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RESEARCH ARTICLE

Fragmented Circularity: Power Asymmetries and Stakeholder Perspectives in the European Plastics Value Chain

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Abstract

Scholarship increasingly recognises that the move towards circular economy is not merely technical but also socio-political, involving contested meanings, conflicting interests and uneven power relations. We contribute to this literature by showing how different actors in the European plastics value chain encounter distinct barriers and hold unequal levels of power and influence within the chain, shaped by their geographic locations, market positions, and framings of circularity. Based on 22 interviews with 27 European recyclers, manufacturers of plastic products/components, and their representative organizations, we show how uneven perceptions of power and responsibility shape "fragmented circularity", undermining the effectiveness of circular economy initiatives.

Keywords Barriers to Circularity · Circular Economy · Circular Ecosystems · Plastics Recycling · Policy-Making · Power Relations · Sustainability Perceptions · Value Chain Governance

1. Introduction

The concept of circular economy (CE) and the move towards it have, to some extent, become taken for granted in European policy and business circles (Friant et al., 2020; Korhonen et al., 2018), and in academia as well, considering the rise of specialised academic journals focused on circular economy. However, what "circularity" entails and how to move towards it in practice remains far from clear. While policy documents and corporate strategies often cast CE as an ostensibly "win–win" strategy that reconciles economic growth with environmental protection (e.g. Friant et al., 2020; Kovacic et al., 2019), a growing critical literature stresses that circular economy is an essentially contested concept whose concrete transition pathways involve political struggles and unevenly distributed costs and benefits (Korhonen et al., 2018; Corvellec et al., 2021; Niskanen & McLaren, 2021; Pansera & Owen, 2018; Tukker et al., 2024). CE scholarship increasingly recognises that the concept is not merely technical but also political, involving contested meanings, conflicting interests and uneven power relations (Korhonen et al., 2018; Corvellec et al., 2021; Friant et al., 2020). This makes it essential to examine how actors themselves frame circularity, how they define the problems that CE is supposed to solve and how these framings shape emerging transition pathways.

CE research has gradually moved from linear value-chain perspectives towards notions of circular business or industrial ecosystems, emphasising multi-actor configurations, interdependencies and systemic coordination (Kanda et al., 2021; Litaudon & Chen, 2023; Marques-McEwan et al., 2023). Studies on circular ecosystems and industrial symbiosis emphasise that aligning heterogeneous actors in complex socio-technical systems such as plastics requires shared rules, coordinated investments and new governance arrangements (Arnold, 2022; Litaudon & Chen, 2023; Siltaloppi & Jähi, 2021). Within this literature, the plastics value chain

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increasingly appears as a paradigmatic case in which circularity demands simultaneous adjustments in production technologies, collection and sorting infrastructure, and regulatory frameworks (Bucknall, 2020; Maione et al., 2020; Siltaloppi & Jähi, 2021). Together, this work can be seen as part of a broader circular economy transition literature that examines how technological, infrastructural, organisational and institutional changes must align for shifts from linear to circular systems to occur.

At the same time, the mainstream CE transition literature tends to conceptualise coordination as a technical or organisational challenge rather than a field of power. Barriers to circularity are typically categorised into technological, economic, regulatory, cultural or organisational factors, and solutions are framed in terms of improved coordination, governance mechanisms or orchestrator capabilities (de Jesus & Mendonça, 2018; Kirchherr et al., 2018; Frishammar et al., 2025). Although some studies acknowledge asymmetries between actors, such as those between manufacturers, recyclers, retailers or producer responsibility organisations, power is often addressed only implicitly, for example through discussions of who can "orchestrate" ecosystems (Zaoual & Lecocq, 2018; DiVito et al., 2025).

By contrast, a growing body of critical CE scholarship shows that circularity is shaped by struggles over problem definitions, competing interests and uneven capacities to influence agendas (Corvellec et al., 2021; Valenzuela & Böhm, 2017; Kovacic et al., 2019; Hendriks, 2024). These studies demonstrate that circular transitions are political processes in which actors mobilise material, structural and discursive power to shape what counts as circular, which solutions are prioritised and who bears the costs.

Against this backdrop, less attention has been paid to how actors themselves construct the problems that circularity is meant to address, what assumptions underpin these constructions and how these framings relate to and reproduce power asymmetries within value chains. Yet these problem representations matter: they shape which solutions appear feasible, who is expected to act and how responsibilities are allocated. Addressing this gap, our study examines *power dynamics and stakeholder perspectives in the European plastics value chain*. We ask the following research questions: How do actors in the plastics value chain frame circular economy and sustainability?; How do different actors perceive their own and others' power and responsibilities in relation to circularity?; and How do these perceptions relate to the concrete barriers and opportunities they identify? Drawing on 22 interviews with 27 European recyclers, manufacturers and their representative organisations, we show how differences in market position, geographical location and understandings/framings of circular economy and wider sustainability contribute to producing what we call *fragmented circularity* – coexisting and sometimes incompatible visions of what circularity requires and how it should be achieved.

2. Theoretical Framing

Efforts to operationalise and achieve the circular economy have generated a substantial body of research across policy, business and academic domains (Friant et al., 2020; Korhonen et al., 2018). Yet despite its prominence, the practical steps required to realise circularity remain difficult to specify and achieve. Much of the existing literature approaches the transition through a barriers-and-solutions approach, mapping the obstacles that hinder progress and outlining how these might be addressed. Within this perspective, moving towards a circular economy is typically understood as identifying and overcoming a diverse set of barriers. Although studies indicate that concrete barriers to be overcome relate to the sector, type of material and type of actor (e.g. producer, recycler, waste collector, consumer), research has concluded that in broad categories barriers and facilitators for the move towards circular economy can be classified as technological/technical, economic/market, regulatory/legislative, organizational, collaborative, and cultural/social (e.g. Baldassarre et al., 2022; de Jesus et al., 2018; Kirchherr et al., 2018; Paletta et al., 2019). For a recent comprehensive overview, see Frishammar et al. (2025).

For example, for the circular practices involving recycled plastics, limited quantity and quality of recycled plastics and their high or volatile price compared to primary plastics can act as important technological and economic barriers, especially for producers who depend on certain types of polymers (Milios et al., 2018). For recyclers, important economic and technological barriers relate to the lack of sufficient amounts of homogeneous and clean waste and the lack of existing facilities that would be able to process inferior quality waste, a development that would need considerable investments, and thus financial incentives (Milios et al., 2018; Siltaloppi and Jähi, 2021). Depending on the sector, concrete barriers and facilitators might differ as

well (Baldassarre et al., 2022), considering the type of products produced and existing regulations that apply for a specific industry.

The type of solutions offered to overcome identified barriers include better coordination of the value chain (increased cooperation and alignment across the chain), infrastructure development, increasing investment in technology development, banning the incineration of recyclable materials and other supportive regulatory changes, and reducing the number of different polymers and additives when producing products (Maione, Lapko and Trucco, 2022; Milios et al., 2018; Siltaloppi and Jähi, 2021). Critical literature emphasises that systematic and all-encompassing changes are necessary, including reconfiguring existing institutions and societal norms and reshaping societal systems to support the move (Iacovidou et al., 2025).

The barriers-to-solutions framing is increasingly echoed in the circular ecosystems literature, which extends the analysis from individual firms to multi-actor configurations and emphasises the need for more integrated system coordination. In this research strand, challenges to circularity are typically conceptualised as issues of misaligned incentives, insufficient connectivity, or missing governance mechanisms among interdependent actors (e.g. Pietrulla, 2022; Kanda et al., 2021; Aryee et al., 2025). Consequently, proposed remedies often focus on designing or strengthening ecosystem-wide structures of collaboration – through shared roadmaps, harmonised standards, digital traceability tools, or orchestrator roles tasked with aligning stakeholders and facilitating value co-creation (e.g. Bauwens et al., 2020; Battistella & Attanasio, 2025; Kanda et al., 2021; Litaudon & Chen, 2023; Marques-McEwan et al., 2023). This work provides valuable insights into how circularity requires new forms of coordination across organisational boundaries and how collective outcomes depend on the quality of these interactions (Aryee et al., 2025).

Taken together, the barriers literature and the circular ecosystems strand can be seen as key components of an emerging circular economy transition perspective, which seeks to explain how shifts from linear to circular systems unfold across technologies, infrastructures, organisations and institutions. CE transition research highlights that circularity is not achieved by isolated firm-level changes, but by the gradual alignment of socio-technical systems and multi-actor configurations (Bucknall, 2020; Kanda et al., 2021; Siltaloppi & Jähi, 2021).

However, the literature tends to frame such coordination primarily in functional terms: as a matter of efficiently integrating resources, synchronising activities, and embedding circular practices across a network. In doing so, it often assumes a baseline compatibility of interests and problematises collaboration mainly when it fails to deliver expected synergies. Only a handful of recent empirical studies explicitly foreground hierarchy and shifting "power positions" within circular ecosystems: for instance, Huikkola et al. (2025) on waste-management ecosystems in Finland, Marreiros Barbosa et al. (2024) on extractive fishing in the Brazilian Amazon, and Battistella and Attanasio (2025) on a circular innovation ecosystem in the coffee industry. Yet, even these studies focus mainly on the capabilities and practices of orchestrators rather than on broader structural power asymmetries. What receives far less attention are the asymmetries that shape who can steer collective arrangements, who defines the goals of coordination, and whose concerns or constraints are rendered peripheral. The language of orchestration and co-creation implicitly acknowledges hierarchy – some actors have more capacity to "orchestrate" than others – yet this is rarely theorised as a question of structural power, uneven influence, or discursive authority. As a result, the circular ecosystems literature tends to underplay how different actors may not only hold divergent priorities, but also have unequal abilities to impose their definitions of circularity or shape the trajectories of transition.

In other words, much CE transition work, especially in its ecosystem variant, explains *how* coordination should occur, but pays less attention to *how different actors understand the transition itself* and *how power asymmetries shape those understandings*. This is where our study departs from most existing transition and ecosystem analyses: instead of focusing on orchestrator roles or coordination mechanisms, we examine how actors in the plastics value chain frame circularity and CE transitions through distinct problem representations, and how these framings are intertwined with their instrumental, structural and discursive power.

All in all, we focus on an important blind spot that the circular economy barriers literature has mostly neglected and circular ecosystems literature downplays, namely the role of existing and changing power dynamics of producers and recyclers (and also other actors involved). By "power" we refer to a capacity of social agents – like companies in the plastics value chain – to further their interests (Lukes, 2005), including influencing legislation and the functioning of the value chain. We argue that due to power dynamics – resulting from companies' position in the value chain, brand reputation, and geographical location among other things – their willingness and concrete aims for moving towards circular business models differ. This line of reasoning is supported by the basic principles of critical sociology and the political economy of business power literature (e.g. Fairfield, 2015; Levy and Egan, 2003) which highlights that firms have different levels and types of power

(especially instrumental and structural, but also discursive) depending on their market position. For example, Mah (2021: 126) calls the circular economy "a complex, global arena of political struggle over the future of industrial transformation" where company strategies and power are crucial in framing and shaping outcomes.

What is more, as Korhonen et al. (2018) among others have argued, circular economy is an essentially contested concept, being perceived as something positive to be aspired towards, yet lacking conceptual clarity. This makes especially salient the possibility that different actors can understand or strategically interpret the circular economy quite differently and argue for the solutions and practices that align with their interests (Friant et al., 2020; Rhein and Sträter, 2021). Thus, we argue that considering power resources and dynamics in the move towards circular economy is crucial, as it can influence how issues around circular economy are framed and what kind of solutions are preferred. In the context of the plastics value chain, this implies that barriers cannot be interpreted only as misaligned incentives or insufficient technology, but as outcomes of uneven capacities to shape the emerging circular ecosystems.

Our use of the WPR framework (Bacchi & Goodwin, 2016) in the empirical sections can therefore be read as a contribution to CE transition theory: by analysing how different actors *represent* the problems that circularity and CE transitions are meant to solve, we show how fragmented circularity pathways emerge from competing problem framings that are themselves conditioned by unequal power relations within the value chain.

3. Methods

3.1. Research Design and Rationale

This study examines how actors in the European plastics value chain frame circular economy (CE), sustainability, and their own and others' power and responsibilities. Because these questions concern interpretations, meaning-making, and problem representations, we adopted a qualitative research design based on semi-structured interviews with organisational actors. Qualitative interviewing was well suited to capturing how practitioners articulate barriers, responsibilities, and power dynamics from their own situated perspectives. We address the research questions outlined in Introduction.

To analyse how actors construct "the problem" of circularity, we used Bacchi and Goodwin's (2016) *"What's the Problem Represented to Be?" (WPR)* approach. Although originally developed for policy analysis, WPR is increasingly used to examine organisational, institutional and governance framings. This makes it appropriate for our study for three reasons: (1) CE transitions are shaped by stakeholder framings of what counts as "the problem," (2) power asymmetries often manifest discursively through the ability to define appropriate solutions, and (3) WPR provides a structured set of analytical questions for identifying assumptions, silences and power effects in interview material.

The WPR framework therefore enabled us to examine how manufacturers, recyclers and industry associations articulate the challenges of circularity, the assumptions that underpin these articulations, and the power relations they reveal.

3.2. Sampling Strategy and Case Selection

The data for answering these questions was collected in the framework of PRIMUS project during 2024. One aim of the project was to capture perspectives from organisational actors operating in or representing the automotive, household appliance and plastics recycling industries (Kall et al., 2025). These sectors were selected because they are highly plastics-intensive and subject to EU-level CE pressures. We targeted companies headquartered and/or operating in Estonia, Finland, Germany and Spain, as these countries differ in industrial structure and recycling infrastructure, enabling us to capture variation in perceived barriers and power asymmetries. We aimed to involve both market leaders, sustainability innovators and those more sceptical towards green transition and both parts manufacturers and original equipment manufacturers (OEMs). Contacts for potential interviewees were found via web searches and through PRIMUS project network.

We had to revise our initial sampling strategy for two main reasons. First, the home appliance and automotive sectors are practically non-existent in Estonia, prompting us to include plastics-parts manufacturers

serving other industries. Second, several target groups, particularly automotive OEMs, declined participation, resulting in a less diverse sample than originally intended and requiring extended recruitment beyond the initial countries. These constraints constitute important methodological limitations. See Table 1 for the overview of interviews. All in all, we conducted 22 interviews with 27 individuals (occupying different managerial, technical or policy positions) representing organisations in 10 different European countries.

Table 1. Overview of stakeholder study interviews

Interview code	Type of organisation	Number of interviews	Number of interviewees**
HAM	Home appliance manufacturer (OEM)	3	5
APM	Automotive parts manufacturer	5*	7
PPM	Plastic parts manufacturer outside home appliance and automotive sectors	5	5
ITA	Industry trade association	5	5
R	Recycling company	4	5

* Two of them also produce some parts for the HA sector. ** In some cases, two persons from the same company (usually complementing each other's expertise) were interviewed.

3.3. Data Collection

In-depth open-ended interviews lasted between 17 to 86 minutes, average length being around one hour. Four were done face-to-face, and most by using video-conference software. All participants provided informed consent. Interviews were anonymised and organisational identifiers removed to ensure confidentiality.

While asking the questions, our aim was to be as open as possible and not to direct interviewees, but rather let them tell about their perspectives and experiences. For example, we did not define sustainability or circular economy, but asked what it meant for them. Allowing interviewees to express their own conceptualisations first was a crucial part of our methodology, as it helps us to access the discursive discussion surrounding CE. Main topics covered related to sustainable production and CE (including the EU's Green Deal), the use of recycled plastics in automotive and home appliance industries, associated barriers and opportunities, and the influence of national and European regulations.

3.4. Data analysis

Data analysis followed a three-stage process that combined inductive coding with the deductive structure of the WPR framework. During the first stage, two researchers independently coded transcripts using inductive open coding focused on circularity framings, barriers and opportunities, responsibility attributions, and references to influence or power. Coding differences were discussed in peer-debriefing meetings. Stage two included WPR-guided axial coding. Codes were then reorganised using WPR's guiding questions:

1. What is the problem represented to be?
2. What assumptions underlie this representation?
3. What is left unproblematic or silenced?
4. How is the representation defended or challenged?
5. What solutions become possible or impossible?

This enabled us to systematically identify how different actors constructed problems and responsibilities within the CE transition. Stage three focused on the comparison of WPR-derived themes across actor groups (OEMs, parts manufacturers, recyclers, and trade associations) to identify convergences and divergences in framings and to highlight material and discursive power asymmetries.

3.5. Methodological Limitations

This study faces several limitations. Access to certain key actor groups, particularly automotive OEMs, proved difficult, which may limit the diversity of perspectives. The uneven representation of countries reflects recruitment constraints rather than theoretical intention. In addition, WPR emphasises discursive constructions and may not fully capture material constraints unless explicitly raised by participants. These limitations are acknowledged when interpreting the findings.

4. Results

This section presents our findings from the interviews through the analytical lens of the WPR approach (Bacchi & Goodwin, 2016). We use WPR to examine how actors construct the "problem" of circularity, the assumptions and silences embedded in these constructions and the power relations they reveal, in line with recent calls to foreground the political and contested nature of CE transitions (Corvellec et al., 2021; Gregson et al., 2015; Mah, 2021).

4.1. Problem Representations Across Actors

Manufacturers, recyclers and trade associations frame the problem of circularity in markedly different ways. Among manufacturers, circularity and sustainability are closely intertwined, whilst circularity is primarily represented as a challenge of product design, technological readiness and market acceptance. Sustainability is first and foremost a matter of planning products for long lifetimes and recyclability, and ensuring that new materials do not compromise the quality and performance expected by customers. As one manufacturer explained, "Sustainability is about ensuring the product is designed for longevity and recyclability, reducing environmental harm from the very beginning." In this framing, circularity becomes a problem of finding appropriate materials and integrating them into existing production processes without excessive cost or risk.

Manufacturers also emphasised that real improvements require understanding current recycling processes more deeply, indicating that design and recycling do not stand apart. As one manufacturer noted, "/…/First, learn to look at the current status of the recycling process. What we can improve at the recycling sites, collecting appliances, sorting, what we can disassemble before, what we can shred, what we can sort afterwards… then it should be from the cost side also positive, and then we are integrating this in our appliances. Next, we have to adapt the production processes." This illustrates that while circularity is framed as a design challenge, manufacturers also rely on improvements in downstream systems.

Our finding nuances circular ecosystem and barriers-to-CE research that highlights product design and material choices as key levers for circularity (Baldassarre et al., 2022; Kirchherr et al., 2018; Kanda et al., 2021) by showing how manufacturers' design-centred framing is closely tied to their structural position and control over specifications. Rather than design being a neutral enabler, our results indicate that it functions as a problem representation that implicitly legitimises OEMs as primary orchestrators of circularity, adding a power-sensitive layer to earlier ecosystem and orchestration studies (Bertassini et al., 2021; Bauwens et al., 2020; Trevisan et al., 2023).

Recyclers construct the problem differently. For them, both circularity and sustainability hinge on waste quality, material purity and the structure of waste collection systems. The central difficulty lies not in product design but in the practical conditions under which waste is delivered to recycling facilities. One recycler explained, "Sustainability is all about how we manage waste. We need clean, well-sorted materials to recycle, but without that, everything else falls apart." Their problem representation places responsibility largely outside their control, located in consumer behaviour, OEM material choices, inconsistent sorting and insufficient collection rates.

This means, of course, that recyclers also recognise the importance of using easily recyclable materials that are introduced into the design process of a product, but it is just a given, not the core essence of the concept of sustainability. Manufacturers can be seen here as potentially hindering the development of sustainability and circular economy by choosing the "wrong" materials for production, thus making the recycling processes more difficult.

This divergence in focus illustrates the fundamental gap between manufacturers' emphasis on sustainable product design and recyclers' reliance on processing efficiency. Manufacturers tend to see sustainability and

circularity as a way to reduce costs and improve brand image, often linking it to market demand for sustainable products. Recyclers, however, struggle with the quality and purity of materials they receive for processing, making sustainability and circularity more of a processing than a design issue, albeit these remain inevitably intrinsically connected.

This perspective builds on previous work that identifies waste quality, sorting and infrastructure as central barriers for plastics recycling (Milios et al., 2018; Paletta et al., 2019; Siltaloppi & Jähi, 2021), but it goes further by showing how recyclers themselves construct circularity as a systemic coordination problem rather than merely a technological one. In contrast to ecosystem studies that often focus on orchestrators' capabilities (Kanda et al., 2021; Marques-McEwan et al., 2023), our analysis foregrounds recyclers' dependence on upstream actors and their limited agency in steering transition trajectories.

Associations tend to frame circularity as a matter of regulatory coherence and policy design. They emphasise inconsistencies between EU-level ambitions and national interpretations, unclear definitions of recycled content, and the challenges of adapting to rapidly evolving regulations. For them, circularity is primarily a governance problem requiring better coordination and harmonisation across jurisdictions and industrial sectors, because "any difference within the single market would mean an uneven competition".

In line with circular ecosystem and governance research that underscores the role of rules, standards and orchestration mechanisms (Langley et al., 2023; Marques-McEwan et al., 2023; Pietrulla, 2022), the associations in our study frame circularity primarily as a regulatory alignment challenge. However, our findings also highlight their role as discursive intermediaries who actively shape how "workable" circularity is defined, complementing politics of circular economy studies that emphasise struggles over definitions and interests at the policy level (Hendriks, 2024; Leipold, 2021; Kovacic et al., 2019).

Interviewees generally also emphasised the multifaceted nature of sustainability, indicating that in addition to ecological and social sustainability, that are often at the centre of the discussions regarding circular economy, the third dimension, economic sustainability, is in practice directing a lot of choices. What can follow, is that concrete companies or other actors can focus only on a specific aspect of sustainable process, design, material choice etc. depending on what is economically most feasible or attractive for them at the time. Important principles, such as reducing production, can be pushed out of sight altogether.

Contrasting perspectives also shape behaviour in ways that affect actors' willingness to invest in circular economy practices. Manufacturers, who see sustainability as primarily a design issue, often do not prioritize improvements in recycling systems, while recyclers are more focused on optimizing existing processes. This divide in emphasis highlights the challenges in creating a truly circular system where both design and recycling work seamlessly together. If it becomes a "chicken or the egg" question for the actors and the recycling and designing processes do not move forward hand in hand, sustainability as a whole can suffer. The three representations reflect the broader dynamics noted in CE transition literature: transitions do not hinge on a shared understanding of the "problem," but emerge from a plurality of contested interpretations shaped by actor positions and capacities.

4.2. Underlying Assumptions and Logics

Each problem representation rests on implicit assumptions that shape what is considered possible or desirable. Manufacturers tend to assume that circularity must be economically feasible and not jeopardise the stability of production processes. They emphasise that risk-averse management practices limit their ability to adopt novel materials. As one OEM representative put it: "We can't take just another material, because we are equipped especially for this technology, these plastic parts. So, it's really not easy as experts to give our bosses a concrete idea, because they know it would all be risky, and that is money, perhaps coming back in 15 years… so they're very shy to take the risk."

Recyclers operate with the assumption that circularity is only viable if upstream systems change significantly. They repeatedly stressed that they are "ready to invest in better technology, but without a steady supply of quality recyclables, it doesn't make sense. We need better coordination across the whole system." Their underlying logic is systemic: technological investments alone do not generate circularity without improvements in waste flows, product design and regulatory frameworks.

Manufacturers and recyclers both take for granted that consumer expectations play a critical role in shaping their room for manoeuvre. Several parts' manufacturers highlighted that both OEMs and consumers might need to "lower their expectations about the quality and aesthetics of plastics," since recycled plastics may

inevitably differ from first-use material. This expectation reflects common assumptions found in CE literature that consumers are both crucial and unreliable agents in circular transitions, as they must sort waste and accept quality variations but cannot be easily coordinated (Kirchherr et al., 2018; Paletta et al., 2019).

Associations assume that compliance burdens and the lack of market-level equality can distort competition and undermine circularity efforts. Their emphasis on regulatory clarity reflects an assumption that circularity can only progress if rules are uniform, predictable and enforceable.

These underlying assumptions speak directly to barriers literature that notes the importance of economic feasibility, risk perceptions and market logics in hampering circular transitions (de Jesus & Mendonça, 2018; Frishammar et al., 2025; Millar et al., 2019), but they also show how such constraints are embedded in actors' interpretive logics about what circularity can or should be. Similarly, our findings enrich discussions on shared responsibility in CE governance (Paletta et al., 2019; Velenturf & Purnell, 2021) by demonstrating how responsibilities are actively displaced between actors through competing problem representations, rather than merely being "unclear" or "distributed."

4.3. Silences, Omissions and Contestations

WPR analysis reveals several areas that remain under-articulated or entirely absent in actors' framings. Manufacturers seldom acknowledge how their procurement practices influence recyclers' ability to scale up. Despite discussing design for recyclability, they rarely reflect on the continuing preference for inexpensive first-use plastics, which can undermine the market for recycled materials. Recyclers, meanwhile, remain largely silent on the environmental limitations and energy demands of their own processes, or on organisational barriers that may inhibit investment in more flexible recycling technologies.

Across all actor groups, there is a noteworthy absence of discussion on production reduction. Although interviewees repeatedly emphasised the need for better materials, better sorting and better regulations, they did not suggest reducing the overall consumption of plastics or limiting product output. This omission reflects the broader tendency of CE discourse to remain compatible with growth-oriented industrial logics rather than challenge them directly.

Another shared silence concerns the political character of circularity. While actors frequently referenced regulations and policy involvement, few explicitly engaged with the idea that lobbying, differential access to policymakers or corporate influence shape which circular solutions become institutionalised. Thus, instrumental power of actors – i.e. their differing capability to influence policy (Fairfield, 2015) – can be downplayed by companies, supporting critiques that CE discussions often depoliticise questions of power and responsibility.

By drawing attention to what is left unsaid, particularly around production reduction, procurement practices and recyclers' own limitations, our analysis empirically illustrates patterns that critical CE scholars have theorised, such as the tendency to prioritise techno-economic fixes over systemic change (Corvellec et al., 2021; Larrinaga & Garcia-Torea, 2022; Valenzuela & Böhm, 2017). The near-absence of discussions on reducing plastic throughput resonates with arguments that CE is often aligned with growth-oriented agendas (Hobson & Lynch, 2016; Mah, 2021), but our data show how this alignment is reproduced in everyday organisational framings of circularity.

4.4. Power Dynamics Embedded in Problem Representations

The differences in problem representations reflect and reinforce existing power asymmetries within the plastics value chain. Manufacturers and especially OEMs occupy a structurally dominant position because they determine product specifications, material choices and production standards. As one OEM representative stated, "If we design our products right, the rest of the system can fall into place. We have the power to make a real difference from the start." This statement encapsulates the degree to which design authority enables OEMs to shape the conditions under which circularity is possible.

Parts manufacturers often described themselves as constrained by OEM specifications and global production strategies. They noted, for example, that OEMs expect components to be shipped across the globe, which makes localisation or material optimisation difficult. This reinforces the uneven distribution of influence across the chain and limits the agency of smaller firms.

Recyclers, whose work is often dependent on material flows they do not control, are structurally and discursively positioned as reactive. They frequently emphasised that "We can only do so much with what we're given. We can't change how things are made, but we can make sure the recycling process works as efficiently as possible." Their power is therefore constrained by both material realities and institutional arrangements.

Geographical and market asymmetries also play a major role. Interviewees from smaller markets or countries with weaker infrastructure explained that fulfilling regulatory requirements or adopting new technologies places disproportionate burdens on them, reducing competitiveness and limiting their ability to influence circularity trajectories.

Associations and large manufacturers tend to exert discursive power by shaping how circularity is defined in policy debates. Several interviewees suggested that lobbying by some corporations can influence policies in ways that may not align with the broader aims of sustainability, sometimes resulting in greenwashing or reinforcing existing advantages.

These patterns concretise, at the value chain level, the forms of business power discussed in political economy and critical CE literature (Fairfield, 2015; Levy & Egan, 2003; Friant et al., 2024; Tukker et al., 2024). Whereas previous work has largely conceptualised power asymmetries in abstract terms or at macro-policy scales, our analysis shows how instrumental, structural and discursive power are enacted through specific problem framings, such as OEMs' emphasis on design authority or recyclers' reactive positioning, thereby linking firm-level practices to broader asymmetries in circular economy governance.

4.5. Implications for Circularity Pathways

The divergent problem representations identified above generate fragmented pathways towards circularity. Manufacturers emphasise gradual, technologically driven change based on improved product design and stable regulations. Recyclers emphasise urgent improvements in sorting, waste quality and infrastructural investment. Associations focus on regulatory consistency and level playing fields. Consumers, although frequently mentioned as essential, are generally portrayed as passive, unreliable or difficult to motivate and are not considered active agents in shaping transitions.

These divergences mirror broader findings in CE transition literature that highlight how circularity is better understood as a contested, multi-actor process rather than a unified transformation. The lack of alignment across actors' problem representations and timelines constrains the emergence of coherent circular practices. As such, circularity becomes fragmented not only in practice but in its conceptual and political construction.

The consequences for policy are significant. Because actors support different solutions based on their own problem representations, policies aimed at promoting circularity risk being pulled in multiple directions. Recyclers call for improved waste systems; manufacturers emphasise design standards and technological support; associations stress harmonisation and enforceability. These differences underscore why CE policy processes often involve negotiation, contestation and uneven implementation rather than seamless alignment. Furthermore, the voice of those actors with more bargaining power will likely dominate, intensifying market inequalities and potentially pushing some companies "on the losing side" to discursively undermine the circular transition as such.

Viewing these divergent framings through the lens of "fragmented circularity" adds a new dimension to CE transition and ecosystem studies, which often call for increased coordination and actor alignment (Aryee et al., 2025; Kanda et al., 2021; Marques-McEwan et al., 2023) but pay less attention to how fundamentally different problem representations make such alignment difficult. Our results complement recent critiques that highlight ideological diversity and contested visions within CE (Friant et al., 2024; Gregson et al., 2015; Padilla-Rivera et al., 2020) by showing empirically how these tensions materialise within a single industrial value chain and shape the concrete pathways that actors consider viable.

5. Concluding Discussion

The findings of this study emphasise that achieving a circular economy of plastics is not just a technological challenge but also a political and social one. The process is shaped by power dynamics and diverse framings of problems, with manufacturers, recyclers, and other actors in the chain all trying to influence the system to their benefit. Thus, our results speak directly to circular economy transition debates, which increasingly

highlight that shifts from linear to circular systems depend not only on new technologies and infrastructures but also on how different actors interpret transition goals and negotiate their respective roles within evolving circular ecosystems (Kanda et al., 2021; Siltaloppi & Jähi, 2021; Bucknall, 2020).

Utilizing Bacchi and Goodwin's (2016) *"What's the Problem Represented to Be?"* framework, we looked at how sustainability and circular economy are framed by different actors, what is emphasised and what is left out. We conclude that related to their position, different stakeholders can have ontologically somewhat divergent views on the circular economy, particularly around the roles they play and their understanding/framing of sustainability and circularity. These differences in perspectives suggest that a more nuanced understanding of the circular economy is needed, one that acknowledges the distinct roles and priorities of different actors and the reality of operating under the global capitalist growth-oriented system – a conundrum some of the interviewees also struggled with during the interviews. As has been highlighted by previous research (Friant et al., 2020; Korhonen et al., 2018; Rhein and Sträter, 2021), our study confirms that sustainability and circularity are generally seen as positive, yet rather vague aims, and stakeholders can pick and choose the aspects that best align with their material interests.

This issue has gained further attention in recent literature emphasizing the ideological diversity embedded in CE implementation (Gregson et al., 2015; Padilla-Rivera et al., 2020). Some actors interpret CE more narrowly as a set of technical solutions (e.g., material recovery), while others see it as a transformative socio-economic agenda (Geissdoerfer et al., 2020; McDowall et al., 2017). These competing visions often coexist uneasily, which may result in fragmented initiatives and weak systemic cohesion.

Our findings empirically illustrate how such ideological and interpretive diversity plays out within a single industrial value chain, contributing to what CE transition studies have described more abstractly as misaligned or partial transitions (Marino & Pariso, 2020; Velenturf & Purnell, 2021). By tracing how manufacturers, recyclers and associations construct different "problems" for circularity to solve, we show that fragmented circularity is not only an outcome of complex socio-technical systems but also of incompatible problem framings embedded in these systems.

In line with critical CE scholarship (Corvellec et al., 2021; Valenzuela & Böhm, 2017; Kovacic et al., 2019; Hendriks, 2024), sociological insights (e.g. Levy and Egan, 2003) and company power perspectives (e.g. Fairfield, 2015), we also highlight the uneven power distribution among stakeholders across the studied industry due to a variety of factors, including actors' position and role in the chain, geographical location, and access to influence the political and policy-making processes.

Manufacturers, particularly original equipment manufacturers, tend to see themselves as the primary drivers of change through control over sustainable product design and materials choice, yet their decisions are frequently constrained by market pressures and short-term economic considerations of shareholders and boards of directors. Recyclers, conversely, face the burden of adapting to decisions made upstream, often with limited resources and infrastructural support, left to clean up the mess created by others. Meanwhile, parts manufacturers are caught between OEM demands and recyclers' capacities to provide suitable materials, indicating a complex web of interdependencies. The general population, despite being crucial to the successful functioning of recycling systems and increasing the demand for sustainable products, are often viewed as passive and unreliable consumers (and not as political actors) in the process. These power imbalances reflect broader social and structural inequalities, with some actors wielding more control over the system than others. This multi-layered picture refines circular ecosystem views that emphasise coordination and orchestration (Kanda et al., 2021; Marques-McEwan et al., 2023) by showing that the ability to coordinate is itself conditioned by unequal instrumental, structural and discursive power. In other words, not all actors in a circular ecosystem participate on equal footing in steering the direction of CE transitions.

Recent scholarship (Bauwens et al., 2020; Genovese & Pansera, 2021) highlights that power asymmetries are exacerbated by global supply chain dynamics and the North-South divide in CE adoption and benefits. For instance, decision-making power in CE initiatives is often concentrated in economically advanced regions, while the environmental and labour burdens disproportionately fall on less industrialized areas. Similarly, workers in recycling and remanufacturing often face precarious conditions (Gregson et al., 2015; Bolis et al., 2020), yet their voices are rarely included in high-level CE discourse.

These power asymmetries are significant because they shape the policies, practices and outcomes of the circular economy, including whose social concerns are incorporated or overlooked – an issue highlighted by recent reviews documenting the marginalisation of social aspects in CE debates (Zavos et al., 2024). OEMs have the power to influence product design and, by extension, the quality of materials entering the waste stream. Recyclers, in contrast, must work within the constraints of the materials they receive, often struggling

with contamination and inefficiency. To address these power imbalances, policymakers must consider the needs and perspectives of all actors in the system and ensure that no group is marginalized.

The findings also highlight the importance of national context and market position in shaping perceptions of circular economy practices. Different countries and regions face varying levels of infrastructure, technological capacity, and regulatory frameworks that influence their ability to implement circular economy practices effectively (Marino and Pariso, 2020; Mazur-Wierzbicka, 2021). For example, recyclers in countries with more advanced recycling systems may face different challenges than those in regions where waste management infrastructure is underdeveloped. The diversity of national systems complicates the implementation of EU-wide policies and while the EU has set ambitious targets for circularity, the ability of individual countries to meet these targets will depend on their national circumstances. This highlights the importance of considering the specific needs and challenges of different regions when designing circular economy policies, so as not to alienate local businesses and lose their support for moving towards CE.

Further, scholars have warned of "one-size-fits-all" CE strategies (Friant et al., 2020), which fail to engage local knowledge systems, cultural values, and socio-economic realities. Particularly in the Global South or in marginalized regions within the EU, CE solutions must be context-specific and equity-oriented (Haas et al., 2015; Schröder et al., 2019) to ensure that those needing help to meet new standards will receive it.

Recent meta-analyses have similarly pointed out that collaborative governance frameworks in CE often neglect the negotiation of actor roles, interests, and institutional trust (Velenturf & Purnell, 2021; Friant et al., 2024). Moreover, CE implementation is frequently critiqued for being reduced to techno-managerial solutions, ignoring the political economy dimensions (Valenzuela & Böhm, 2017; Millar et al., 2019). The "voluntary consensus" model of CE risks ignoring deep-seated tensions between growth imperatives and ecological limits.

Our analysis of fragmented circularity adds an empirically grounded layer to these critiques by illustrating how, even within a single sector and region, CE transitions evolve through contested interpretations of problems and responsibilities, rather than through a unified move towards shared transition goals. This suggests that CE transition literature must engage more systematically with problem framings and power dynamics if it is to capture how circular pathways are actually shaped in practice.

Bridging divides in material conditions and perspectives of different actors requires at least better communication and collaboration across sectors, as well as a more inclusive approach to defining roles and responsibilities in the circular economy. On a more fundamental level, trying to fit well-functioning and fair circular economy inside the current economic system where short-term profits and economic growth, fuelled by over-consumption of cheaply made goods, are priorities, is questionable (e.g. Hobson and Lynch, 2016; Mah, 2021) – at least without strong legislative support, public investments, and the support of general population. This, however, seems to need a more fundamental systemic change.

Critics argue that as long as CE strategies remain embedded within a neoliberal economic paradigm, they are likely to reproduce existing inequalities and ecological degradation (Ashton et al., 2022; Jackson, 2021). Thus, beyond technical fixes, a transition to circularity may require reimagining economic priorities, social justice frameworks, and institutional design. From a CE transition perspective, this reinforces the view that circularity should not be understood merely as a shift in resource flows, but as part of a broader socio-political reconfiguration in which questions of justice, power and competing visions of societal futures are central (Friant et al., 2024; Tukker et al., 2024).

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Data availability The data supporting the findings of this study are not publicly available. Informed consent obtained from participants did not include permission for data sharing beyond the scope of the present research. As a result, sharing the underlying data would violate ethical requirements related to participant confidentiality and consent. No repository deposition has therefore been made.

Declarations

Competing Interests The authors declare no competing interests.

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