



## Barriers to recycling plastics from the perspectives of industry stakeholders

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1 **Title: Barriers to recycling plastics from the perspectives of industry stakeholders:**  
2 **qualitative study**

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**Abstract**

Previous research exploring the psychological, social, and environmental barriers to recycling has predominantly focused on consumer attitude and behaviour. However, the plastics system involves a chain of stakeholders with a role in decision-making and actions in relation to plastic production and management post-use, affirming the need to explore the barriers to recycle across various other stakeholders implicated in the lifecycle of plastic product and packaging. To expand this evidence-base, N=12 in-depth qualitative semi-structured interviews explored the perspectives of some of the stakeholders responsible for various aspects of the plastic life cycle (fast moving consumer goods industry, retailers, and waste management professionals). Using a semi-directed content analysis approach via NVivo, three overarching themes were extracted from the data: 1) Disempowerment and lost opportunities 2) Solutions and opportunities reside with use of legislation 3) The circular economy stakeholders need motivation, and to be more knowledgeable. The themes suggest that stakeholders implicated in the plastics lifecycle lack the drive and perceived personal and organisational efficacy to generate meaningful change in the plastics system. These barriers are exacerbated by a lack of collegial partnerships between stakeholders to facilitate knowledge transfer and collective action. This study recommends greater collaboration and communication between stakeholders implicated in the end-to-end plastic ‘chain’, and makes a renewed call for further legislation, having shed light on important socio-political and pragmatic barriers to reducing plastic waste.

**Key words**

Plastic waste, Circular economy, Recycling Behaviour, Qualitative research, Knowledge Exchange

## 1 **1. Introduction**

2 It is estimated that annually, eight million tonnes of plastic waste find their way into our oceans  
3 across the globe (Ellen MacArthur Foundation, 2017). Despite recognition of the harmful  
4 impact of plastic waste, strategies to address this challenge are often circumscribed by  
5 idiosyncratic policy, which lack generalisability (Dhanshyam & Srivastava, 2021). It has been  
6 estimated that G20 countries cause 66 per cent of plastic waste globally, but a review of their  
7 policy initiatives was found to be insufficient in scope (Fadeeva, & Van Berkel, 2021), with  
8 little attention paid to reduction of waste, something necessary to achieve a circular economy  
9 i.e., no waste (Jaeger & Upahhyay, 2020). A circular plastic economy is posited by G20  
10 countries (Fadeeva, & Van Berkel, 2021). Such an economy aims to: Reduce, Redesign,  
11 Remove, Reuse, Recycle and Recover plastic waste (UNEP, 2016). If we look to the end of the  
12 plastic life cycle, processing will be dependent on the degree to which plastic materials have  
13 been separated from other waste correctly (by consumers and organisations/industries), and the  
14 extent to which the plastic materials made can be recycled, both in terms of the materials used  
15 in products/packaging, and the infrastructure available to recycle i.e., recycling plants and  
16 processors. There is a view held by some economists such as Siderious and Zink (2022) that a  
17 circular economy cannot succeed, because it continues to try to adhere to a *free market system*,  
18 the goals and principles of which are directly opposed to the ideals of the circular economy,  
19 and its pro-environmental goals. This is exacerbated by the existence of further obstacles, such  
20 as the Circular Economy Business Model (CEBM) being more multi-faceted compared to a  
21 linear business model LBM); a lack of confidence in the finances; consumer leanings; a lack  
22 of suitable regulatory restrictions and infrastructure; and organisations not having suitably  
23 knowledgeable and skilled managers to execute a CEBM (Hina, Chauhan, Kaur, Kraus, &  
24 Dhir, 2022). The problem is therefore complex and may also require a shift in political thinking  
25 at the high levels in governments. Government decision-making has huge implications on the  
26 extent to which Extended Producer Responsibility (EPR) can be effectively implemented. Such  
27 decisions are tied up with other competing socio-political circumstances and therefore  
28 governments need also to be incentivised to endorse change at the level of the supplier and  
29 industries. Future research studies would benefit from focusing on government perspectives  
30 towards the barriers to implementing EPR systems.

31 In the United Kingdom (UK) a plastic circular economy is less visible, despite growing concern  
32 about the escalating environmental and economic costs of excessive plastic waste. However,  
33 UK government is resolved to tackle this issue, with ambitions to obliterate disposable (i.e.,  
34 non-recyclable plastic) packaging by 2042 (Defra, 2018). A Plastics Packaging Tax (Hirsh,

1 2019) is also in operation in the UK. The European Commission (2019) is working to  
2 operationalize its Single Use Plastics Directive, initially tabled in May 2018. In the UK, while  
3 campaigns such as the plastic bag tax resulted in large scale behaviour change at the level of  
4 the consumer (DAERA, 2021), maintenance of the use of re-usable plastic bags has gradually  
5 receded, and other streams of plastic pollution remain (Siderius & Zink 2022).

6  
7 In Northern Ireland, the current producer responsibility scheme for packaging has existed for  
8 25 years. The full cost of disposing of packaging waste has historically been the responsibility  
9 of local taxpayers and local councils. Current overall recycling rates sit at around 50%.  
10 However, plastic waste rates are much lower. The Government department in Northern Ireland  
11 who has overall responsibility for legislation in this matter is Department of Agriculture,  
12 Environment and Rural Affairs (DAERA). They are currently developing an EPR Strategy, but  
13 implementation is not due until 2024. The goal is to shift the costs of packaging throughout  
14 their lifecycle to companies who produce the packaging, referred to as the “polluter pays”  
15 principle. Also less sustainable materials will become more expensive to obtain, and new  
16 challenging recycling targets will be set for plastic.

17  
18 It is acknowledged that the plastics system involves a chain of stakeholders with a role in  
19 decision-making and actions in relation to plastic production and management post-use.

20 Previous research, primarily with manufacturers, identified the behaviour of consumers and the  
21 inadequate policies and incentives of government as the main barriers to implementing a  
22 circular economy (Kumar et al., 2019). Many stakeholders believe that they are already playing  
23 their part in attempting to deliver the circular economy and consequently they are identifying  
24 the other areas where change is required. Stakeholders often deflect responsibility from one  
25 cohort to another (to include policymakers, manufacturers, retailers, recyclers, consumers),  
26 when in fact the responsibility is cross-cutting and requires behavioural and procedural change  
27 across these diverse groups (Heidbreder Bablok, Drews, & Menzel, 2019). The introduction of  
28 EPR to Northern Ireland will begin to help in this regard.

29  
30 Research by McNicholas and Cotton (2019) used qualitative interviews to explore professional  
31 and consumer stakeholder perceptions of the perpetuating factors and prospective solutions  
32 toward marine plastic waste. The overarching message was that it is crucial to engage various  
33 stakeholders such as policy makers and legislators, as well as supporting consumers as they  
34 navigate a plastic-abundant environment (McNicholas & Cotton, 2019). Similar conclusions

1 were drawn in Nepal in relation to the need for better communications among stakeholders  
2 producing plastics (Bharadwaj & Rai, 2021). In addition, Heidbreder and colleagues (2019)  
3 explored different intervention strategies to mitigate waste from beverage bottles and plastic  
4 bags, and the take-home message once again, emphasised the importance of collaboration  
5 across stakeholder groups to ensure interventions are effective. Beyond this research, less  
6 attention has been placed on understanding the occupational and organisational barriers that  
7 confront key stakeholders and therefore a gap in our understanding of this remains.

8

9 Much of the previous psychological and social scientific evidence has focused on the  
10 psychological, social, and environmental factors influencing recycling behaviour in consumers  
11 (e.g., Hage, Söderholm, & Berglund, 2008) and explored behaviour change interventions at the  
12 level of the consumer (e.g., Heidbreder, et al., 2019). Recent relevant insights come from  
13 exploratory research with consumers, which implicates a number of barriers created by  
14 stakeholders to improve plastic collection rates , such as the abundance and variety of plastic  
15 packaging generated, which results in choice fatigue (e.g. Roy et al., 2021). Consumers' believe  
16 that stakeholders involved in decision-making around the manufacturing of plastic packaging  
17 should pioneer the change needed in our relationships with plastics (Roy et al., 2021).

18

19 To expand the current evidence base beyond the consumer, it is necessary to further explore  
20 and understand how systems perpetuate the production and waste of plastic products. If the  
21 focus continues to be on one part of the plastic value chain, or circular economy, the latter end  
22 of the stakeholder chain will continue to be overlooked, where professionals are involved  
23 collecting and processing any discarded or recycled plastic materials from householders and  
24 businesses. This is a significant part of the chain, because, if plastic waste mis-managed, or  
25 sent to landfill, the opportunity to recycle is lost. Thus, consulting with representative  
26 stakeholders involved in decision-making related to production and handling of plastic  
27 products is an important subsequent step in this research area, so that we can understand  
28 different stakeholder perspectives, and obstacles faced; perceived or real. The development of  
29 a deeper understanding of the challenges perceived and experienced by professional  
30 stakeholders is a useful starting point in the development of more cohesive and achievable,  
31 sustainable plastic waste reduction strategies. In turn, this understanding can support  
32 consumers as they navigate a plastic-abundant environment by informing organisational  
33 decision-making and influencing consumer purchasing environments (Bharadwaj & Rai,  
34 2021).

1 This study aims to build on previous stakeholder research (e.g. McNicholas & Cotton, 2019)  
2 and recent relevant consumer-centred research (Roy et al., 2021), by exploring in-depth, the  
3 perceived barriers and facilitators to addressing plastic waste from the perspective of various  
4 stakeholder representatives (manufacturers, retailers, waste management specialists and local  
5 government). By doing so, we will provide a more holistic overview of the psychosocial,  
6 environmental, and structural factors influencing the end-to-end plastic waste management  
7 system.

### 8 **3. Materials and methods**

#### 9 10 **3.1. Design**

11 This qualitative study adopted a semi-structured interview design which was deemed most  
12 appropriate to address the complex research question. Ethics approval was obtained through  
13 the authors' institution prior to recruitment (Queen's University, Faculty of Engineering and  
14 Physical Sciences; EPS 19\_318). This study is written in line with the Consolidated Criteria  
15 for Reporting Qualitative research (COREQ) guidelines to support the sound reporting of  
16 methods and findings (Tong, Sainsbury, & Craig, 2007). This report has been pre-registered as  
17 a pre-print on Open Science Framework [insert identifier].

#### 18 19 **3.2. Participants**

20 Recruitment took place during Autumn 2019, using convenience sampling. The researchers  
21 invited several important stakeholders in the plastic's circular economy within a single region  
22 of the UK to participate. The 12 participants represented manufacturers of plastics, retailers,  
23 waste managers, a large University, recycling companies and local and central government.

24  
25 The interviews took place at a mutually acceptable venue, either on University premises or at  
26 the participant's place of work. Before the interviews began, the participants were given the  
27 information sheet and offered the chance to ask questions. The participants were also advised  
28 that they could stop at any time during the interview. If they still wished to proceed, they  
29 completed the consent form. Age and sex and role of participants are displayed in Table 1.

30  
31 **[INSERT TABLE 1 HERE]**

### 1 **3.3. Data Collection**

2 All the researchers involved in the coding and analysis (DR, MD, EB, KO) were experienced  
3 in the use of qualitative methods, and adopted a phenomenological approach (Smith, 1996).  
4 Semi-structured questions and the interview schedule were designed to gain an understanding  
5 of existing plastic consumption and plastic waste disposal services, and any challenges and  
6 opportunities being experienced by each stakeholder.

7

### 8 **3.4. Conceptual Framework**

9 The interview schedule was set within the context of a broad behavioural theoretical framework  
10 that encapsulates the multiple factors involved in plastic waste production and disposal; the  
11 Capability, Opportunity and Motivation (COM-B) model of behaviour (Michie, Hyder, Walia  
12 & West, 2011; Michie, van Stralen, & West, 2011). Given the inter-disciplinary and multi-  
13 dimensional nature of the plastic materials economy, part of the discussion is set in the context  
14 of the Ecological Systems Theory developed by Bronfenbrenner (1974). The semi-structured  
15 interview schedule included example scenarios to elicit current beliefs, attitudes, and feelings  
16 towards policy implementation (see supplementary file 1 (S1) for interview schedule). DR  
17 conducted the interviews and is an experienced qualitative researcher with a phenomenological  
18 orientation, but who also integrates this naturalistic enquiry with a realist stance (Pistrang, &  
19 Barker, 2012). This is because of her experience and knowledge of applying socio-cognitive  
20 models to explain sustainable behaviour and attitudes towards the environment. Biased  
21 interpretation was mitigated, by other members of the research team reading the transcripts to  
22 check for consistency in the emerging codes, and continued reviews of the analysis (Korstjens  
23 & Moser, 2018). The interviews lasted 45 minutes on average, and these were audio recorded.  
24 The participants were unknown to DR before the interviews took place. The core research team  
25 (DR, MD, EB) held coding meetings regularly, and concluded, after 12 interviews, that no new  
26 themes of note were emerging and consequently were satisfied that saturation point had been  
27 reached (Namey, Guest, McKenna & Chen, 2016).

28

### 29 **3.5. Data analysis**

30 The analysis was based on a semi-directed content analysis approach (Hsieh & Shannon, 2005)  
31 along with a search for emerging themes. The researchers therefore allowed for the possibility  
32 of novel patterns to emerge while also considering the findings within the context of the COM-  
33 B framework, and other relevant theoretical frameworks. This also preserved the flexibility to

1 offer interpretations of all the data, and to allow themes to be derived from the data. DR initially  
2 familiarised herself with the data and used NVivo 12 software to assist with coding by category  
3 and consistency, and then looked for any patterns that presented. This was an iterative process.  
4 A reflexive record was kept of the decision-making of the researcher as she coded and searched  
5 for patterns in the data. A subset of the transcripts was initially coded by other members of the  
6 team (MD and EB) to ensure reliability and to ensure that findings were trustworthy and  
7 practically sound. Overarching themes were finally identified and checked by the whole  
8 research team to confirm they provided a good representation of the findings (Braun & Clarke,  
9 2006). This process ensured that reflexivity was maintained throughout the analysis to support  
10 credibility and confirmability, particularly with recognition of the potential influence of  
11 researcher bias (Korstjens & Moser, 2017).

12

#### 13 **4. Results**

14

15 Three overarching themes were extracted from the interview data: 1) Disempowerment and  
16 lost opportunities; 2) Solutions and opportunities reside with use of legislation; 3) The circular  
17 economy stakeholders need motivation, and to be more knowledgeable.

18

##### 19 **4.1. Sense of disempowerment and lost opportunities**

20 There is a sense of disempowerment, that opportunities are being lost, due in part to a perceived  
21 lack of investment in the core infrastructure to increase recycling rates and appropriate facilities  
22 that could help to maximise the repurposing of the varieties of plastics in the marketplace. This  
23 is felt particularly among those responsible for developing recycling capacity and service and  
24 within both local institutions and local authorities.

25

26 *“[Our region] has got an infrastructure deficit of about 30 years behind the rest of the*  
27 *UK and further behind Europe. We just do not have the facilities to dispose of materials*  
28 *and so much of our waste is being offshored; its being sent to Europe for incineration”.*  
29 *(Local Authority leads)*

30

31 There are considerable financial benefits to be made by local authorities if recycling rates  
32 could be improved and it is seen a lost opportunity, only adding to sense of frustration.

33

34 *“If everybody did everything today, we could save £2million using the existing architecture that*  
35 *is in [name of City] right now... “If we look at some of the most recent studies there is easily £50*  
36 *million gross value to be added to the [name of region] economy through better recycling, and*



1           *that is from one particular recycling agent, who is prepared to put their head about the parapet*  
2           *and say it” (Local Authority lead)*

3  
4   The use of social media was also a subject of debate, as using this medium for educating the  
5   public only reaches those who are able, and comfortable, with using social media. It was felt  
6   that the medium for dissemination of knowledge needs to be capable of reaching all age groups.

7           *“There's an awful lot - the default at the minute is social media, just stick it on social*  
8           *media, and we've done our bit, but there's a hell of a lot of people out there that do not*  
9           *care, there's people my age group who don't have Facebook or Twitter because they*  
10          *don't like it and there's my mum and dad who never have, and never will, and it's a lot*  
11          *of the older generations as well really..they don't realize how it's going to hit wee Mrs.*  
12          *Jones's, who is 70 years old and doesn't have Wi-Fi” [Local Authority lead].*

13  
14   An enhanced level of knowledge among producers of plastic packaging about what happens  
15   at the end of the cycle is essential, as it appear that gaps still exist, and producing food  
16   retailers are prioritizing the use of attractive packing for marketing purposes, over the needs  
17   to protect the environment.

18  
19          *“And we have companies, that say they are going to minimize packaging and [Name of*  
20          *company] did they, where they are minimizing packaging? They go on and put it in a*  
21          *purple box, then in a film bag thing. and then - how is that recyclable?” [University*  
22          *Sustainability Representative]*

23  
24   Those responsible for providing recycling services also took the view that profits have a higher  
25   priority than the environment among manufacturers, and this was part of the problem, creating  
26   feelings of pessimism about how much can be achieved.

27          *“The only way that it's going to change for them [manufacturers], is if they're told that*  
28          *they have to ... there's other companies that feel, we need to make so many millions this*  
29          *year and so, to hell with the environment!” (Recycling Company Representative).*

#### 31   **4.2. Solutions and opportunities reside with use of legislation**

32  
33   There was an acknowledgement that nations are placing a greater value on environmental  
34   issues, albeit sometimes from economic necessity, but some policy changes have now been  
35   introduced aimed at reducing plastic exports:

1       *“The politicians would never have had environmental stuff at the front of their*  
2       *manifestos. But if you look at the manifestos both labour and conservative have said,*  
3       *we are going to ban plastic exports, and you know that is quite a radical thing to do,*  
4       *because the infrastructure ... and the technology isn't here for us to deal with it”.*  
5       *(Government Representative).*

6  
7       Some stakeholders acknowledged that it would make their job easier if augmented pro  
8       conservation legislation was in place, as there is an imbalance between what they could  
9       potentially do, compared to what is manageable, determined by availability of resources. And  
10      conversely, politicians are reluctant to introduce changes that would be unpopular with voters,  
11      thus negatively impacting on any motivation they may have to enforce the very policies that  
12      could increase recycling rates.

13  
14      One principle that is being adopted by the UK Government across all its nations in a few years,  
15      is the ‘polluter pays’ principle and so producer responsibility schemes are being enhanced  
16      (Dawson, 2019).

17       *“A Circular Economy Waste Package, again from the EU, and at moment that's to be*  
18       *introduced next year, so that's already in the pipeline, I think July next year it's to be*  
19       *introduced by so that's on the cards” (Government lead).*

20  
21      Despite these initiatives and enabling new legislation, there are still many people who have a  
22      role to play in the circular economy who are not cooperating with each other.

23       *“So there is a barrier between manufacturers and retailers. There are barriers is all over*  
24       *the place when you speak to them, the whole way up the value chain” (Government*  
25       *Lead).*

### 26 27      **4.3. The circular economy stakeholders need motivation and improved knowledge**

28  
29      Production of virgin plastic is not slowing down, as oil companies are looking to the plastic  
30      market for their future survival, given the car industry is moving to using more sustainable  
31      sources of fuel.

32       *“Shell is investing., 18 billion dollars in terms of new plastic production because they*  
33       *are looking to the future, they are going to have to retain market value”.* *(Local*  
34       *Authority Representative)*

35  
36      Without some sort of incentive for plastics industry to reduce production of virgin plastic, not  
37      all plastic can be repurposed and recycled. This is because the existence of open loop recycling

1 internationally means a lack of an effective circular economy, and plastic packages not yet  
2 being designed-for-recycling to ensure plastic materials will be processed downstream.  
3 Consequently, this is keeping recycling rates drastically below what they should be.

4 *“The real failing in our existing system, in recycling and manufacturing systems, is we  
5 have open-source recycling. So there is not a clear-cut home for all the materials we are  
6 placing into the marketplace, and they can leak from the system. 91% is leaking into the  
7 system... so it means it is going for a large part, somewhere else” (Local Authority Lead).*

8  
9 Large corporations have a narrow scope, and their efforts comprise of working with  
10 environmental charities, primarily to change behaviour around littering and recycling.

11

12 *“We have partnerships with [environmental organisations]. So, we really work with them  
13 quite closely to understand how we can change behaviour in relation to littering,  
14 recycling” (Large Corporation)*

15

16 It is very possible that food packaging manufacturers may have good intentions to create less  
17 food packaging, but these fail by add-ons of attractive marketing covers, on top of the plastic  
18 tubs etc.

19 *“And we have companies, that say they are going to minimize packaging [Name of  
20 company] did they, where they are minimizing packaging? They go on and put it in a  
21 purple box, then in a film bag thing.. and then how is that recyclable?” (University  
22 Sustainability Representative).*

23

24 Improved understanding among manufacturers is needed, in terms of the type of collection  
25 arrangements that are provided by relevant local authorities, and also the types of bins that are  
26 given to householders to sort plastics and other waste and, importantly, which plastics,  
27 recycling companies can re-purpose. The perceived disconnect between consumers’ behavior,  
28 and its wider environmental impact may also come from a poor understanding among  
29 individual consumers about how their unwillingness to separate plastics at point of disposal  
30 affects the environment directly or indirectly.

31

32 *“I think there needs to be some kind of mechanism to make people make the link  
33 between their own consumption and the potential effect that it has on the environment”.*  
34 *(Government Representative).*

35

36 Also, the effortful nature of recycling, coupled with a lack of clarity and confusion around  
37 how to recycle properly was recognized as a challenge. The most confusion lay with the  
38 recycling of plastics.

1  
2       *“It’s plastics...it’s the clarity of what can and can’t be...what we find is that if you get*  
3       *too specific, it overwhelms people” Recycling Company)*  
4

5 It is not all bad news; there has been an increase in the amount of plastic waste that is  
6 separated by householders for collection over the last few years, and the recycling company  
7 suggested that this may be a result of consciousness driven by, for example, the impact of the  
8 ‘Blue Planet Effect’ seen first-hand.  
9

10       *“If we tracked our material sales of plastic, to indicate what came into us, when that*  
11       *program was first shown, what it, about one and a half or two years ago? That’s where*  
12       *you’ll see a spike because people went, shit, really, is that what happens to that poor wee*  
13       *bird with all the plastics in it, that really has had a massive effect... It’s trendy now to be*  
14       *environmentally aware”.* (Recycling Company)

## 15 **5. Discussion**

16

17 This exploratory research sought to investigate the beliefs and attitudes of a range of  
18 stakeholders (manufacturers, retailers, waste management specialists and local government) on  
19 the challenges and opportunities related to the management of plastic waste. Using the COM-  
20 B model of behaviour (Michie, et al., 2011) as scaffolding for an interview topic guide  
21 facilitated an in-depth exploration of the extent to which stakeholders feel *capable* of  
22 contributing to the change needed for a circular plastics system, perceive that there is  
23 *opportunity* and resource available to influence organisational change, and the extent to which  
24 they feel *motivated* and empowered to take action.  
25

26 It is understandable that those charged with collecting and recycling the nation’s waste feel  
27 disempowered. One reason for this is simply the absence of an EPR scheme in Northern  
28 Ireland, making its absence fairly unique in the wider European context. The Local Authority  
29 waste management services cited years of underinvestment in both household collection  
30 services, and recycling facilities, as one of the main obstacles to increasing recycling to optimal  
31 levels. This speaks to existence of barriers to CE highlighted by Hina et al., (2022) at the  
32 beginning of this paper. This is a sticking point, because it is less expensive to export plastic  
33 waste to other countries, and it is cheaper to make new virgin plastic rather than try and  
34 repurpose discarded plastics (Border, 2018). In smaller regions of the UK, the challenge, even  
35 with investment, will be harmonising what are now, conflicted political agendas. Adding to  
36 this sense of disempowerment is the perception among professionals involved in collecting and

1 recycling plastics, that large retailers lack insight into the extent to which their marketing  
2 activities exacerbate the problem, not least in their use of colour in packaging. Among many  
3 of the stakeholders interviewed, consumers are perceived to be at the crux the plastic waste  
4 problem through lack of appropriate plastic waste sorting behaviour, which is a further barrier  
5 posited by Hina et al., (2022). There is no doubt that consumers' (in general) lack sufficient  
6 knowledge and lack motivation to seek information about the types of plastics that can be  
7 repurposed and sorted, so that recycling companies can collect them and convert to valuable  
8 recycled plastics.. But arguably there is reluctance and lack of perceived incentives among  
9 manufacturers and retailers to reduce plastic production and simplify the materials being used  
10 by large food retailers. The findings by Roy et al (2021) suggest that the disorganised  
11 abundance of plastic materials that have to be sorted for recycling is but one important reason  
12 (out of many) as to why many consumers find recycling a challenge. This implies the need for  
13 change at the level of plastic packaging design (to include a strong multi-national legal  
14 framework on use of complex, coloured, and mixed material packaging) as well as increasing  
15 the opportunity to recycle by means of environmental restructuring (more consistent bin  
16 availability and visual cues to help consumers navigate the recycling system). This echoes Hina  
17 et al's (2022) assertion that a lack of suitable regulatory is a barrier to a CE, and also Jaeger  
18 and Upahhyay's (2020) findings that manufacturers need to move away from current norms  
19 and engage in more innovative product design to contribute to the development of a circular  
20 economy. Di Foggia, Giacomo; Beccarello, & Massimo (2022) suggest that a way to support  
21 this change is to adopt a waste sector manager or systems operator (SO) with an overarching  
22 co-ordination responsibility, but will rely upon an EPR being put in place. Creating such posts  
23 will ensure environmental goals are the focus across the waste management sector. This multi-  
24 level regulator could provide information, report plans, monitor and report goals and results,  
25 support and co-ordinate local councils activities, and engage local residents (DiFoggia et al,  
26 2022).

27 Other research has reinforced the notion that improved packaging can be achieved through  
28 innovation, and collaboration with the supply chains, and use of pilots to test different  
29 collection processes that could handle the various types of plastics (Gong, Putnam, You &  
30 Zhao, 2020). If however the CE continues to work within a free market system, a continued  
31 lack of overarching administrative or government control, will mean efforts to collaborate  
32 more, but also efforts to bring changes to plastic packaging design, will fail (Siderious & Zink  
33 (2022).

1 But assuming an EPR will soon be in place in NI, knowledge transfer and training among  
2 leaders in each sector will be of value as a risk averse company culture is one of the main  
3 barriers to the implementation of a circular economy (Hina et al., 2022; Kirchherr et al., 2018).  
4 When managers in an organisation have an internal rather than an external locus of control,  
5 they are more likely to display perseverance, applying new efficient procedures in making  
6 decisions, within technical limits (Kerdlap, Low & Ramakrishna, 2019), organizing their own  
7 work and that of their subordinates (Dumitriu et al., 2014).  
8 However, consumer-facing companies can empower themselves to be more circular, and  
9 Bocken and Konietzko (2022) suggest one way is to this is to adjust their business models by  
10 developing strong visions of sustainability, and building their understanding of how customer  
11 behaviour impacts upon the environment. All of which can be achieved by these companies  
12 collaborating more with each other (Hull, Millette & Williams, 2021). Such consortia of like-  
13 minded individuals could be the environment where creative solutions, and consequently  
14 feelings of empowerment may then emerge, underpinned with legislative support  
15 (Langendahla, Mark-Herbert, & Cook (2022)).  
16  
17 The responsibility is cross-cutting and requires behavioural and procedural change across these  
18 diverse sectors (Heidbreder et al., 2019). Discussions about the circular economy within an  
19 organisation need to reach more influential departments such as operations or finance  
20 (Kirchherr, et al., 2018). One suggestion could be to develop an accessible education program.  
21 Help could be sought from an organisation such as the UK Waste and Resources Action  
22 Program (WRAP) which already works alongside industries involved in the manufacturing and  
23 retail of plastics and already, 1.5 billion un-recyclable black plastic ready-meal trays have been  
24 replaced with recyclable alternatives by supermarkets since 2018 (Clear on plastics, 2021). The  
25 use of the modified Ecological Systems Theory (EST) developed by Bronfenbrenner (1974)  
26 (see Figure 1) could be visualised in an accessible education program or interdisciplinary  
27 workshop; given how it explains the impact context and its interaction with individual  
28 behaviour. It could be used to highlight the importance of communication and collaboration  
29 between the different systems and supply chain stakeholders to understand how their actions  
30 impact upon each other i.e. the ‘ripple-effect’. Figure 1 contextualises stakeholders interviewed  
31 to EST and frames them within the wider supply chain and product lifecycle, drawing upon  
32 key findings elicited from the interviews. This modified EST visualises the respective roles of  
33 stakeholders and highlights the need to co-create solutions to any implementation problems.  
34 See Gasde et al. (2021) for a more comprehensive example of how these stakeholders fit within

1 a product life cycle. Crucially, industries involved in plastic manufacturing should learn how  
2 waste is collected, sorted and recycled. But equally recycling companies would also benefit  
3 from gaining a greater understanding of challenges and trade-offs that fast moving consumer  
4 goods industries have to negotiate. Each section of the model can thus be used as scaffolding  
5 to explore the internal idiosyncrasies related to plastic waste and recycling within systems as  
6 well as exploring their intersectionality across different contexts and cultures.

7  
8 [INSERT FIGURE 1 HERE]

## 9 10 **5.1 Conclusion**

11 This qualitative research captures the challenges perceived and experienced by professional  
12 stakeholders including manufacturers, retailers, waste management specialists and  
13 government. The perceived and experienced barriers discussed provides a sense of the  
14 psychological, systemic, and pragmatic limitations experienced by stakeholders. It is important  
15 to consider that some strong opinions overall could be the result of 75% of the sample being  
16 female as previous research for example, Dilkes-Hoffman, Pratt, Laycock, Ashworth, and Lant  
17 (2019).found that males view the issues of plastic waste pollution to be less serious than  
18 females, something to be considered when developing education progammes. Also, it is  
19 apparent that no stakeholder cohort bears, or should bear, sole responsibility for the plastics  
20 dilemma. But a strong multi-sector legal and knowledge framework is essential, along with  
21 significant investment to develop the infrastructure enabling the processing and repurposing of  
22 a broader range of plastics, including low grade plastics. Adopting an interdisciplinary  
23 approach to addressing complex societal challenges is certainly not a new concept; but it is  
24 often overlooked, which can lead to any attempts to findings a solution to plastic waste  
25 exacerbating the waste problem. There is a reason to have some optimism, as further legal  
26 frameworks stem the tide of non-recyclable plastic entering the plastic supply chain, but this  
27 must be accompanied by investment in infrastructure and collaborative education  
28 programs/projects utilising helpful socio-ecological models (as discussed above). Engaging in  
29 these interdisciplinary activities to inform decision-making, organisational processes, and  
30 environmental change (e.g. architecture of purchasing environments) in relation to plastic  
31 manufacturing, retail, and waste management, can support consumers as they navigate a  
32 plastic-abundant environment.

1 Furthermore, the scapegoating of consumers to account for the suboptimal levels of recycling  
2 is an example of responsibility deflection which should not be overlooked, particularly because  
3 this belief generates feelings of disempowerment. It is vital that stakeholders such as  
4 manufacturers and retailers (and the legislators involved in product development and sales) are  
5 supported and encouraged to explore their role in helping consumers make better decisions. As  
6 eluded to above, one example of where manufacturers, retailers, and waste management  
7 professionals' roles and capabilities can be galvanised more effectively include changes to  
8 plastic packaging design (which may necessitate legislation change on use of complex,  
9 coloured, and mixed materials if change is to be adopted on a national and international scale).  
10 Another example includes increasing the opportunity to recycle by means of environmental  
11 restructuring (e.g. making better use of visual cues to help consumers navigate the recycling  
12 system and ensuring comprehensive availability of recycling resources). Again, such  
13 innovations require interdisciplinary partnerships, collaboration, humility to recognise the  
14 responsibilities of their role, and through partnership working recognition that they can  
15 influence other systems implicated in the plastic lifecycle.

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18

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21

## 22 **Declaration of interest statement**

23 This manuscript has not been previously published and is not currently under consideration  
24 elsewhere. The work is original and our own, and no copyright has been breached by the  
25 inclusion of any content drawn from another source. The submitted manuscript has been  
26 approved by all co-authors who have no conflicts of interest. The study followed strict ethical  
27 guidelines and was approved by the Ethics Committee of the Psychology Department at Queens  
28 University Belfast.

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## 30 **Data Accessibility Statement**

31 The dataset is held in a secure repository at Queens University Belfast Psychology  
32 Department. Interested researchers wishing further data should initially contact [insert details  
33 – removed in anonymous version].



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**Appendix**

Supplementary document 1 (S1): Interview Schedule for Stakeholders

The interview schedule will used to give some focus to the discussions and encourage reflections on current practices around beliefs, any barriers, any solutions, and consumer behaviour. A small number of structured scenarios may be used to prompt their understandings around **motivation, capability** (knowledgeable, being in control), and **opportunity** of all stakeholders.

**N.B.** Not all questions will be relevant to each stakeholder, but we have included the full set of questions in the schedule. We will skip any questions that are not relevant to the respondent on the day.

Questions	Prompts
<b>(1)Please tell us a little bit about your job.</b>	<i>What is their role in their company - are they scientists, retailers, managers, etc.</i>
<b>(2)When it comes to recycling, could we do more, what could we do?</b>	<i>Governments, businesses, industry, retailers like Sainsbury's etc.  Probe knowledge–do you think it is better to bury than burn it?</i>
<b>(3)Who needs to take responsibility?</b>	<i>Government, manufacturers, businesses retailers, consumers, industry etc.  Is it a consumer responsibility or shared responsibility?</i>
<b>(4)What are opportunities and best ways to encourage re-use and recycling more?</b>	<i>Probe where do they think the opportunities lie.</i>

	<i>Probe knowledge and understanding of plastics and best ways to reduce plastic waste.</i>
<p><b>(5)What do you understand about sustainable plastics should we use them more?</b></p> <p><i>(Glass bottles, cloth bags for shopping, food packaging made from sugar cane products, tapioca or paper etc.</i></p>	<p><i>Ask about the benefits and also any barriers to more widespread manufacturing and consumption of sustainable plastics.</i></p> <p><i>Think of food packaging, containers, or children's toys, or shoes, building houses, window frames, plastic containers for cleaning fluids etc.</i></p>
<p><b>(6)If you haven't already, why have you not implemented new, more sustainable plastics (eg. bio-based plastics)?</b></p>	<i>What are the barriers/facilitators to doing this? (for manufacturers)</i>
<p><b>(7)What would make it easier to recycle the materials you collect?</b></p> <p><i>(Recycling businesses and collectors, e.g. Bryson, Council)</i></p>	<i>How they are separated, or the materials used, better advice and education for consumer etc?</i>

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<b>Questions</b>	<b>Prompts</b>
<p><b>(8) What could consumers do to make this easier?</b></p> <p><i>(Recycling businesses and collectors, e.g. Bryson, Council)</i></p>	<i>Do you think they need help to do this – who is best placed to help them?</i>
<p><b>(9) Is there anything that other people could do to make your recycling business more viable?</b></p> <p><i>(Recycling businesses and collectors)</i></p>	<i>In addition to the consumer – what else could be done, by whom?</i>
<p><b>(10) How flexible can your recycling business be – can it easily adapt to new products?</b></p> <p><i>(Recycling businesses and collectors)</i></p>	<i>What are the barriers / facilitators to this?</i>
<p><b>(11) What level of communication do you have with manufacturers/retailers about new products and any adaptations you need to make?</b></p> <p><i>(Recycling businesses and collectors)</i></p>	<p><i>Any opportunities to meet, any associations you all are part of;</i></p> <p><i>Any tensions/ barriers to this happening?</i></p>
<p><b>(12) Anything you would like to add that we haven't covered?</b></p>	<i>Is anything you are currently doing to tackle the issue but we haven't touched on?</i>

	<p><i>What are the biggest hurdles for your stakeholder/company?</i></p> <p><i>Something around the relevance and importance for that stakeholder/company – is it an important business objective (the need to recycle plastics/reduce plastic waste etc.) ?</i></p>
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3 Table 1. Demographic Breakdown of Interviewees by Age and Sex

<b>SEX</b>		
<b>AGE</b>	<b>Male</b>	<b>Female</b>
<b>&lt;30</b>	0	1 (Sustainability management representative in a university)
<b>30-40</b>	0	2 (Representatives of a company that produces, bottles and distributes soft drinks). 1 (Representative from large recycling services provider). 1 (Environmental management representative in a university).
<b>41-50</b>	0	1 (Owner of company selling refills and eco-friendly products). 1 (Policy lead, Central Government). 1 (Policy lead, Central Government).
<b>51+</b>	3 (x 1 Senior manager, x2 Policy leads in Local Authorities/Local Government.	1 (Policy lead, Central Government).

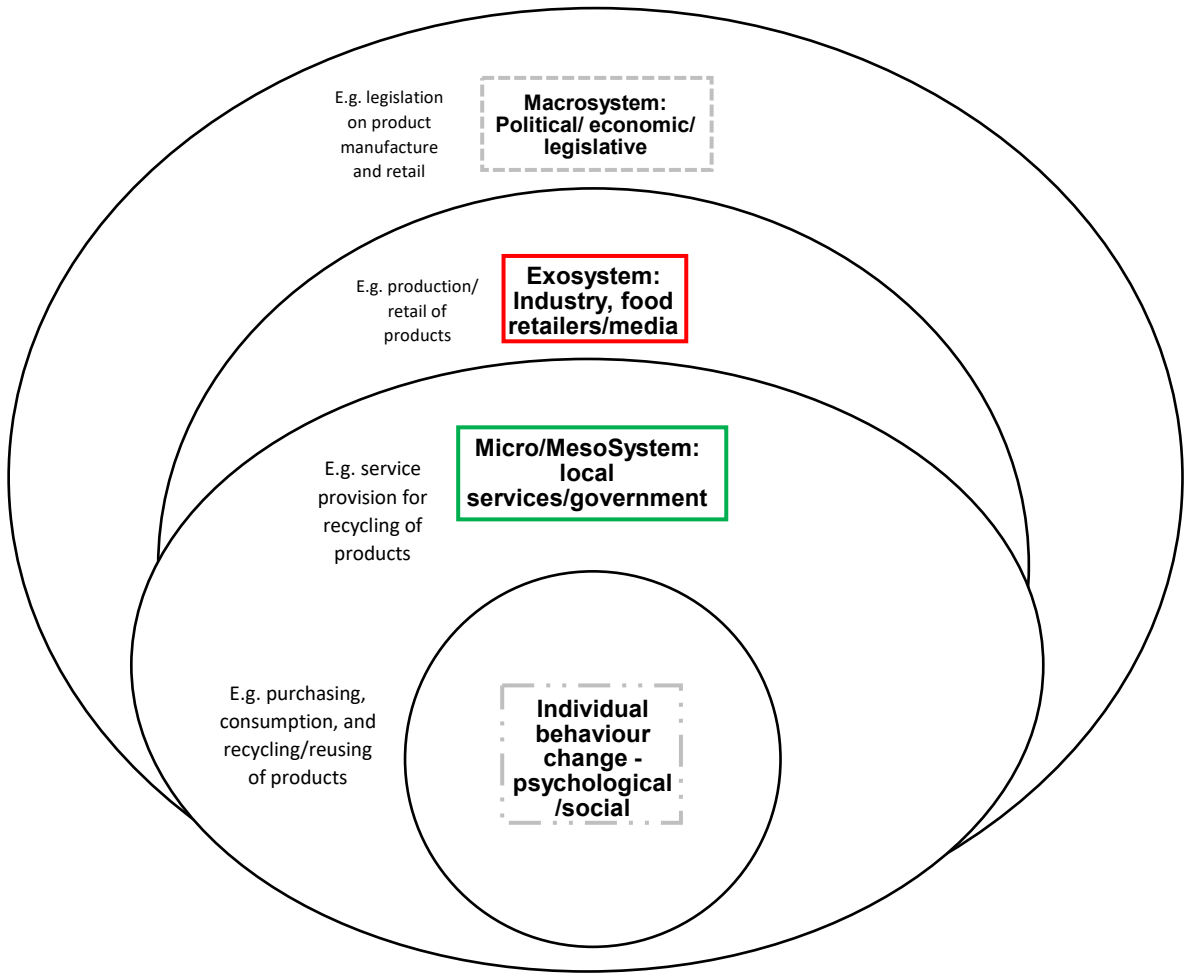
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**Legend:**

 Representative stakeholders interviewed: Policy lead Central Government, Senior Policy Manager (EST construct pertains most strongly to theme 4.2. i.e. legislative change needs).

 Representative stakeholders interviewed: Refill/eco-friendly company owner, Representative plastics manufacturer (EST construct pertains most strongly to theme 4.3. i.e. motivational and educational support needs).

 Representative stakeholders interviewed: Recycling services representative, Sustainability/environmental management representatives, Policy leads for Local Authorities/Government (EST construct pertains most strongly to theme 4.1. i.e. infrastructure and service developmental support needs).

 Not interviewed but implicated in the supply chain and lifecycle of products (EST construct pertains most strongly to theme 4.3. i.e. motivational and educational support needs).

**Figure 1. Bronfenbrenner’s Ecological Systems Theory (EST) contextualised to the Circular Economy, with Supply Chain Stakeholders represented and framed in the data.**