy officer interviewed elaborated on how this was a much easier course of action than developing a policy from scratch due to the existing infrastructure, despite the fact it was originally designed for chemicals and therefore needed to be adapted for use with microplastics (P1, 2024). The REACH restriction however exempts several applications of microplastics from the restriction in order to avoid double regulation. However, those regulations have their own timelines for revision, delaying the prevention of releases from those sources. A similar reliance on existing regulatory tools is also visible in the case of unintentionally released microplastics. Although the Commission initiated the process of regulating unintentionally released microplastics with the intention of developing a new piece of legislation, the responsibility of reducing releases from most sources was delegated to pre-existing regulations dealing with those products. While a new regulation on plastic pellets was developed on the basis that there was no preexisting regulation on them, it nonetheless drew heavily upon existing the monitoring and certification scheme voluntary developed by actors in the plastics supply chain. While not explored much in this empirical analysis, the AMF report on intentionally added microplastics also speaks of ‘regulatory consistency’, the need to align EU regulation from those of other countries and transnational alliances so as to reduce the costs of compliance with a diversity of regulation (Scudo et al., 2017). With respect to microplastic regulation, regulatory consistency takes the form of a uniform definition of microplastics as well as the adoption of microplastic regulation on a similar timeline. Successfully regulating a policy object therefore requires alignment not only with the EU’s regulatory temporalities, but global ones as well. In some cases, this means that regulations are introduced more swiftly than otherwise would have been possible, but in others, addressing the issues is delayed to a future point in time. When regulating microplastics, this is especially problematic as they are near impossible to recover once released to the environment and take hundreds of years to fully degrade.

In the discussion of regulatory categories, we saw how both the REACH restriction and the plastic pellet regulation include the use of transition periods. While the REACH restriction

entered into force on October 17, 2023, various applications were granted transition periods in order to develop alternatives to microplastics, the longest instance of this being for lip, nail, and make-up products, which are only required to be microplastic-free 12 years following the entry into force of the restriction. Although to a lesser extent, in a similar manner to the REACH regulation, the plastic pellet regulation requires companies to obtain third-party certification that they have implemented the mandatory measures to mitigate plastic pellet loss within 24 months of entry into force of the regulation but extend this requirement to 36 months for medium-sized operators. In multiple ways, then, caring for microplastics is entangled in existing institutional temporalities. Firstly, when microplastics are taken up as a policy issue is to a large extent dictated by broader regulatory movements within the European Commission. Secondly, the regulation of microplastics builds upon the EU's existing regulatory framework, which had the effect of expediting some regulatory action while delaying others. Finally, regulatory restrictions are applied cautiously, delaying the implementation of the measure outlined in the regulation even once it has come into force.

5.5 Final comments

Since the Commission put forth their proposed plastic pellet regulation in October 2023, the European Parliament (in April 2024), followed by the Council (in December 2024) have both published their positions on the proposal and are, at the time of writing, engaged in trilogue negotiations (EP, 2025). Between June 2013 when microplastics first emerged on the policy scene and now, the only regulatory measure in place specifically targeting microplastics is the restriction of intentionally added microplastics under the REACH regulation, and this is but a small step: intentionally added microplastics comprise a very small percentage of total volume of microplastics in the environment. Beyond plastic pellets, the regulation of unintentionally released microplastics has been relegated to the future, to a time when more data on their release patterns are available and when relevant regulation is scheduled for revision. As long as we continue to generate and mismanage plastic waste, this will continue to be a source of microplastics as well. Even if we stop emitting microplastics today, there is still the issue of the microplastics already present in the environment, the legacy of the Plastics Age. Microplastic regulation leaves a lot to be desired, but what can be learned from having examined in detail the EU's regulatory processes?

On one hand, we have seen how people mobilize around objects and how the force of this sort of political engagement can trigger action at higher levels of governance. The Beat the Microbead campaign gained tremendous momentum, with Greenpeace petition for a ban on microbeads in the UK receiving 365,000 signatures in four months, becoming the largest environmental petition to reach the government at the time (Buranyi, 2018). On the EU-level

as well, traces of their influence are visible in the early documents flagging microplastics in cosmetic products as a potential issue. On the other hand, the technical nature of the regulation drafting process means that those who contribute to shaping its development are more often than not industry experts whose interests are not representative of the broader public. Environmental organisations are perhaps the actors best suited to bridge this gap by translating peoples' concerns into technical input. Recognising the politics that plays out in technical spheres is the first step towards imagining a more democratic European Union.

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