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Reducing the tide of single-use plastic pollution: how the EU's Single-Use Plastic Directive drives (and fails to drive) private company reflexivity

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ABSTRACT

Single-use plastics (SUPs) are having catastrophic effects on marine environments. Establishing effective reduction and circularity strategies is complex and necessitates a legal approach that fosters reflexivity and learning by regulated companies, especially those that produce and sell SUPs. Reflexive environmental law (REL) offers a promising starting point to identify drivers and techniques in law that foster reflexivity, yet fails to consider how to define and identify reflexive responses by regulatees. Using reflexive governance and social learning literature, this article identifies four responses: negative, single-loop adaptive, double-loop reflexive and triple-loop reflexive. The article uses an explorative case study of the EU's Single-Use Plastics Directive (SUPD), and its transposition by France and Germany, to analyse how the SUPD fosters company reflexivity through techniques building autonomy, accountability and responsiveness and adjustability. Through, among others, interviews with companies that must comply with the SUPD, this article reveals that single-loop and double-loop responses are the most prominent. However, reflexivity is shown to be inhibited by institutional, organisational and market factors. Better understanding of the dynamics between reflexive drivers within law(s) and the institutional, organisational and market characteristics of regulated actors is needed to design more effective regulations to transform to a sustainable circular plastics economy.

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Introduction

Single-use plastics (SUPs) make up the biggest proportion of waste in the marine environment (Chen et al., 2021). In 2019, the EU issued the Single-Use Plastics Directive 2019/904 (SUPD) to target plastic products commonly found on EU beaches. Sitting under the EU's New Circular Economy Action Plan (European Commission, 2020), the SUPD seeks to reduce marine plastic pollution by targeting both upstream producers as well as downstream consumers and waste managers to increase the circularity of plastics by reducing, reusing and recycling regulated plastic items (Ellen MacArthur Foundation, 2017; European Commission, 2020).

Though sustainability improvements, such as technical or organisational innovations, are improving possibilities for plastics circularity, the prioritisation of reduction, reuse and then recycling remains fiendishly difficult to achieve. Regulators must grapple with the great diversity and dynamicity with regards to plastic polymers, products and supply chains; new innovations; consumer demands and the very definition of circularity (Kirchherr et al., 2017, 2018). This complex nature of circularity for SUPs means that the EU regulator

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has gaps in knowledge and resources to achieve circularity (Orts, 1995; Teubner, 1983) so must work with plastic industry actors to drive circularity forward.

However, the market is powerful and locked into the linear take-make-use economic model which is a key barrier to circularity transformations (Kirchherr et al., 2018; Mah, 2021). Reflexive responses by companies that comply with the SUPD have great potential to accelerate the circular plastics transition. Defined as the introspective process whereby a social actor (e.g. individual, organisation or system) undertakes learning and reflection on their own performance and then adapts their performance (or not) accordingly (Pickering, 2018), reflexivity provides a way to understand whether and how companies, or any governing actor, 'question their own foundations-rather than just modify their practices' (Dryzek & Pickering, 2017, p. 353). Reflexive learning and responses are considered fundamental to move beyond automation and towards more conscious and transformative futures (Feindt & Weiland, 2018, p. 666; Johannessen et al., 2019, p. 152). From a regulatory perspective, company reflexivity helps address knowledge and resource gaps by enlisting market actors to build 'more efficient and effective environmental protection' (Lobel, 2012, p. 3; Orts, 1995, p. 1333). Thus, understanding the regulatory drivers of reflexivity holds potential to avoid regulatory and market lock-ins and achieve more transformative changes in modern global economies, such as the plastics economy (Johannessen et al., 2019, p. 152).

Reflexive environmental law (REL) is a socio-legal theory focused on how the design of law, including legislation and private regulations, contributes towards building a more reflexive society (Orts, 1995; Teubner, 1983). In particular, insights from REL literature enables understanding how various techniques in regulatory instruments build potential for driving company reflexivity to different degrees (Orts, 1995; Ross & de Almeida, 2024). Based on a literature review, Ross and de Almeida (2024) argue that these techniques relate to three reflexive law drivers: (1) giving a degree of *autonomy* to regulated companies; (2) enhancing the engagement of wider society to build *accountability* and *responsiveness* on companies' decision-making and (3) building *adjustability* into regulatory instruments. However, empirical investigation into the de facto effects of these overarching drivers on processes of learning and response by regulated companies is missing. This limits understanding on the extent to which autonomy, accountability and adjustability in regulation drive market actor reflexivity and stimulate truly transformative change.

To fill this gap, this article aims to broaden the conceptual and empirical understanding of how REL drivers and techniques instil different types of responses from regulatorees. While this framework could be applied to any form of regulation (public or private), we focus on public legislation. Through an explorative case study of the SUPD in France and Germany, this article takes a new REL framework of reflexive drivers (Ross & de Almeida, 2024), and combines it with a framework based on ecological reflexivity and organisational learning literature to categorise responses into the following four types: negative, single-loop adaptive, double-loop reflexive and triple-loop reflexive. Though one legislative act may not drive reflexivity alone, legislations can comprise various policy instruments and are powerful tools shaping companies' sustainability trajectories (Scotford, 2021; Similä, 2002). The SUPD is an interesting case as its product-specific measures regulate according to different circular strategies with some being considered more transformative (reduction and reuse) and others less transformative (recycling) (Kirchherr et al., 2017, p. 224). The analysis focuses on the links between the REL drivers – autonomy, accountability and responsiveness and adjustability – within the SUPD and the reflexive responses by regulated actors.

The following section provides further detail on the frameworks of REL and reflexivity. Section 'Methods' then presents the case study method, followed by results on the reflexive drivers in the SUPD (Section 'Reflexive drivers in the SUPD') and reflexive responses of companies complying with measures (Section 'Company responses to the SUPD'). Lastly, the results are synthesised in the section 'Discussion' where insights on the relationship between REL and reflexivity to maximise the transformative potential of the law to transition to plastics circularity are discussed. The article ends with the main conclusions in the section 'Conclusion'.

Law's potential to drive reflexivity

This article analyses the reflexivity and learning processes resulting from drivers in regulatory instruments. This section expands, first, on the regulatory drivers of reflexivity in REL literature, and then discusses the

process of reflexivity and learning and their relevance for exploring the effects of the SUPD in France and Germany to accelerate the circular plastics transition.

Reflexive environmental law

Both REL and its precursor, reflexive law, sit under the theoretical umbrella of 'new governance' (Lobel, 2012). Recognising the limitations of the legal system, new governance theories focus on governing mechanisms that harness the participation of regulated companies and broader societal actors (e.g. citizens, civil society) to increase mechanisms' effectiveness and legitimacy (Lobel, 2012; Teubner, 1983). While reflexive law also considers reflexivity by the broader legal (governing) system itself (Teubner, 1983), REL focuses on how the law drives reflexivity in regulated companies (Orts, 1995).

According to a recent literature review, governing mechanisms such as law/policy documents build potential for company reflexivity through various techniques that relate to three overarching REL drivers (Ross & de Almeida, 2024). This REL framework is a new take on reflexive environmental law which previously focused on soft/hard distinctions (Pickering et al., 2019; Teubner, 1983). The framework claims to enhance understanding of the precise techniques in regulation (no matter hard or soft) that (1) give the market space to address the regulated issue and (2) counteract the negative effects of market autonomy through techniques that foster accountability and responsiveness, or adjustability (Ross & de Almeida, 2024).

The first driver, autonomy, concerns integrating companies' knowledge and resources into the regulatory approach. Letting the market 'do its thing' opens up possibilities for new technologies or other sustainability improvements which helps address legal system limitations (Orts, 1995, pp. 1236–1241). However, it is well documented that market autonomy has limitations. For example, industry actors may focus on the easiest or most profitable innovations (Similä, 2002) or do the bare minimum to comply and not respond reflexively (Livermore, 2007). Nonetheless, companies' responses to law will always be somewhat autonomous (Edelman, 1992).

Accountability and responsiveness drivers in regulatory instruments aim to push companies to incorporate more diverse values, i.e. social or environmental values, into their decision-making (Habermas, 1981; Ross & de Almeida, 2024; Selznick, 1994). Techniques for accountability and responsiveness involve a mix of ex-ante and ex-post avenues through which other (non-legal) actors in law and policy formulation or implementation pressure companies to reflexively improve their performance and make up for legal system gaps (Teubner, 1983, p. 273). Such techniques include requirements for self-monitoring and disclosure of company decisions and practices (i.e. ex-post accountability), and mechanisms that expose such decisions and practices to third parties who bring in their own values and concerns, affecting the response (ex-ante responsiveness).

Lastly, the driver adjustability affects reflexivity by increasing the flexibility of regulatory measures. This driver seeks to address rigidity in the law which can lock-in companies to certain technologies or practices or 'lead to companies finding regulatory loopholes that do not get filled quickly' (Ross & de Almeida, 2024). Adjustability in regulation builds potential for reflexivity by instilling the anticipation for change in regulated companies (Hirsch, 2010, p. 1096).

Legislative acts, such as EU directives, comprise various regulatory instruments. For instance, the SUPD, which we elaborate on in the section 'Reflexive drivers in the SUPD', contains a disclosure-based instrument (Article 7 on labelling), market-based instruments (Article 8 on extended producer responsibility (EPR)) and various performance-based instruments (Article 9 on the bans). Different regulatory instruments can contain the three reflexive drivers through application of 11 corresponding REL techniques (Ross & de Almeida, 2024). According to Ross and de Almeida (2024), these techniques are assumed to have varying degrees of influence on company reflexivity.[1] Table 1 shows which techniques correspond to each driver. For further elaboration on these techniques and justification of the drivers, we refer to Ross and de Almeida (2024).

Table 1. REL techniques for driving private company reflexivity for sustainability.

Reflexive environmental law (REL) techniques for each reflexive driver		
Autonomy	Accountability and responsiveness	Adjustability
• **Participation in (re)formulation** of substantive details in the law • **Autonomous choice** of technical improvements • **Explicit options** on substantive details in the law	• **Third-party participation** in (re)formulation of substantive details in the law • **Public disclosure** on decision-making or performance • **Third-party verification** on decision-making or performance • **Awareness raising** on regulated issue • **Self-monitoring and reporting** on decision-making or performance	• **External adjustments** to substantive details in the law • **Threat of regulation** on regulated issue • **Scheduled adjustments** to substantive details in the law

Source: Adapted from Ross and de Almeida (2024).

Reflexive responses

Though a concept deeply rooted in sociology (Habermas, 1981; Luhmann, 1979) and environmental sociology (Beck, 1994), what reflexivity is and how to measure it is still evolving (Lynch, 2000; van Leeuwen et al., 2024). In sustainable governance scholarship, definitions refer to an actor's capacity to undertake learning processes for ecological goals, such as circularity, with the process comprising self-reflection on performance and (non)-improvements to that performance (Dryzek, 2016; Dryzek & Pickering, 2017). According to Pickering (2018), reflexivity encompasses three stages: (1) *recognition* of impacts through awareness, monitoring and anticipation; (2) *rethinking* to learn from past experiences, critique core values and practices and envision possible futures and (3) *response*, comprising changes to practices and processes or core aims (e.g. business strategies), values and discourses (Pickering, 2018).

Pickering asserts that reflexivity requires cognitive or conscious effort which is why the first two stages (recognition and rethinking) involve active learning (Pickering, 2018, p. 1150). The final action-orientated stage (response) is only conscious (and reflexive) when recognition and rethinking takes place. Hence, not all responses are reflexive; some are merely automated and adaptive.

To more accurately define and identify these learning stages of reflexivity and build a typology of responses, we follow van Leeuwen et al. (2024), merging Pickering's framework with a framework on single-, double- and triple-loop learning from Argyris and Schön (1978). Single-loop level responses relate to situations that can fit into existing patterns and schemes (Johannessen et al., 2019, p. 145). Thus, regulations that do not conflict much with existing business practices/strategies are likely to lead to these responses. Though the most common (Johannessen et al., 2019, p. 145), they are only adaptive because they do not exert the cognitive/conscious stages of reflexivity. Responses are automated without proper assessment of alternatives or exploration into new knowledge bases. This connects to what Hillman and Hitt (1999) describe as transactional responses, as opposed to relational.

Next, double-loop learning often stems from new situations that are difficult to fit into existing patterns and schemes (Johannessen et al., 2019, p. 145). This means they require longer-term thinking. Related responses are reflexive because, although still based on error detection and correction (Johannessen et al., 2019), they are not automated but follow from conscious/cognitive learning processes. Such responses take into account broader societal goals, such as for the environment. Therefore, this form of reflexivity connects to what Dryzek (2016) terms 'ecological reflexivity' whereby an actor considers the planetary boundaries of the earth system in decision-making. Indicators of recognition and rethinking in double-loop learning processes include monitoring and assessment of status quo impacts against new options and new knowledge bases for companies (e.g. through new assessment tools, such as life cycle analyses (LCA), or through collaboration/decision-making with other actors). It is assumed that these new knowledge bases reframe existing assumptions/norms/values which spark changes to guiding objectives/goals/policies (Johannessen et al., 2019). However, there is no conscious reflection on underlying assumption/norms/values themselves (Tosey et al., 2012). Thus, signs of

double-loop reflexivity are learning processes that involve the evaluation of existing goals through technological/administrative information.

Lastly, responses at the triple-loop level also require cognitive/conscious learning making them reflexive. Argyris and Schön (1978) term this 'meta learning' at it concerns reflection and conscious changes to guiding norms, values and paradigms that underpin single- and double-loop learning (Tosey et al., 2012). Alike to the double-loop level, this deeper form of learning indicates that broader societal goals (e.g. environmental, ecological, justice, etc.) and values are accounted for in decision-making (Dryzek, 2016). Signs of this third level of learning include data collection and assessments of decision-making processes relating to single- or double-loop levels and/or updates to these processes (Argyris & Schön, 1978, p. 27; Johannessen et al., 2019).

The last responses we distinguish are negative responses to legislation, defined as instances where companies circumvented requirements or adopted less-circular practices in response to the regulatory instrument.

Distinguishing reflexive double- or triple-loop responses from automated single-loop ones is vital for understanding the extent to which economic actors are progressing towards circularity. Currently, companies operate within the existing linear economic system, but the circular economy vision requires a transformation of this system to reduce natural resource use and eliminate waste. The framework distinguishes between smaller steps to the circular economy, recently termed by industry as 'circular-ish' innovations (Ellen MacArthur Foundation, 2022); and bigger steps, e.g. new business strategies that indicate changes to industry goals or the values and assumptions underlying these. Recognising these distinctions helps grasp society's trajectory towards circularity.

Methods

This article is based on a case study of responses to the SUPD and its transposition laws in France and Germany. It uses an explorative case study approach to analyse whether and how three REL drivers instil reflexive responses in regulated companies to accelerate plastics circularity. Interviews with companies complying with the SUPD and non-market actors working with these companies provide a snapshot of this phenomenon to delve into the nuances of REL's effect on reflexivity (Bryman, 2012). In addition to the SUPD itself, we also reviewed national transpositions of the SUPD by France and Germany. This is necessary because EU directives must be transposed into Member State legislation meaning that these national laws affect companies' actions. France and Germany were selected not only for their importance as producers and consumers of plastics in the EU, but also due to their varied approaches in transposing the SUPD into national law (Rethink Plastic Alliance, 2022). Rather than an in-depth comparative case study, this variation facilitates a broader understanding of the ways in which REL can affect company reflexivity.

Qualitative data were collected from May 2022 to September 2023 from three sources: analysis of the SUPD and national transpositions, policy documents on SUPD implementation and semi-structured interviews. First, the legal analysis followed on from a REL review of four instruments in the SUPD by Ross et al. (2024) based on the framework described in the section 'Reflexive environmental law'. The detailed review of three other SUPD instruments – caps and lids, recycled content, collection – and corresponding transpositions by France and Germany are included in the Supplementary material.

In addition, grey literature and EU policy documents were reviewed to provide context and verify facts obtained through interviews. This included news articles from credible sources and policy documents from the EU, France and Germany on SUPD implementation. All legislation and documents were reviewed in English using DeepL translation software where necessary.

Semi-structured interviews (Bryman, 2012) enabled understanding of companies' responses to the law. This comprised 17 anonymous interviews, held in English, with companies that comply with SUPD requirements in France and Germany and 8 experts who assisted these companies in meeting compliance requirements, such as consultancy businesses and policy officers working on SUPD implementation. Interviewee sample data is presented in Table 2 with interview question guides and additional source data accessible in

Table 2. Sample data from interviewees.

ID	Category	Core product(s)	Interviewee role in company	Interview methods (in person location/ online, date)
D1	Distributor	SUPs	1. General and sales manager 2. Purchasing and logistics manager	Germany, March 2023
D2	Distributor, sourcer, manufacturer		Sustainability R&D manager	The Netherlands, April 2023 and online interview April 2023
M1	Manufacturer	SUPs	Sales	Online, March 2023
M2	Consultancy, manufacturer	Reusable packaging	Co-founder	Online, March 2023
M3	Manufacturer	SUPs	R&D	Online, May 2023
M4	Manufacturer	SUPs, food and beverage, cosmetics, household	R&D	Online, April 2023
M5	Manufacturer, retailer	Food and beverage	Global sustainability R&D manager	Online, May 2023
M6	Manufacturer	SUPs, food and beverage, cosmetics, household	Global sustainability R&D manager	Online, June 2023
M7	Manufacturer, retailer	Food and beverage	Sustainability R&D manager	The Netherlands, June 2023
M8	Manufacturer	SUPs, food and beverage, cosmetics, household	Global corporate affairs manager	Online, Sept 2023
A1	Industry association	SUPs	1. Communications manager 2. Communications	Online, July 2022
A2	Industry association	Food and beverage	Communications	Online, May and July 2023
A3	Industry association	Beverages	Advisory and communications manager	Online, June and July 2023
R1	Retailer	Food and beverage	Owner	France, May 2023
R2	Retailer		Owner	France, May 2023
R3	Retailer		Server	France, May 2023
R4	Retailer		Server	France, May 2023
Supplementary interviews				
P1	Plastics policy	Knowledge	EU circular economy policy	Online, May and June 2022
P2	Plastics policy		EU circular economy policy	Online June 2022
C1	Consultancy		Sustainability advisor	Online, May and June 2022
C2	Consultancy		Sustainability advisor	Online, June 2022
C4	Consultancy		R&D manager	Online, June 2022
C3	Consultancy		Packaging advisor	Online, June 2022
C5	Consultancy		Product passport software expert	Online, May 2023
T1	Tech researcher		Plastics circularity researcher	Online, June 2022

the Supplementary material. Interviews were obtained using online sources (e.g. LinkedIn and Google) and through snowballing methods. Written consent was obtained for all participants.[2] Most interviews were digitally recorded and transcribed, except for four interviews with retailers in France which were manually recorded through notetaking. Data analysis comprised exploratory exercises to code concepts in interview transcripts (via word and excel) from fields of ecological reflexivity and organisational learning (Section 'Reflexive responses'). This resulted in the iterative development of the four categories of responses presented in the section 'Reflexive responses'.

Reflexive drivers in the SUPD

This section explains the seven regulatory instruments in the SUPD and corresponding French and German transpositions and compares the autonomy, accountability and responsiveness and adjustability techniques in these instruments. This comparison enables exploration into how different REL elements in the legal framework affect company responses.

Aiming to reduce marine plastic pollution, the SUPD contains various articles affecting different SUP products most commonly found on EU beaches. The different articles come into force at different dates and are categorised into the following seven key instruments:

- Reuse: Sustained reduction of takeaway food and beverage containers from 2022 to 2026 (Article 4).
- Bans: Market restrictions on various SUP products (including cotton bud sticks, cutlery and plates) by 2021 (Article 5).
- Caps and lids: Caps and lids must remain attached to drinks containers and bottles of up to 3 litres by 2024 (Article 6).
- Recycled content: Plastic bottles made of PET must contain 25% recycled plastic by 2025 (Article 9), and all plastic bottles to contain at least 30% recycled material by 2030 (Article 6).
- Labelling: Various products (e.g. cups, wet wipes and sanitary pads) must display 'product contains plastic' labels highlighting disposal methods and environmental risks, by 2021 (Article 7).
- EPR: Various products (e.g. food and beverage containers, wet wipes, fishing gear and bottles) to sign up to extended producer responsibility (EPR) schemes in accordance with the Waste Framework Directive (2008/98/EC) by 2024 (Article 8).
- Collection: 25% of bottles to be separately collected by 2025, increasing to 90% by 2029 (Article 9).

Figure 1 compares the number of REL techniques coded within each instrument in the SUPD and corresponding regulations in France and Germany to assess the extent to which each instrument builds potential for the market to 'do its thing' (autonomy), 'internalise wider societal values' (accountability and responsiveness) or 'anticipate changes' (adjustability). A more detailed analysis can be found in the Supplementary material.

Broadly speaking, autonomy techniques, represented by the dark grey columns in Figure 1, are present in all instruments. The technique 'autonomous choice' is present in every instrument as none prescribe specific technologies to adopt. Three instruments (EPR, caps and lids and reuse) also contain the autonomy technique 'participation in (re)formulation of substantive details' meaning that companies have a say in formulating the regulatory measures.

Accountability and responsiveness and adjustability techniques (represented in respectively light and medium grey in Figure 1) are more varied. For accountability, one instrument (bans) has no techniques, another on recycled content has only one technique, but three instruments have various techniques, including 'third-party participation' in the (re)formulation of regulatory measures (EPR, caps and lids, collection). 'Public disclosure', another technique driving accountability, is included in the labelling and EPR instruments. Adjustability is the least prominant driver with 'external adjustments' included in EPR, 'scheduled adjustments' being present in recycled content and collection and the 'threat of regulation' being part of the bans and EPR.

Company responses to the SUPD

Table 3 shows four categories of responses to the SUPD instruments. First, negative responses are instances where companies circumvented requirements or adopted less-circular practices in response to the regulatory instrument. Second, single-loop adaptive responses were not preceded by the conscious/cognitive stages of

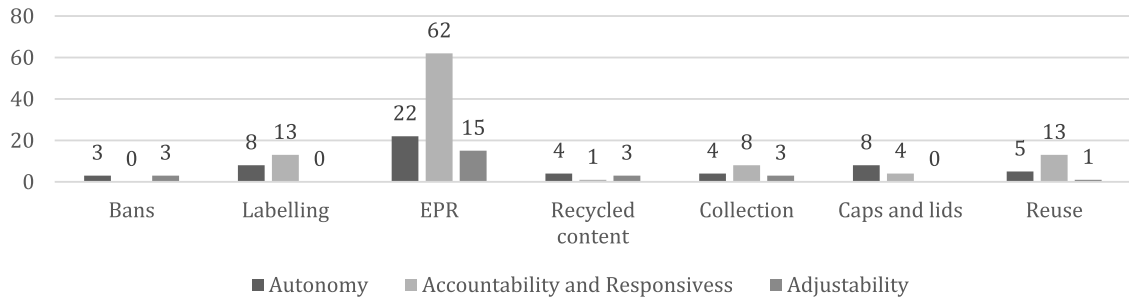

Figure 1. Comparison of total number of autonomy, accountability and responsiveness and adjustability techniques in SUPD instruments and French and German transpositions.

Table 3. Company responses to each SUPD instrument.

	Responses			
Instrument	Negative	Single-loop adaptive	Double-loop reflexive	Triple-loop reflexive
Labelling	Product characteristics adjusted (with no/low SUP reduction) to circumvent compliance.	SUP label added to products.	–	–
Bans	Marketing labels or product characteristics adjusted (with no/low SUP reduction) to circumvent compliance.	Alternative materials used for the same product. Production discontinued.	Alternative materials used/ explored for the same product through new knowledge bases.	–
EPR	–	EPR tax paid in accordance with Waste Framework Directive (WFD).	–	–
Caps and lids	–	Designs for caps and lids altered through new knowledge base.	Designs for caps and lids altered through new knowledge base. Caps and lids removed. Consumers educated about regulatory requirements.	–
Recycled content	–	Recycled plastics (PET) used in SUP bottle production.	SUP bottle collection and recycling systems explored through new knowledge base.	–
Collection	–	–	New business models explored to reduce SUP bottles, e.g. bulk supply. Industry goal for recycled content in SUP bottles adjusted to 100%.	
Reuse	Existing reuse strategy discontinued due to exclusion from regulatory scope.	Portfolio expanded to include reuse items.	New business models explored to supply core product differently (e.g. bulk supply).	New decision-making policy explored to increase approval of riskier but long-term sustainability innovations.

learning (recognition and rethinking). Ultimately these are situations where companies did not go beyond basic compliance requirements. Lastly, double- and triple-loop reflexive responses were preceded with recognition and rethinking. These were often linked to new knowledge bases, while triple-loop responses relate to long-term strategies/thinking by companies.

In addition, interviews revealed that double-loop responses to two instruments, collection and recycled content, were linked. This was because the incorporation of recycled content into a product is only possible and economically viable as long as high-quality plastics are collected, sorted and recycled (A1; A2; A3).

The next section explores, first, how these responses were affected by autonomy, accountability and responsiveness and adjustability drivers in the SUPD instrument; second, where the effects of these reflexive drivers were disrupted due to other, contextual, factors and; third, where reflexive drivers stemming from the broader legal and market environment (i.e. market competition, consumer pressure and other law/policy) stimulated reflexivity.

Driving reflexivity through SUPD instruments

The analysis reveals a relationship between the presence or lack of REL techniques and responses by regulated companies. All instruments contain the autonomy technique 'autonomous choice', meaning that specific technologies are not prescribed but companies can experiment/decide themselves. As each instrument had multiple responses, we cannot draw a direct link between this autonomy technique and the response; however, those reflexive responses relating to technologies would not have been possible without this autonomy. For instance, though most responses to the bans were single-loop adaptive, some companies took the initiative to establish new knowledge bases to develop non-plastic alternatives for the banned products, e.g. through

using decision-making tools such as the 10R framework, LCA and the snail model from the Ellen MacArthur Foundation or through collaboration with a local technical university (D1; D2; C3). In response to the caps and lids instrument, which also includes the autonomy technique 'participation in (re)formulation' and had more double-loop responses than the bans, companies investigated a whole host of technical options, including designing themselves out of the regulation by removing the caps and lids completely (M6, M7). These explorative responses showed signs of recognition and rethinking and would not have been possible if no autonomy techniques were present.

A link also exists between instruments containing the autonomy technique 'participation in (re)formulation' and the accountability and responsiveness technique 'third-party participation in (re)formulation' and the emergence of company reflexive responses. These techniques created spaces for mutual learning as companies and third parties were obliged to work together to formulate substantive details in ensuring compliance with the instrument. Specifically, caps and lids required new industry standards to be developed, with input from companies and third parties, to ensure caps and lids stay attached to beverage containers. To avoid being forced into a standard that did not suit their products, companies engaged in recognition and rethinking by exploring options and attempts, e.g. numerous innovation trials and assessments, to go beyond compliance by removing the caps entirely (M5; M6; M7). For the collection instrument, companies helped formulate a bottle collection system by participating in various consultations and evaluations during which different options were assessed (A2; A3; ADAME, 2023; European Commission, 2021).

The interaction between the two instruments, collection and recycled content, meant that the two participation techniques (for autonomy and accountability and responsiveness) in the collection instrument transferred to the recycled content instrument. Upstream manufacturers implementing recycled content requirements and downstream waste experts implementing collection requirements both took part in consultation and evaluation procedures required by the collection instrument to help raise and address various linked challenges with meeting the compliance obligations, such as issues with monitoring bottle collection (European Commission, 2021) and health-related issues if using recycled plastics in certain products (M7; A2; A3). Such cross-sectoral collaboration was previously a rare occurrence (D2; M7; C2). These participation-focused REL techniques exposed companies to new knowledge bases and stimulated mutual learning which expanded companies' compliance options.

Adjustability is the least prominent driver in the SUPD (see Figure 1), but the results show that the technique 'scheduled adjustments' in recycled content fostered a reflexive response by building anticipation for regulatory changes. The instrument incorporates adjustable targets of 25% recycled plastic content in PET bottles by 2025 and 30% recycled content for all bottles by 2030. Companies not only aimed for the higher target but have gone beyond this, aiming for an (unofficial) industry target of 100% recycled content (A1; A2; M5; M6). This was because many industry front-runners already had established their own virgin-plastic reduction targets. The SUPD thus became tied into existing market competition. Moreover, future policy to strengthen recycled content was anticipated, which made it more economical to aim higher rather than fall behind later (M6; A2; C2).

Contextual disruption to reflexivity

While a relationship exists between REL techniques and reflexive responses, the results also show that this is not always a one-to-one relationship. Results point to various contextual factors that inhibit the translation of autonomy, accountability and responsiveness and adjustability drivers within the SUPD into reflexive responses by companies. This is highlighted, first, by the EPR instrument, which contains more techniques than any other instrument and should thus, in theory, have stimulated reflexivity. Specifically, the REL review of EPR (Figure 1) suggests that companies should participate in formulating the EPR system (autonomy) also with third parties (accountability and responsiveness) to stimulate company reflexivity. However, responses were only adaptive with companies signing up to pay the waste management fee rather than exploring recycling or even reuse options.[3] The broader regulatory context beyond the SUPD meant that techniques for EPR in the SUPD did not drive reflexivity in practice. Member states have already established EPR systems for

certain kinds of waste through the EU's Waste Framework Directive (2008/98/EC) (WFD), and the SUPD merely requires companies to join these existing EPR schemes if they have not done so already. Moreover, the adjustability technique 'external adjustments' in the EPR instrument is assumed to drive reflexivity by building anticipation in companies for continuous adjustments to the EPR system. This is because the administrative management of the EPR system is external to the legislative system. However, in practice, respondents commented on the closed and rigid nature of the EPR system (D1; D2; P1). This meant they did not anticipate that the system would adjust, blocking any chance of reflexivity.

Second, the accountability technique 'public disclosure' is present in EPR and labelling instruments. Instead of pressuring regulated companies to reflexively enhance circularity, information requested did not match company contexts and no reflexivity manifested. Specifically, for EPR, only confirmation of company participation in the WFD's EPR system was disclosed which, according to one interviewee, did not affect circularity strategies and may even look good for marketing (D2). Here, disclosed information did not align with the context needed to compel companies to be more responsible for litter. For the labelling instrument, companies spoke of the necessity of products (e.g. sanitary products or to-go coffee cups) and the fact that these products are produced by 'face-less' companies, e.g. companies of unfamiliar brands (D1; D2; P1; P2). As one policy officer put it: 'do you know the name of the company making disposable cups for your office? No' (P2). This confirms that public disclosure is unlikely to stimulate consumer pressure to drive company reflexivity in contexts where the company is not consumer facing and/or where the social need for a product is high (Saurwein, 2011). Without these techniques working, the option to pay the EPR tax, compared to more circular take-back schemes, became too attractive and labelling requirements became another tick-box compliance procedure. Thus, SUP companies responded in a short-term transactional way, rather than undertaking longer-term, reflexive learning processes.

Lastly, companies' core product, or primary source of revenue, is important as it indicates ties to single-use business models. Data show a greater breadth of exploration in the cognitive/conscious stages of learning among companies whose core products are food, beverage, household, cosmetic items contained within SUPs, compared to those focused on SUP packaging or products themselves. These non-SUP companies are less dependent on disposability as a business model which expanded their consideration of alternatives beyond single-use in the rethinking learning stage. For instance, beverage manufacturers explored alternative means of supply, e.g. bulk packaging or fountains (M5; M6; A3). This wider scope of exploration was based on critiques and changing assumptions about 'risky' single-use models, also indicating a greater depth of rethinking. Alternatively, SUP producing companies focused on alternative products and materials under the single-use model, even in cases of reflexive responses. For example, one SUP company started a reflexive collaboration with a local university but focused on alternatives to polystyrene takeaway boxes (D1). Despite the lack of exploration beyond existing business models, SUP companies acknowledged the end-of-life impacts of their reusable and compostable alternatives (D1; D2; M1). Thus, the SUPD diverts SUP companies away from one problem and towards another. Moreover, the results show that companies that intentionally loopholed around compliance requirements were SUP companies.[4] Companies whose core product/business model is more entwined with the regulated issue have a higher tendency to respond negatively.

Drivers beyond the SUPD

Finally, the analysis shows how reflexive drivers not only in the SUPD, but also within the market, and from society or policy change more generally, contributed to the reflexive responses observed. Autonomy drivers beyond the SUPD are private regulation or other market forces that drive reflexivity on related SUP products. A previous example highlighted the unofficial industry standard for 100% recycled content for SUP bottles which, though linked to adjustable targets in the SUPD, cannot be directly attributed to it. Instead, front-running companies targeted the highest percentage possible (A2; A3; M5; M8) which spiralled into an unofficial industry-wide goal as companies did not want to risk falling behind (A2; C2). Market competition also had the reverse effect, i.e. driving negative responses. For example, one company responded negatively to the SUPD by halting their reuse strategy because their products were *not* included in the scope of the reuse instrument. For

this company, continuing with the reflexive development of their reuse strategy was too risky, as they did not want to stick out from the crowd (M6). Here, the lack of policy support did not raise the bar and the market competition necessary to drive reflexivity was missing.

The results also reveal that consumer pressure was an accountability and responsiveness driver on its own. The only example of triple-loop reflexivity came from a Multi-National Corporation (MNC) (M5) who had to comply with five different instruments (reuse, caps and lids, EPR, recycled content and collection). When asked if the triple-loop response (changes to internal R&D decision-making policy) could be directly attributed to the SUPD, the respondent said that it was not the only driver. Another was accountability and responsiveness to citizens and civil society. In their words: 'as good corporate citizen we must demonstrate that we deliver against our commitments and also show pro-activity in various areas' (M5). Here, accountability and/or responsiveness is an integral part of the corporate conscience (Selznick, 1994, p. 398) and links to the REL technique 'awareness raising', which drives reflexivity though building recognition in companies that consumer preferences for greater circularity are likely to increase in the long-term.

Second, this triple-loop reflexive response was affected by adjustability in broader policy and societal norms beyond the SUPD. For example, frustration with in-house R&D decision-making stemmed from awareness of fast-moving changes to consumer demand and broader policy visions: ' … we have to adapt to the changing environment' (M5). Another MNC commented on adjustability between the different Member State approaches, and how the company had adopted the most stringent measures from France due to anticipation that these would become EU wide standards (M6). On the other hand, adjustability also drove negative responses detracting from reflexivity. France's targets were considered by industry as too high and at times conflicting. Assessments to prove this were underway. Lobbying to adjust the targets downwards may thus be detracting from reflexive responses to meet them (A1, A2). Nonetheless, many respondents were focused on upcoming regulatory adjustments, e.g. upcoming EU packaging regulations or reuse more generally, which were expected to direct their learning and circularity strategies moving forward (D2; D5; M6; M7; C1; C2; C5).

Discussion

This article explores the effects of the reflexive drivers of autonomy, accountability and responsiveness and adjustability, on the reflexivity of companies that need to comply with the SUPD, through a case study of companies in France and Germany. The results show that all four types of responses materialised, with multiple responses to the same instrument, sometimes even within one company. Moreover, results show that autonomy, accountability and responsiveness and adjustability drivers in the SUPD affected reflexivity to different degrees depending on their interrelations. In particular, the combination of autonomy and accountability and responsiveness techniques for 'participation for (re)formulation' in the caps and lids and collection (also linked to recycled content) instruments stimulated reflexivity. Additionally, there was a connection between the adjustability and accountability and responsiveness techniques of 'scheduled adjustments' and 'awareness raising' in building anticipation in companies for increasingly stringent circular policy directions and consumer preferences in the future. This anticipation contributed to reflexive learning about the need for more long-term planning and innovation strategies. However, the analysis shows that there is no one-to-one relationship between the REL techniques and the response as contextual and other factors affected the response, either enhancing or blocking effects of the REL techniques. In this section, we discuss three theoretical implications for understanding the relationship between REL drivers, techniques and reflexivity.

First, the results reveal an additional regulatory technique that can drive reflexivity. This is the broader vision and policy aim that the instrument seeks to implement. Instruments setting a trajectory for companies towards future technologies or systems (e.g. reuse, caps and lids, collection and recycled content) stimulated more cognitive/conscious learning to rethink company goals and objectives, than instruments regulating existing ones (e.g. bans, labelling and EPR). In the analysis, the reuse instrument had the most circular future-orientated vision, the widest reach in terms of companies it affected, and the greatest variation in responses. The regulator can build reflexive parts of the law, but if the vision/goal is not a strong enough 'change agent', then company reflexivity may be limited (Voss et al., 2006, p. 422). This highlights the role of law as a boundary setter and

considers the problem known as ossification where companies do not go beyond minimum requirements (Livermore, 2007). The scope of inclusion in the law's vision boundary is also important as shown by the example of a company's negative response to not being included in the scope of the reuse instrument. Similarly, such visions should go beyond narrow, technocratic interpretation of the vision presented. Otherwise, future visions, such as a blue or circular economy, become equated to providing good business and technological innovation potential rather than societal transformation (see Friant et al., 2020; Voyer et al., 2018). We propose that such 'visions of future technologies or systems', when building anticipation within companies for continuous progress toward a long-term policy goal, constitute a new adjustability technique (to be incorporated into Table 1) as they compelcompanies to focus learning efforts on a future trajectory (Hirsch, 2010, pp. 1083–1084). This means such visions are expected to set a stable trajectory for change which companies or other regulatees are required to work towards. Moreover, these visions place less focus on individual circularity goals and more on transforming the market itself to address deeper-rooted barriers to circularity (Hobson & Lynch, 2016; Mah, 2021) and focus reflexive learning on the assumptions/norms/values underpinning business.

Second, understanding the way in which REL drives reflexivity requires not just the analysis of techniques in individual instruments but also how the interaction between instruments and laws fosters reflexivity. Reflexivity is sometimes a response to a combined set of instruments or laws, rather than one. For example, the connection between collection and recycled content instruments meant the REL techniques and their effects carried over. Here, the autonomy technique 'participation in (re)formulation' in one instrument brought stakeholders from different parts of the value chain together to find a solution to the compliance challenges they experienced. Production and waste sectors collaborated to reincorporate waste back into production (Kirchherr et al., 2017). In addition, mutual learning about conflicts between requirements for recycled content and health and safety rules for SUP beverage bottles manifested (A1; A2). Thus, this REL strategy addressed 'obstructing laws and regulations' which is a key barrier to circularity (Kirchherr et al., 2018). The participation-focused autonomy technique combined with this smart regulatory mix brought different industry actors together to account for the variation in market actor contexts; maximising the chance of mutual learning and a positive effect (i.e. reflexivity) (Gunningham & Sinclair, 2017). Another example is how the connection between EPR in the SUPD and WFD blocked the predicted reflexivity from manifesting. Moreover, harsher legislation in France and upcoming packaging regulations in the EU built anticipation which drove reflexive learning as companies wanted to keep up with the changing times. Therefore, although REL literature takes a systems-thinking view and acknowledges the broader governance network (Orts, 1995, p. 1232), the analysis shows how REL reviews of legislation techniques must move beyond the boundaries of one law and understand how interconnections between regulations affect the drivers of reflexivity. This is necessary for addressing complex, wide-reaching challenges such as SUP production and marine plastics.

Third, responses to the SUPD differ across companies, which brings up the question whose reflexivity is being driven. Results indicate that characteristics of companies matter, such as the size, the role of motivated individuals, whether a company is consumer facing or not, and their core product/source of revenue. This is in line with institutional perspectives recognising that context shapes companies' sustainability responses generally and, specifically, in response to reflexive law (Saurwein, 2011; Selznick, 1994; van Leeuwen & van Koppen, 2016). Well-known consumer-facing brands tend to be more concerned with societal and market pressure to live up to their commitments and develop more circular business models. For these companies, REL techniques relating to citizens are important drivers (e.g. 'public disclosure' and 'awareness raising' techniques). On the other hand, non-consumer-facing SUP companies did not respond to such pressure but are responsive to the adjustability technique 'threat of regulation', and autonomy and accountability and responsiveness techniques for 'participation for (re)formulation'. Additionally, larger MNCs demonstrated reflexivity at the organizational level through ongoing procedures for sustainability (and in one case, triple-loop reflexive changes to the procedures). In contrast, for smaller SUP companies, reflexivity seemed to be driven by key passionate individuals who developed new knowledge bases that shaped thier circularity strategies.

Conclusion

This article assesses a legal approach to addressing one of the root causes of marine plastic pollution by investigating how upstream actors are (or are not) driven by law, in particular the SUPD, to engage in learning and reflexive responses. The article used a combined conceptual framework to identify reflexive drivers within SUPD instruments and instances of social learning and reflexive responses by regulated companies. The framework distinguishes between negative responses, adaptive responses (based on single-loop learning) and reflexive responses (based on double- and triple-loop learning) with greater potential to transform companies towards circularity.

The results show a diverse array of responses to each instrument and even multiple responses by one company to an instrument. While most responses were adaptive and double-loop reflexive, some triple-loop and negative responses were observed as well. The analysis confirms that company reflexive responses can be enhanced using reflexive drivers in law. Notably, results show how autonomy and accountability and responsiveness techniques for 'participation in (re)formulation', and accountability and adjustability techniques 'awareness raising' and 'scheduled adjustments' contributed to reflexive learning and more long-term planning for circularity by companies. Nonetheless, the effect of reflexive law drivers is also bound by the broader institutional, organisational and market environment in which regulated companies are embedded.

We conclude that legislators are not just enforcers but play a crucial role in the effective application of the reflexive drivers by selecting those best aligning with broader contexts to stimulate reflexivity. By better understanding the dynamics between reflexive drivers within (multiple, mutually reinforcing) law(s) and the institutional, organisational and market characteristics of regulated actors, policymakers can design more effective regulations to facilitate double- and triple-loop reflexivity in transitioning to a sustainable circular plastic economy.

Future empirical research is needed to compare strengths of different REL techniques based on how they affect companies across different institutional and market environments. Moreover, these studies can extend to different regulatory and governance instruments to explore the breadth of reflexive governance across society and issue areas. Such research should focus on the interplay between autonomy, accountability and responsiveness and adjustability across instruments, and the regulatees' broader context to foster reflexivity and social learning.

Notes

1. Ross and de Almeida (2024) provide an initial assessment of the 11 REL techniques, categorising them as having a high, medium or low influence on regulatee reflexivity. However, such analysis falls outside the scope of the present study, which instead prioritises examining the range of regulatee responses.
2. We confirm that the topic of research was not of a sensitive nature and that anonymous interviewees are not exposed to physical, emotional, social, political or legal risks by participating in this research. As a result, this research did not require ethical approval according to the guidelines of Wageningen University's Social Sciences Ethics Committee.
3. Reflexive responses were observed for only two products regulated under EPR but this was, according to respondents (D1; D2; M5; M6; A2; A3) in response to collection and recycled content instruments (for bottles) and reuse instrument (for takeaway containers). These respondents made a clear distinction between compliance with EPR and these other instruments.
4. See negative responses to the labelling and bans in Table 3.

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