PRIMUS

WP6. Social sustainability and acceptance of recycled plastics

Task 6.4

Citizen and consumer acceptance analysis

Deliverable 6.2

Social sustainability and acceptance of recyclates

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DISCLAIMER

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DEFINITIONS/GLOSSARY

Environmental awareness, environmental consciousness, pro-environmental mindset – knowledge, attitudes and beliefs, related to environmentally sound practices.

Environmental self-efficacy, environmental sense of agency – belief that one has the ability and competence to perform pro-environmental behaviours and influence environmental outcomes.

Persona(s) – fictional illustrative representations of ideal customers, incorporating demographics, psychographics, behaviours, and motivations. Persona construction offers a comprehensive and holistic view of individual customer profiles, enabling personalised marketing efforts.

Primary plastics – previously referred to as "virgin plastics".

Recyclate acceptance – positive attitudes and beliefs related to the use of recycled plastics.

Recycled plastics commitment – behavioural intentions related to recyclate containing consumer goods (purchase intentions, willingness to pay extra).

Responsible consumption – making ecologically sound consumption choices.

Secondary plastics – those plastics that have undergone recycling, or that enter the use phase for a second time.

Stakeholder(s) – a person (or a group of persons) or organisation with vested interests in plastics recycling.

ABBREVIATIONS

APM: Automotive Parts Manufacturer

CBAM: Carbon Border Adjustment Mechanism

CE: Circular Economy

ELV: End-of-Life Vehicles

EU: European Union

FEAD: European Waste Management Association

HAM: Home Appliance Manufacturer

ITA: Industry Trade Association

PPM: Plastic Parts Manufacturer

OEM: Original Equipment Manufacturer

PFAS: Per- and Polyfluoroalkyl Substances

PPA: Polymer Processing Aids

R: Recycler

RP: Recycled Plastics

WEEE: Waste Electronics and Electrical Equipment

EXECUTIVE SUMMARY

The objective of D6.2 deliverable was to carry out industrial stakeholder survey and four representative public/consumer opinion surveys in European countries to explore perceptions of and experiences with recycled plastics, and drivers and barriers of awareness and acceptance. Accordingly, rich and unique original data is collected and analysed.

In-depth interviews with stakeholders from automotive and home appliances industry, recyclers, other plastics industry and research organisations revealed that recycled plastics are crucial for sustainable production but require strong infrastructure and legislative support. Sustainability is seen as an inevitably multifaceted concept – environmental, social, as well as economical. It was acknowledged that growth oriented economic systems are not compatible with sustainability. Thus, producers stressed the need for economically feasible regulations. Also, the need for clear regulations that would support European infrastructure for production was expressed. Besides, better monitoring of waste streams was emphasised. For wider adoption of circular materials, financial incentives and possibilities for cooperation and coordination between different actors are needed. It was perceived that responsibility for circularity is not carried by all parts of the production chain but is largely left to manufacturers. Barriers to adopting recycled plastics include costly waste collection systems and plastic segregation. Commitment to sustainability, innovation, and dedicated sustainability teams were seen as key drivers for adopting recycled plastics. Stakeholders also highlighted the role of consumers who were seen as economically rational and choosing sustainable products when economically feasible.

The consumer survey conducted in Estonia, Finland, Germany and Spain reveals public environmental concern and behavioural commitment to recycled plastics. Overall, respondents prefer products made with recycled plastics due to their perceived environmental benefits, but in Estonia and Spain there is slightly greater uncertainty about that. While there is intention to purchase products containing recycled plastics, price sensitivity is a significant barrier. Furthermore, Finland and Germany express higher confidence in recycled products, while Estonia and Spain show greater uncertainty about their experience which could hinder acceptance. Significant share of respondent, and more so in Estonia and Spain, express concern over either health safety, lack of long-term studies or inadequate regulations regarding recycled plastics compared to conventional plastics. Another barrier is relatively low awareness of recycled plastics. Drivers to acceptance of recycled plastics include rather positive perceptions of overall safety in comparison to conventional plastics and environmental friendliness. Additionally, four consumer segments were distinguished: Ecologically Committed, Fairly Concerned, Ambivalent/Hesitant, and Unconcerned/Sceptical. The Ecologically Committed segment has high environmental concern and willingness to invest in sustainable products, while Unconcerned/Sceptical shows distrust towards recycled materials. However, in all countries, many individuals with moderate views in hesitant group demonstrate engagement in recycling. Accordingly, illustrative personas for the Ambivalent/Hesitant segment were created to understand how their concerns and barriers to recycled plastics could be addressed.

On behalf of Authors

Eve-Liis Roosmaa, Tallinn University

PRIMUS PROJECT

PRIMUS project is dedicated to significantly contribute to the goals of the European Strategy for Plastics and enhance the amount of quality and safe recycled plastics that enter the European markets. PRIMUS is a project funded by the Horizon Europe in the following call: *HORIZON-CL4-2021-RESILIENCE-01-10: Paving the way to an increased share of recycled plastics in added value products (RIA)*. PRIMUS is a 3-year project with a total budget of 7 M€. PRIMUS has 10 partners, and 2 affiliated entities.

PRIMUS will actively engage with the plastics value chain stakeholders and innovatively develop novel methods and technologies to significantly increase the circularity, and production and use of sustainable, safe and quality recyclates in added value products. The main technological focuses are on advanced mechanical recycling coupled with broad analytics and novel pretreatment methods for removal of hazardous substances and counteracting degradation. PRIMUS will produce 4 demonstrations where new added value products will be made from recycled and upgraded non- or underutilized plastic waste streams from waste electronics and electrical equipment (WEEE) and end-of-life vehicles (ELV). The four demo products will be automotive interior parts, automotive cooling circuits and its elements, a food contact application refrigerator, and a closed-loop demonstration of washing machine seals.

The project aims at establishing EU widely accepted and transparent procedures to control quality and safety of recyclates, especially for the waste streams containing hazardous substances like brominated flame retardants. The framework related work will include broad engagement of the European plastics sector and recyclers, but also the society, citizens and communities as well as consumers. Safety and trackability back to origin, traceability, are consistent and overlapping themes in PRIMUS. PRIMUS will not only technically and industrially support the uptake of recyclates in products but will also address and support the concerns of the society and enhance the uptake of products that have recycled content.

1 INTRODUCTION

1.1 Scope

Sustainability requires a transition from linear to circular economy, briefly described as „9 R's" (ranking from 0 to 9): Refuse, Rethink, Reduce, Re-use, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover (Potting *et al*., 2017). This requires both application of new technologies, and transformation of social practices. Using high-tech materials like recycled plastics (RP) in consumer products is an innovative way to reduce human environmental impact. Acceptance and uptake of recyclate based products by consumers is thus a necessary component of practice change. Studies on new technologies (Gaskell *et al*., 2010) indeed describe great variation in public perception of new high-tech objects. To promote wider acceptance of consumer products containing RP, attitudes and views should be studied in different segments of population. Knowledge of diversity of beliefs and practices related to plastic in general and to RP in particular leads to the doubt in "one fits all" universal solutions (see Steger *et al*., 2021). By understanding this diversity researchers and practitioners can develop targeted strategies to enhance public attitudes towards the use of recyclates in products, ultimately promoting sustainable consumption practices.

This deliverable introduces analysis and results from stakeholder surveys (qualitative interviews) along with four representative social/public opinion surveys (quantitative questionnaire) to explore views about experiences with recycling plastics, enabling to produce new knowledge on drivers and barriers to awareness and acceptance. These surveys focus on views of two stakeholders: a) industrial and b) citizen (consumer) communities. Industrial stakeholder interviews were carried out among plastic recyclers and home appliance and automotive manufacturers. Citizen and consumer surveys were conducted in selected European countries (Estonia, Finland, Germany, Spain) representing different contexts: post-socialist countries and others, larger and smaller internal markets, stronger and weaker economies, etc.

1.2 Audience

Various value chain actors/stakeholders: industrial (plastic recyclers, home appliance and automotive manufacturers) and citizen (consumer) communities, policy makers, standardisation bodies, academic community.

1.3 Contributions of partners

The following Table 1. Partners´ contributions depicts the main contributions from participant partners in the development of this deliverable.

Participant short name	Contributions
all	Project partners participated in the stakeholder interviews which gave further insights into mapping stakeholders involved in plastics recycling; the interview process guided the development of stakeholder survey interview plan.

all	Project partners commented on the citizen/consumer survey questionnaire questions and highlighted some of the issues/questions that should be addressed.

Table 1. Partners´ contributions

1.4 Relation to other activities in the project

The following Table 2. depicts the main relationship of this deliverable to other activities (or deliverables) developed within the PRIMUS project and that should be considered along with this document for further understanding of its contents.

Deliverable Number	Contributions
T7.3	Provide input for the creation of the PRIMUS stakeholder's communities (industrial and citizens) based on developed stakeholder personas

Table 2. relation to other activities in the project

1.5 Structure

- **Section 1**: Contains an overview of this document, providing its Scope, Audience, and Structure
- **Section 2**: Contains the objectives and expected impacts of the project
- **Section 3**: Contains the results from the industrial stakeholder survey
- **Section 4**: Contains the results from citizen and consumer study
- **Section 5**: Provides the conclusions and discussion

2 OBJECTIVES AND EXPECTED IMPACT

2.1 Objective

The objective of this deliverable was to conduct a stakeholder survey (qualitative interviews with industrial community) and carry out four representative social and public opinion surveys done locally (quantitative questionnaires among citizens/consumers/ general public) in selected European countries to explore views about and experiences with recycled plastics, following the analysis of global ISSP 2010 and 2020 dataset and Eurobarometer study on attitudes regarding environment to reveal attitudes and consumption patterns. As an output, this work provides novel horizontal stakeholder personas, and new knowledge about drivers and barriers of awareness, social engagement and sustainability and how the context impacts them.

2.2 Expected Impact

The deliverable will enhance acceptance of and commitment to recycled plastics in added value products among industrial and citizen (consumer) communities.

3 ACCEPTANCE OF AND COMMITMENT TO RECYCLED PLASTICS BY EUROPEAN INDUSTRIAL STAKEHOLDERS

This chapter begins with a literature review documenting barriers and enablers for the use of recycled plastics in the production in general, and in automotive and home appliance industries in particular. This is followed by original survey and analysis conducted among manufacturers or their associations in Europe, focusing on home appliance and automotive industries. Next part documents the experiences and perspectives of recyclers or recycler associations. Furthermore, intertwined with the analysis are expert views from other stakeholders in the field, i.e. research professionals and consultants.

The original data consists of 28 interviews with 33 stakeholders from 10 European countries, representing or examining manufacturers' or recyclers' views on the use of recycled plastics. See Table 3 for the overview of interviews and their codes used in the analysis.

Table 3 Overview of stakeholder study interviews

Interview code	Type of organisation	Number of interviews	Number of interviewees**
HAM	Home appliance manufacturer (OEM)	3	5
APM	Automotive parts manufacturer	5*	7
PPM	Plastic parts manufacturer outside home appliance and automotive sectors	5	5
ITA	Industry trade association	5	5
R	Recycling company	4	5
RCO	Research and consulting organisation, including university	6	6

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

Detailed overview of sampling and interviews can be found in Annex 1, and general interview plan in Annex 2.

The end aim of the analysis is to exemplify how different stakeholders perceive differing barriers to the use of recycled plastics and how their respective fears and wishes for the sector are also intertwined with their positions in the field. Similarities and differences between stakeholders will be commented on. The intention of this analysis is to potentially understand, through an examination of these varied circumstances, what might be the best ways for stakeholders and the society to enhance the use of recycled plastics.

One of the overarching principles governing this analysis is the notion of a "problem". Following a slightly modified version of the "What's the Problem Represented to Be?" (WPR) framework, originally developed and elaborated by Bacchi and Goodwin (2016) for policy analysis, an attempt is be made to answer the following questions:

1. What are different stakeholders' definitions of the problem at hand?
2. What sort of assumptions and logics underlie these specific problem representations?

3. What has been left out from the problem representation?
4. How has this approach to the problem been defended and/or disrupted?

and additionally, we were interested in

5. What are the potential solutions offered to the problem?

These questions encourage a critical and reflexive approach to the analysis of recycled plastics' use and help to reveal hidden assumptions of and power dynamics between stakeholders. This will help to find effective ways for framing and addressing issues surrounding recycling and using recycled plastics.

3.1 Earlier research on automotive and home appliance sectors

The barriers and drivers for transitioning to a circular economy and increasing the use of recycled plastics among manufacturers have been broadly categorized into technical/technological, economic, regulatory/legislative, and cultural/social aspects. Technical barriers, such as quality issues, and economic challenges, including cost disparities between recycled and primary plastics, remain significant. Regulatory factors, such as regional differences in legislation, and cultural aspects, such as consumer demand for sustainable products, also influence the uptake of recycled plastics (de Jesus et al., 2018; Kirchherr *et al*., 2018; Paletta *et al*., 2019).

Cultural and regulatory drivers are evident in market and policy pressures to promote sustainable production. For instance, in the household appliance industry, companies like Whirlpool and Miele have integrated recycled materials into their production processes, focusing on recycling as part of incremental circular economy strategies (Bressanelli *et al*., 2020). However, Milios *et al*. (2018) showed that in the Nordic region, technological and economic barriers dominated, particularly the accessibility and cost of recycled materials, alongside limited traceability and additional quality assurance requirements. Despite the perception that recycled plastics are generally cheaper, their price remains volatile, influenced by supply-demand dynamics, while primary plastic prices fluctuate with oil prices. Insufficient communication and transparency across fragmented value chains further hinder progress. Nordic producers emphasize the need for coordinated value chains, technological investments, and regulatory interventions to overcome these obstacles (Milios *et al*., 2018).

Sector-specific variations also shape the barriers and drivers for using recycled plastics. In the Nordic region, the automotive industry, despite substantial recycled plastic use, avoids advertising this due to concerns about perceived quality. In contrast, furniture manufacturers highlight recycled plastics to attract environmentally conscious consumers (Milios *et al*., 2018). The automotive sector, accounting for 18% of a vehicle's mass in plastics, uses primarily pre-consumer waste due to its homogeneity and suitability for mechanical recycling. This sector's adoption of recycled plastics is driven by cost-saving measures and consumer sustainability expectations (Baldassarre *et al*., 2022).

Further drivers in the automotive sector include global sustainability trends, policy targets for plastic recycling, high availability of post-consumer plastic waste, and advancements in chemical recycling technologies. However, barriers persist, such as

confidentiality among manufacturers, issues with traceability and verification of recycled plastics, fluctuating costs of primary and recycled plastics, and quality challenges associated with post-consumer waste. Improving chemical recycling methods, developing advanced sorting technologies, and establishing design rules aligned with current limitations could address these challenges (Baldassarre *et al*., 2022; Ajorloo *et al*., 2021).

In conclusion, addressing barriers and leveraging drivers for recycled plastics require sector-specific approaches, regulatory alignment, technological innovations, and enhanced value chain coordination. While significant challenges remain, targeted strategies can facilitate the transition to a circular economy and greater adoption of recycled plastics. This study will shed even more light on the specific barriers stakeholders report they face and what could be done to overcome them.

3.2 Stakeholder study results: Home appliance, automotive parts and other plastic parts manufacturers

This chapter will look closely into how manufacturers and the organisations that represent them[1] identify sustainability, how they consider the role of recycling and what importance they give to different legislative efforts to make production more sustainable. It is important to acknowledge that production is an interdependent system and making it more sustainable, thus, is dependent on the (sometimes conflicting) decisions of different actors. For example, parts manufacturers form an important part in the chain of production, as they may or may not provide OEMs with adequate recycled parts for manufactured products. However, this relationship is interdependent, as OEMs may or may not request for such materials in products, since they might problematize their appearance and performance as not pleasing enough for the consumers or their price too high. At the same time, manufacturers are also in need of high-quality recyclates from the recycling industry. Hence, they are required to find a way to balance different market forces and the ideal of sustainability.

3.2.1 What is sustainability and can it go hand in hand with production demands?

One of the main contradictions expressed in many of the interviews with manufacturing representatives was the tension between the necessity to produce and sell more products and the current "inevitability" of producing these products with recycled plastics and under the category of "sustainable production". Thus, on the one hand, it is important to convince the consumer to buy, but on the other hand, to buy in a "sustainable" way in the framework of the classical growth model of economy. These tensions are not only found in different stakeholders' representations of the situation, but also in one and the same interview:

[1] In quotes/interview citations, APM refers to automotive parts manufacturer, HAM refers to home appliance OEM and PPM refers to plastic parts manufacturers who do not operate in the home appliance or automotive sectors. Furthermore, ITA refers to industry trade association.

> *"/…/ it seems that now everybody wants to be sustainable, but at the same time, we buy many things that come from other parts of the world. So, I think that if we didn't have the regulations that forced us to make this change, it wouldn't be easy, because it's quite easy to say one thing and then do another one. I mean, we consume a lot… too many things nowadays. It's quite easy to maybe say that you are sustainable, that you want to have a greener wall, that you want to recycle, but then at the same time, we consume many, many things. And I think that if regulations will not change, it won't be easy for us to change." (APM1)*

Interestingly, the company is here seen as attempting to be "sustainable", but the consumer as the one "wanting to consume more and more", whilst the market reality is somewhat reversed, i.e. it is important for the producer that the consumer consumes, even if the production is executed in a more sustainable way. This generates a paradox that however "sustainable" the production, producing more is also seen as a problem (however inevitable) in itself.

On the other hand, sustainability was also seen as an inevitably multifaceted concept: environmental, social as well as economical. This approach does not address the paradox of consumption and sustainability, but places sustainability in the framework of the market, emphasising the importance of sustaining the production to remain sustainable as a whole. The interviewee perceives sustainability as a compromise between all these aspects, one being unable to exist without the other.

> *"So, there are a lot of things that are important to make a product, and sustainability is one of them that is put on top of everything. And so, it is important. But some people think that sustainability is the only focus point of a product. And that's not true, you also have the design. You can develop something that is very nice-looking, but it's very expensive and it's completely circular. But if not, nobody buys it. We are not going to develop it. We are not even going to the market. So, there is always a business case needed with some look and feel and some design features, and sometimes that's compromising sustainability." (HAM2)*

Furthermore, many mention the need to find a compromise between safety and sustainability, as primary materials are often considered as the safest option in several applications (as they are free from prohibited additives etc.).

One interviewee emphasises the "tough truth" of the importance of succeeding in the market, also bringing in the question of consumers' decisions. He is uncertain whether consumers would actually buy pricier products with high concentrations of recyclates or if it is just something they hope to do:

> *"I think both for the consumer and also for us, you have to find the right business case, and that's why it's called a circular economy. Yeah, the economy is there. Circular is there. That means it can exist in our society where economic growth is the driver. /…/ The economy plays an important role. So, you must have a business case, otherwise it won't sell, otherwise I won't buy. This is the very tough truth, I think, that we are facing. We have this whole circular concept, and all the importance that we attach to climate and environment is, of course, relevant. Not going to say that it's not relevant and that it's not important, but it has to find the right business case, and this is what we have to work on. /…/ And the end consumer needs to find the right business case in the market and needs to be convinced of the business case. And that's the whole difficulty of this exercise. /…/ If you ask people, I think that what they answer is different than what they actually do when they are buying, yeah. And I think that there is still a big gap between the intention and what the consumer is really doing." (HAM3)*

Furthermore, it is sometimes proposed that the general public should adapt to the fact that products will have a lower quality and, at the same time, will be more expensive, which simply means that there is a need to convince the consumer of the inescapability of this situation in order to continue selling products with recycled components successfully:

> *"/…/ The problem is the balance between the cost that it could have on the final performance, because at the end, we cannot have something much more expensive. I mean, if we have something that has a lower quality, it must be cheaper. If we have to do something, we need to make some changes to improve that quality. It cannot be much more expensive, because otherwise it won't be easy to sell. I mean, it's not easy to sell something, let's say, with a lower, or at least different quality that we are not used to, and even more expensive, that's not easy, so we need to adapt. We have to make changes, and we have to accept that a different material will have a different performance or different aesthetics. /…/." (APM1)*

One of the reasons behind these difficulties is cited to be the lack of competitiveness of the European Union market – labour costs are higher, material costs are higher, data reporting costs are higher – which makes it hard to develop a proper, working business case.

Similarly, when it comes to sustainability, another tension may appear between the OEMs and their suppliers. Namely, market logic does not seem to benefit sustainability as suppliers need to comply with the requirements of the OEMs to ship their products all over the world, thus generating great amounts of CO2. Therefore, the option of producing closer to the consumers is sometimes seen as impossible or very difficult, as one of the interviewees noted:

> *"/…/ before, some years ago, you could be a local supplier. I mean, you could supply for some OEMs in Europe and then not supply in some other regions. But at the moment, you cannot do that. The OEMs want to have a global supplier that can supply for their modelling in Germany or in Romania or whatever, and then the same supplier MUST supply for the model in Asia, for the model in North America or South America. So, it's something that you need to adapt to. You cannot say, no, I want to produce only in Europe, or I want to produce only in China. So, at the end we are not in the position of deciding that /…/." (APM1)*

There are, of course, some producers who emphasise that technically there are no barriers (for them) when it comes to adding recycled components to their products, but they cannot be sure, which alternative for current materials is the best (i.e. economically viable). They are simply hesitant to choose a direction, as this comes with additional costs that do not bring benefits straight away. They argue that going through the development phase and then the production phase of a product containing new recycled and recyclable materials could take up to ten years:

> *"We can't take just another material, because we are equipped especially for this technology, these plastic parts. So, it's really not easy as experts, to give our bosses a concrete idea, because they know it would all be risky, and that is money, perhaps coming back in 15 years, if we think of closing the loop. So, they're very shy to take the risk. They say, okay, let's do some brainwashing activities. Let's do a little bit of advertisement. But creating a totally new idea of a product, for example, is another topic that's really difficult. /…/ But if you say, make this wonderful green product, I ask you, how is it defined, and when do we have to deliver it? /…/ Otherwise… we can talk about this. We can do some calculations. We can do trials, all that we are doing. But we have no security. We are not safe. Whether what comes really, really comes, because it's not all about scientific decisions, it's about all others, too." (HAM1)*

This approach recognises a need for a complete change of the products on the market to become "fully sustainable". Anything less can be seen as "brainwashing", as the interviewee notes, since advertisement in the right direction might help with the sales, but the product remains much less innovative than what is needed for a truly sustainable production.

Considering these paradoxes and shortcomings, it is to be expected that many of the interviewees support the creation and implementation of clearer and in some ways stricter regulations by the European Union. For the overwhelming majority of our interviewees from larger countries, market forces alone cannot resolve the problem of reliance on primary plastics but need to be supported by regulations that pay closer attention to each stakeholder in the chain of production, helping to balance their potential profit losses. For example, for some automotive plastic parts producers, the delicate position between OEMs and recyclers can be thrown out of balance, once OEMs start collaborating directly with recyclers:

> *"/…/ Sometimes we can get stuck, because in this new ELV [end-of-life vehicles] regulations and the accelerated developments in the electrical car market, material producers started working directly with the OEMs to develop their formulations with recycled materials, improve their specifications, update their specifications according to the new targets, our margins are getting a little bit lighter to compete with other suppliers /…/ So we get stuck between these two stakeholders when it comes to new regulations, especially for ELV directive. But on the other hand, these regulations are opening a new area for us to be on the market as not only converters, but also technology developers, because developing, for example, recycled material is one thing, but processing in a very efficient way is another thing." (APM2)*

At the same time, as the interviewee also points out, changes in market relations can open up new avenues for technological development, as long as the company succeeds in addressing this need. Some manufacturers are even more positive and expect the prices of recyclates' processing to reduce, once the demand for sustainable materials grows and production scales up. They also believe that recyclers, on the other hand, need to be approached by the OEMs to help the discussion further and show them the "reality of the market". Those interviewees point out that OEMs do not want more expensive products, but inevitably, there will be, at least for some time, a rise in prices. This is due to the fact that recyclers either "do not want to" change their technologies and hence fall out of competition, or "want to change" and have to put additional resources into the move towards better technologies – thus the price will increase.

3.2.2 What is the role of recycling for manufacturers?

Many manufacturers recognise the importance of recycling in the chain of sustainable production and see it, among other things, as a way to "rectify" the use of plastics in the eyes of those who see plastic as an inherently bad and toxic material:

> *"/…/ A sustainable product is one where the aim is to limit plastic in every way possible, even to the point of banning it in some cases. It's said that plastic is bad because the oceans are full of it, all the shorelines are covered in it, and the forests are full of it... Well, if you look at the amount of plastic, you won't see any hands or feet attached to it. I haven't seen the plastic go there by itself. So, what we have done is bring it there. In reality, we should focus more on how to ensure recycling and collection. To me, that's the key point. If we now reduce the amount of plastic, that doesn't necessarily mean that we are somehow saving the environment /…/". (PPM1)*

Producers thus mostly believe that the recycling industry has to mature in order to reach the level of expectations of the producers and the overall sustainability goal. At the same time, some also noted that producers need to lower, in some sense, their expectations for recycled materials, to be able to choose from less options for their products. This means that there seems to be a mismatch between what producers expect and what recyclers deliver – there are examples of good recycling results, but the quality is still often not enough for some industries. This mismatch can result in the chicken-and-egg problem – what comes first, the change in recycling processes or alterations in the product design? Or do they go hand-in-hand? Many are still expecting more efforts from the recycling industry:

> *"/…/ "we have the information, and you can also read it from standards, what you should avoid in the design for better recycling. But in the end, we have to improve the process of recycling and ensure that the functionality and the durability is there, and that's the reason why we are not changing our design. Yeah, only in the case where we don't have a chance to improve a certain cycling process, for example, to differentiate between this material and that material. Then we have to look at the design to avoid this in the future. But this improvement in the design we will see in 10, 15, years /…/ Therefore, we have the order. First, learn to look at the current status of the recycling process. What we can improve at the recycling sites, collecting appliances, sorting, what we can disassemble before, what we can shred, what we can sort afterwards, after the shrilling, back gain, then it should be from the cost side, also positive, and then we are integrating this in our appliances. Next, we have to adapt the production processes. We must change in some cases, because virgin plastic is another challenge for our processes with recycled materials, because we have longer process times. We need more materials in our parts, because the thickness of the wall has to be a little bit bigger and so on. And these are process changes. And afterwards, if we have a stable process, then we can talk about design changes." (HAM3)*

All in all, there are disparities in levels of optimism when it comes to the quality of recycled materials and their use in new products. The overwhelming majority is pointing out that it is still considerably more expensive to produce anything with recyclates, even if OEMs are requesting more sustainable options. Furthermore, producers continue to face challenges in sourcing high-quality recycled materials, particularly for technical products, as the European market fails to offer enough recyclates and the foreign markets have different quality standards. Variability in recycled materials often disrupts production processes and makes it difficult to meet the more stringent standards.

At the same time, in order to prevent "greenwashing", regulations currently exclude post-industrial scrap from recycled content calculations, creating additional compliance hurdles. This is while the reduction and reuse of scrap is seen as one of the most obvious and necessary steps towards better sustainability, especially for parts manufacturers, as OEMs do not pay for this material (only for the finished product) and hence there is a great economic incentive behind scrap reduction:

> *"No, we don't do the recycling process internally. We directly buy recycled material, but we don't recycle. Although it's true that with some of our scraps, that we have close to the machine, we have a matching when we can introduce, for example, plastic spruce. And we break this into very little parts, and then reintroduce them in the manufacturing process with the OEMs that we arrived at an agreement with, telling them, okay, we have 2% of this of the scrap, but we analyse that it's possible to introduce this percentage again in the manufacturing process, and we guarantee more performance, so this partner is going to follow. So, this kind of process, we have it internally but always discuss it with the customer." (APM5)*

This chimes with one interviewee's statement that good recycling is not just about removing different toxic materials from products, but it is a "whole system", which needs to be bolstered from every possible angle. For example, several companies do not have good recyclability of their own products yet:

> *"The holistic goal should always be to make closed loop cycling materials from our products and get them back via the recycling process in our products again. And implementing this structure is very complex, and we also need regulations and other segments of the product life cycle need regulations that make everything fit together." (HAM1)*

This is seen partly because receiving proper materials for a product with recycled content is problematic and a lot of times relatively expensive as well because highly energy-consuming chemical recycling is needed. This means that the efficiency of recycling might not be high enough. The issue is further complicated by lack of uniform material specifications across OEMs, which limits the efficiency of recycling and the reuse of materials. Thus, many interviewees call for universal industry standards that would help to make producers' expectations clearer.

Another, related issue brought up by several interviewees from different industries is the problem with mass balance and the overall difficulty with estimating the exact contents and features of a specific batch of recycled plastics. Furthermore, interviewees sometimes noted that the recycling sector is not as "professional" as the traditional supply sector of primary plastics when it comes to identifying and ensuring the quality of their product:

> *"/…/ It's a sector that from the professionality point of view, it's not at the same level that the common material, raw material supplier /…/ from the knowledge point of view, from the compounding point of view, from the support that you need in the development phases for your part or your compounding process. /…/ For example, if I'm going to ask the recycling company, /…/ can you control the viscosity and the Newtonian phase? Because I probably need to know this concept, they are not clear, and they might not understand, because they never need to use this kind of concept for the business cases, okay? And our sector is actually, very, I don't know if the word is traditional, but it's a sector where it didn't start yesterday. So yeah, we have traditions, like how to do things /…/". (APM5)*

This is at least partly seen as the result of several potentially green or sustainable directions that could be taken on the market, but no one can be exactly certain which directions are the most profitable. Hence, bigger companies might be tempted to try to pursue all of them (bioplastics, chemical recycling and different corresponding technologies) and to not give up on the production of primary plastics either. The opposite can be true – the production of primary plastics makes it possible to add "high quality" materials to the recyclates, creating both lower and higher commercial grade products. Furthermore, bigger companies require bigger batches of recyclates, as they produce more, but it is unclear how to ensure the quality and comparability of each of these batches and thus the comparability and uniform quality of the product. What complicates this further, is the need to produce locally to reduce the carbon footprint, but the providers of good recyclates are, in some cases, not locally available.

In sum, one of the singularly largest problems is identified as the low-collection-rate issue. For several industries, the collection of used products has not been successful and most of the potentially recyclable products or parts "go missing". This is believed to be due to lack in tracking the waste and not putting enough pressure and responsibility on other parts of the stream (i.e. not only on the producers of products) to deliver waste to appropriate locations. Thus, closing the loop becomes even more problematic, as the industry is yearly losing huge amounts of recyclable waste. What is seen as ideal by many, is to try to keep different waste streams separate (for example food contact materials separate from the rest) so that they can be easily reappropriated without big losses in quality, and to make sure that every member of the loop, including consumers, waste collectors and governments, are on board and held responsible when directing waste streams.

This might become especially crucial in smaller markets, i.e. countries, where collection streams are also relatively lower than elsewhere. As there is technically a common market for recyclates, collection is still organised country-by-country, sometimes on the local government level. Thus, national regulations could become European level regulations, or, as one interviewee notes, national governments should be more involved in developing a working waste-collection system.

> *"/…/ For us, the main challenge is related to regulations and the fact that the government is not fulfilling its obligations. When the government does not enforce its existing regulations and laws, as a result, in our opinion, sorting is not done adequately. Not enough, not with sufficient quality, and not in sufficient quantities. /…/ We lack a powerful, fully automated sorting plant here that could sort plastic. /…/ This should be a volume business, and it should happen fully automatically, like it does generally in Europe. But here, that doesn't exist, there are no companies for that, and, well, why is this so? The most likely reason is that it's tied to several factors, like regulations. The current laws don't support it. And the second issue is that... it seems we can manage without it. Plus, there's no real pull for it here. We talk a lot about the circular economy and recycling, and we'd like someone else to do it, but we don't do it ourselves... Our government's task is to create that pull so that the materials can be used. We don't need subsidies, we just need a place to sell them. So, if the government itself doesn't buy, for example, doesn't integrate circular economy practices into its procurement processes and doesn't consider it, then why would they demand this from someone else? Saying, "We don't do it, but you should"? And I think that's the main problem today! /…/." (PPM2)*

3.2.3 Legislation – what kind and for whom?

Taking the current recycling conditions into account, it is thus not the simple question of how many regulations, but which type of regulations and whom they might benefit. From a very positive point of view: one of the interviewed producers was even able to rely on EU regulations to guide the product development of his company and to explain better the need for greater sustainability:

> *"I would say largely, especially now with the EU Green Deal and all the underlying regulations as part of the deal, like the equity sign, for example, deforestation regulation, that there is a much closer connection between regulations and sustainability than before. Like it's really happening now, and we are leveraging really on those regulations to drive a lot of sustainability topics. For example, we have a regulation called the carbon border adjustment mechanism CBAM, where my goal is not just the reporting, but we are trying to convince and explain that, looking at the impact of steel, for example, that the sources of steel, versus the price and all the administration behind managing CBAM, is it really worth buying steel from the same place than before? Or in terms of volume, you know? So, we are trying to use this also in terms of the conversation around decision making, when, for example, we are sourcing certain types of materials or selecting certain types of materials in our products. /…/ It's quite an interesting journey, but for me, I think I see it as an opportunity, because it's helping us drive a lot of things. Maybe if those regulations were out, there would be resistance, because it's driving cost, it's driving investment. We need resources. But now it's easier to have these conversations, because we can say, well, we can easily point at the regulations. We can point at the impact and the consequences of not being compliant and so on." (APM4)*

On the other hand, some manufacturers, depending also on the type of products they produce, state clearly that they see problems with legislation because it seems to be too "unrealistic", as if the legislators have not been aware of the actual possibilities that are available for manufacturers on the market:

> *"Well, sometimes it's exaggerated. If you look at what they want to regulate on PFAS, for example, I would say, because the restriction on all possible feed PFAS would really jeopardize production of all types of appliances, because PFAS' are used everywhere. And for some of the PFAS, you cannot just find an alternative. /…/ So, there should be more, let's say, a pragmatic approach. And there should be more openness to listen to the experience of the industry, and less regulation from an ivory tower. Sometimes we really have the feeling that the ones that are regulating and writing the legislation or proposing the legislation, they have no clue what they are regulating, and they have no clue about the impact that it causes on the industry, on the supply chain and on the distribution chain afterwards. Therefore, a little bit more realism is needed in legislation." (HAM3)*

Taking this into account, there are differences between producers. Some interviewees, especially when coming from smaller companies (for example, with a clear focus on creating a product, rather than just creating a product part, and doing it on a smaller scale) might experience issues with "getting their point across" to associations that could help to communicate their specific and more complex problems at the EU level. Bigger producers of product parts are seen as better represented and having to face fewer issues, such as how to ensure the sustainability criteria of a fully developed product, how to acceptably market it (correctly and at the same time successfully communicating the positive effort that has been put into developing the product), how to ensure the further recyclability of the newly developed product and how to ensure that the administrative costs of ordering a

smaller rather than a bigger batch of materials from abroad, for example China, do not exceed the benefits.

The scepticism regarding any regulations can be partly traced back to conflicting understandings of sustainability, as some interviewees emphasise the importance of understanding sustainability as a very complex system that is intrinsically intertwined with our current economic models and value systems. For example, as one interviewee pointed out, there are sometimes "problems" with the way legislators might view plastics as a subpar and inherently environmentally problematic product, instead of emphasising its low carbon footprint:

> *"/…/ By the way, the plastic bag was invented by Swedes in the 1950s, and its purpose was to be more environmentally friendly. This plastic material has, without question – emphasis on "without question" – the smallest footprint compared to /…/ glass, metal, wood, or any other material. Plastic has the smallest production footprint. The fact that we don't know how to utilize 100% of it isn't the fault of the plastic itself /…/." (PPM3)*

Any strict regulations that are attempting to reduce the carbon footprint, might, unintentionally, enlarge it, if close attention is not paid to the ways in which we use other resources to produce a new resource through recycling. The interviewee is not convinced that this has been thought through:

> *"/…/ But well, you can't regulate everything completely. That's the thing, like in Europe, they say that post-industrial waste is a more controlled issue. But the main focus is on household waste. However, I don't see a bright future in that regard because, as I'm saying, some things are just so complicated to clean. Not complicated. Expensive. The footprint of cleaning and recycling is larger than simply incinerating it /…/." (PPM3)*

In addition to viewing some regulatory practices leaning in the wrong direction from a moral or a scientific point of view, there are also many practical and economic reasons that are mentioned when claiming that currently planned or implemented regulations might not help or help enough. For example, it is feared that regulations are trying to guide the market towards a direction that it is not able to take, since there still are not enough good quality materials with recycled content available for most uses, including food-contact use. Furthermore, lobbying by larger companies can sometimes lead towards directions that are not seen as the number one priority in sustainability and recyclability, such as the "innovation" of attaching bottle corks to bottles with an additional plastic strip. Even more so, some actions are seen as detrimental to the European market, diminishing its competitive advantage. Here the interviewee suggests that ever since the adoption of the European Circular Economy Plan, plastic producers started to reduce their activities in Europe, but increased them elsewhere, and now are obligated to import plastics with unclear origins to fill the gap:

"/…/ On the one hand, it's very welcome that the European Union is dealing with this regulatory framework to reduce the environmental impact of plastic, but on the other hand, we can see that back in 2016, when the European Union adopted the Circular Economy Action Plan, at the EU level, all the larger producers were already trying to curb the market threat, and production volumes in the EU have been gradually reduced. At the same time, globally, production has actually increased dramatically. And we haven't consumed less plastic in Europe, it's just been imported instead. And now we're importing low-quality plastic. We don't know where it's made, under what conditions, or what quality it meets... We're importing more of it because the automotive industry, electronics – everything still needs plastic. So, /…/ we're solving one problem, but in reality, we're creating a much worse situation, like a boomerang. Yes, maybe now we're talking about CBAM [Carbon Border Adjustment Mechanism] and there's the carbon "surcharge" that will be paid for imports from third countries, but that's not yet coming for plastics in the near future. So, /…/ this is making the situation even more difficult for the development of a quality circular economy here, because we now have even more low-quality, poor materials that we can't process properly /…/." (ITA1)

All in all, the obligation and duty to report on more aspects of companies' activities is often seen problematic by smaller companies operating on smaller markets, as this adds additional costs and, at least until now, offers relatively little rewards, reducing companies' competitiveness in comparison with the "bigger players". One concrete example would be regulations that are seen as initially "meant for" bigger producers by design, but are universally applied to everyone:

"/…/ in the European Union, we now have the microplastic regulation, which, as I understand, was primarily written to address the environmental impact of polymer producers in large European countries. But now the entire EU has to implement it. And now, /…/ the administrative burden, which is aimed at preventing microplastic leakage from raw material producers, needs to be applied even by our small manufacturers. But /…/ being part of this process, I know it was written with large European countries in mind. /…/ here's an example where some of the EU's legislative changes or directives are designed for a different target group, but they end up affecting everyone. And then there are some of these inevitable challenges that we must adapt to. However, we will certainly try to keep the burden to a minimum. We definitely want to do this with the least amount of burden because it's not really relevant for us. We don't have polymer production, which was the actual target. Here manufacturers only process it. So, there are nuances like this. In summary, the goal is to avoid overregulation, but in principle, the whole direction is understood /…/." (ITA1)

The larger companies and associations, on the other hand, see it as a necessity to focus on keeping the market as uniform as possible and lobbying for the same standards, requirements and legislation for all. There is a strive for unified goals and conditions, as the consumer has to get the best products at the cheapest prices. However, smaller and newer companies might suffer due to this mindset, as they are unable to compete with the larger companies' flexibility and RND investments.

In addition to differences between larger and smaller companies with different product development focuses, relatively vague regulations that "just exist", but are not monitored, can create hesitance with compliance and insecurity on the market. Some of the players are seen as being able to quite easily afford the possible fines that are the result of breaking some of the regulations. Furthermore, it is judged that the impact of the currently existing regulations has not been fully monitored or that there is not enough easily accessible information on the results of such monitoring and auditing. This, in turn, can reduce companies' compliance with such regulations:

> *"/…/ Sometimes they [regulations] are just kind of very vague, so it leaves a lot for interpretation. I wish that the regulations were clearer in terms of what is the expectation and how we should deliver on them. And /…/ how are the regulators even going to measure the kind of impact when introducing this [regulation], what are they really seeing? Are we going to get a report to actually see the progress of the impact of those regulations within the EU, for example. Sometimes I don't see it because we have regulations like external producer responsibility, this has been around for decades. But if you try to find data about it or figure out if it has really been impactful. Or what kind of impact has it really had? You don't really get this kind of information or, maybe somebody has done research in academia, but not really from the /…/ EU agency itself, or from the National Agency, it's a bit harder to get information there around the progress or real implications of the regulation /…/." (APM4)*

There are many interviewees who stress that market surveillance is often missing, not sufficiently invested in and too local instead of using the overarching authority of the EU. This can potentially result in unfair competitive advantages or even unsafe business practices:

> *"Legislation is there, and normally everybody should fulfil legislation before the company can place a product on the European market. That's at least the principle. Well, not going to accuse any other company of not playing by the rules, of course, but at least it should be /…/ verified by market surveillance. This is the principle that we have in the EU for most of the legislation. We have for our products /…/ the principle of presumption of conformity and self-declaration. That means that we can declare that our products fulfil all applicable legislation. We mostly do this by adding the CE mark[2] on our products, everybody can do this. And then we have the so-called post market verification, which means that whenever the products are on the market, surveillance authorities can take them and verify whether they really comply with the legislation or not. And this is not happening enough. That is the big issue. /…/ Member states do not invest enough in market surveillance, and they should improve." (HAM3)*

Some interviewees also argue that there is not enough evidence of the success of combating global market forces, i.e. there are doubts whether current regulations are able to make Europe competitive in comparison with, for example, China. Thus, there are fears that without ensuring the competitiveness of the European market, the sustainability goal might be very difficult to reach.

These problems with competitiveness include differences between countries' regulations, whereas production is generally seen as a worry-free process, but selling is "another story". The quality of the product is generally not regarded as an issue, but restrictions and requirements on the packaging are becoming more and more of a hurdle, companies report. The reasons behind packaging restrictions do not seem to be scientifically reasonable for the companies, but rather an "idea" that is quickly implemented and turned into a regulation that could not be anticipated (since it is not based on the principle of a "technical optimal solution", as one interviewee noted). Hence, problems may arise when there is a need to deliver products to different markets in Europe, Asia or the Americas.

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[2] The letters 'CE' appear on many products traded on the extended Single Market in the European Economic Area (EEA). They signify that products sold in the EEA have been assessed to meet high safety, health, and environmental protection requirements (https://single-market-economy.ec.europa.eu/single-market/ce-marking_en)

Material market is indeed global, and research participants often emphasised the importance of understanding this. It was pointed out by one of the interviewees that simply stating a need for 30% of recycled content in products will not benefit the circular economy in general. Due to this regulation, companies are incentivised to simply buy batches of recyclates from abroad and will not (be automatically pushed to) invest in the local circulation of materials.

There are fears that some regulations can have unexpected effects, if they are not reviewed and mitigated carefully. Industries, such as the automotive industry, might start "taking away" materials from the market, since they must comply with the newest regulations that make it compulsory to have a recycled component in products. This means that the prices will go up for those who are not yet obligated but potentially will be obligated in the future to reach similar standards.

> *"I think the European community and all the other countries give lots of money for projects that make plans, that create software, IT surrounding whatever you need. But the real problem for a producer is not solved, because that would be a clear plan, where to go, when comes which regulation, when do I get my money back? Because whatever we do, it's just for making a little bit of money from a little bit of money. It will be our model, and it will stay our model. It's also the biggest problem for us in our role as experts in sustainability, to tell our bosses that we don't want to give a gift to our Earth… No, we think we have to prepare for that, but that will still be the most attractive system in the next few years: earn money." (HAM1)*

Furthermore, assessing the carbon footprint of products is complex in a globalized market. Fairness in comparing products from different regions is difficult due to varying production conditions and CO_2 emission contributions, thus affecting taxing:

> *"The globalisation of manufacturing presents a significant challenge in accurately assessing a product's carbon footprint. For instance, if a product is assembled in Germany, within the EU, but its components are sourced from outside the EU, we need to differentiate between the CO2 emissions paid for within Europe and those paid for outside of it. The real challenge lies in ensuring fairness – making sure that two products, produced under similar conditions but in different locations, are assessed equitably." (ITA2)*

In sum, based on our interviewees' suggestions, there are three big reasons why the circular economy is not working as well as it could. Number one – not enough stimulation for using circular materials. Number two – responsibility for circularity is not carried by all the parts of the production chain but is pushed mostly on the manufacturers. Number three – there is not enough clarity about the future and no "best solution" has been offered, even though smaller actors emphasise that there cannot exist a one-glove-fits-all regulation.

One interviewee emphasises that there exists a clear wish to innovate and to turn towards more sustainable solutions in the industry, but there simply aren't enough incentives that would make it possible. Transitioning from linear to circular systems involves extra steps and costs, making recycled materials often more expensive than primary materials. Financial incentives, such as subsidies for using circular materials (similar to those for green energy and electric vehicles), are crucial but currently missing:

> *"/…/ so, you can better look at why we are failing. And we are not failing because we don't want it, we are failing, because at the end, the business case is not okay, and with circular materials, it's costly. If you go from linear to circular you have more steps. And the more steps you have in a system, the more expensive it is. To absorb this cost, typically, if you have a high-quality recycled plastic, it's costing more than virgin. So, you need to stimulate companies to use it. And stimulation is one. But what is the financial benefit? When we are stimulating green energy, solar panels, you get subsidies. We subsidize all kinds of green initiatives, like solar, wind energy, electrical cars, if you buy one, it's subsidized. But we are not subsidizing green materials." (HAM2)*

For example, implementing tax benefits to support the use of specific materials in factories or taxing oil companies could incentivize sustainability. However, this is challenging because the industry still heavily relies on primary plastics. Promoting the sale of products with recycled content was seen as a potentially more viable solution, but it requires more targeted support or incentives to encourage adoption. Additionally, a sustainability index could promote fairness for consumers and markets, according to interviewees. Lastly, a cascading responsibility, where each entity in the supply chain is accountable only for its direct suppliers, was offered as a practical and effective approach to managing responsibility:

> *"In any business relationship, the responsibility is defined by contractual obligations, which should extend only to the immediate suppliers. Under this model, each company is accountable for their direct suppliers, but not for the entire supply chain. The company at the end of the chain shouldn't be held liable for everything that happens all the way back to raw material extraction. However, they can – and should – be responsible for ensuring their first-tier suppliers are compliant. This is where their accountability should end, and this kind of approach would make for effective legislation." (ITA2)*

All actors, especially the ones in the most difficult market positions, support the need for industry-wide changes to facilitate a circular production model. Standardizing material specifications across OEMs and reevaluating excessively strict performance requirements could simplify recycling processes and enhance material reuse. The focus should, according to the interviewees, shift from waste management to waste prevention, starting at the design stage, to achieve long-term sustainability. This is supported by prioritizing research and development, fostering collaboration within the production cain, and addressing the technical and regulatory barriers associated with incorporating recycled materials. However, success will depend on ensuring consistent material quality, achieving (ideally) global regulatory alignment, and innovating to reduce waste generation at its source, not forgetting the need to gather any waste that is created and keeping it in the loop. Lastly, the unpredictability of political leadership in the EU makes it challenging for industries to commit to long-term sustainable strategies. Thus, without clarity and long-term visions in legislation, these aforementioned goals become more difficult to reach.

3.3 Earlier research on recycling/waste collection sectors

The situation of recyclers in the circular economy model is quite different from producers, even if there are definitely some similarities in the challenges and barriers that both face. Silatloppi and Jähi (2021) looked at barriers to sustainable plastics development and identified three conundrums: limited production of sustainable plastics; lack of uses and demand for sustainable plastics; and missing economic logic

for recycling development. Though all of them are relevant in the overall construction of the playing field, only one of these is especially crucial for waste, sorting and recycling plants – missing economic logic. The authors point to the need to create the momentum for development and growth of recycling infrastructure with costly processes and low value of circulates, thus meeting four types of barriers: technological, operational/supply chain, market, and social (including uncertain global policies in the form of import bans for plastic waste, but also lack of efficient supporting mechanism, e.g. taxation). The authors suggest, based on their analysis of the Finnish example, that there is a need to move from isolated technologies to infrastructure development by bringing in what they label "new assets": systematic development of recycling infrastructure for plastics through multi-actor collaboration that would require both financial incentives for collecting and sorting plastic waste and integration of chemical recycling effectively into the recycling value chain.

Based on the Italian case, Majone, Lapko and Trucco (2022) have also claimed that since the gradual shift from circular economy (CE) implementation to a more systemic approach to CE integrating upstream and downstream solutions occurred at different speeds and levels across the supply chain. Given that companies perceived factors differently and implemented different types of practices, increased collaboration and alignment across the supply chain are required. The suggested future avenues for the plastic packaging sector would include advancement of new and emerging recycling technologies, prioritisation of economically viable and closed-loop alternatives to recover plastic waste, and alignment between national and international directives.

According to the European Waste Management Associations' (FEAD) manifesto from 2024, there are five main incentives that need to be enforced in order for the circular economy to "work". These are: aligning industrial production to the circular economy; strengthening EU autonomy over its supply of resources; harnessing the potential of waste management and the circular economy towards climate change mitigation measures; establishing an enforcement mechanism for European waste management legislation; and ensuring there is a competitive market for waste management. All these initiatives require setting recycling at the forefront of the industry and becoming the core of the efforts made in the name of CE. This is a specific desired change of focus, which is, of course, dependent on the special standpoint that the recycling industry possesses. We will now look into its particular problem statements and the solutions offered.

3.4 Stakeholder study results: recyclers/waste collectors

The standpoint of recyclers (R) has to be, by definition, quite future-oriented, thus creating a suitable precondition for being aware of the necessity of "closing the loop" and "protecting the environment". Recyclers may perceive themselves as the "cleaners" of the world, attempting to right the wrongs that might happen due to inefficiencies in other parts of the loop. They point towards the need for more recycling, rather than using primary materials:

> *"/…/ And you can see that many plastic producers, of course, are at the same table with the stakeholders, which is normal, but they are still claiming that, since there is recycling and we will recycle more and more, we can produce more and more plastics. And I mean, that shouldn't be the narrative. The narrative should be like, we recycle more and more and use more, and we use more and more recycled plastics, but it's not for us an open door to produce more plastics. /…/ Because we have enough plastics produced today, we don't have enough capacity to recycle the plastics produced today. /…/ recycling is the key, of course it is. And it's like something that is meaningful and produces value in the economy and all that stuff. /…/ So, when it comes to greenwashing, I think one of the main issues we see is sometimes the responsibility of the producers." (ITA3)*

The problems that the interviewed recyclers are aiming to address are: the unavailability of recyclable materials, the cost of recycling, the changeability of EU and country-level legislation, the time-consuming nature of bureaucratic procedures that guide the recycling process and the lack of producer responsibility to produce packaging that is easily recyclable. Of course, the end user is seen responsible as well:

> *"/…/ If I have to be responsible to assure the quality of my materials, or I'm responsible to build the traceability of my materials, I also need a solid involvement of the end user, and there is no obligation by the legislation. It's normal. It's okay. But I think that the support of the previous actors in the chain as a coordination centre and… The collective scheme, the authority, that stimulate that user to help us in the traceability of the output... /…/." (R2)*

One of the main assumptions underlying these problem statements is the belief that by organising recycling "better", would enable us to close the loop and attempt to solve the problem of harmful materials getting in contact with nature and entering food chains, thus affecting the environment. By enforcing stricter requirements for both producers and end users, or rewarding them for "correct" behaviour, it is seen as possible and even useful to continue using plastics and other types of materials, with the exception of flame retardants and PFAS' (per- and polyfluoroalkyl substances), as they can be used "forever". This, in turn, would help to battle the use of bio-engineered plastics and different compound materials with very complicated or impossible recycling processes and substantial environmental impacts:

> *"/…/ plastics recycling is very much competing with the other guys who are always selling cellulose as an alternative. /…/ the big money is in the cellulose industry, not in the plastics industry. And, well, it's not as bad as the fossil lobby, but close to it and you see /…/ we exchanged paper wrapping material for pellets. And I'm like, you changed from 15-millimetre-thick plastic that we can recycle if you put it into the right recycling bin. We can make that same stuff over and over and over again, and then you exchange this for three- or four-times heavier stuff that will get moisture and /…/ like we double our food waste by taking out the plastic or replacing it with something else. If we replace plastic with something else, it's from 10 to 100 or 1000 folds more energy, more biodiversity gone." (R1)*

One of the major concerns that is shared by recyclers is the bureaucracy surrounding the permits of waste treatment installations and the long time it might take to require them. Extended waiting times can interfere with any company's operations and here, national differences in legislation matter as well, providing some with advantages and others with disadvantages:

> *"And so, it's complicated for the private actors to find /…/ to understand also, what is the correct way to do their business. Because, from one country to another, they [legislations] are completely different, and sometimes with much stricter implementation of the European rules. So, it's complicated, the question of harmonization, because at the same time, some things are working well in some countries, and then we don't want this to change, and because of the question of harmonization at European level. So, the harmonization is always like a thin line between we need more harmonization, and on the other side, we don't want to change things that are already working really well, and that doesn't need to be a change in another way that we don't know if it is working better or not for these specific needs of the country." (ITA3)*

Thus, some recyclers believe that there is a delicate balance between making sure that the EU law is followed across the EU and enforcing a homogenous law in inhomogeneous countries ineffectively. However, just as differences in country-specific legislation affect companies' operations, so does the legislation that is or is not passed on the EU level. End-of-waste status and standards for recyclable products coming from producers are seen as important legislative goals that have not been reached in desirable ways yet.

Furthermore, countries have reached or are yet to reach these goals in unique ways, as waste collection systems have been set up very differently. Moreover, some, especially smaller countries, might not have the capacity to recycle or utilize in any other way all the waste that has been separately gathered, thus potentially reducing the motivation of the local market to sort and gather:

> *"Now we've got this big focus on the collection of bio-waste, with bio-containers and all sorts of things, but let's be honest—there isn't a single industrial composting facility in this country. So, what's the point of all this? Where does it all end up? In my opinion, it's often the case that a lot of requirements or rules are introduced or attempted to be implemented, but the infrastructure just isn't there. So, what's the purpose of it all?" (R3)*

The motivation to recycle better in smaller countries is further reduced by the fact that many are not able to get hold of bigger quantities of (properly separated) waste in order to keep their recycling lines running profitably. High energy prices further complicate this issue, highlighting the fact that the European market is, in principle, united, but local conditions might differ significantly, providing some with advantages and others with disadvantages:

> *"Actually, obtaining high-quality material is one of the key challenges because if packaging isn't collected separately enough, or at all, the sorting quality and the proportion of contaminants affect the purity and quality of the material. There have been times when there hasn't been enough material at all to produce anything. Of course, this material is much more unstable compared to pure material, which presents its own challenges. And lately, the price of energy has also been a factor, since recycling is an energy-intensive process. /…/ We already purchase ready-made granules, but we also recycle plastic waste, both our own and that of others. However, last year we reduced the amount of third-party waste we process. We shut down a line that could wash consumer-collected waste, as it was old, inefficient, and the investment for a new line would have been too large. First of all, the capacity of the new line would have been too high. Secondly, since we operate here, it's not reasonable to transport waste here, to process it there, and then transport the resulting granules elsewhere. It's just not logistically viable to move such large quantities of waste." (R4)*

What is left somewhat unproblematic in some of the recyclers' problem representations, is the expertise of the recycling industry to identify and sort materials in a manner that is safe and efficient. That, of course, depends on the way the problem statement is set up. Meaning, if the recycler is quite confident in its company's technology as well as emphasises the importance of producers' responsibility in finding suitable solutions for products in terms of packaging recyclability, and/or believes in the end-users' ability and willingness to recycle "properly", s/he also seems to be less prone to emphasise or notice anything that concerns the limits of recycling processes. For example, the question of "forever chemicals" might be approached in two distinctly different ways – either in a way that emphasises the fact that they are being used less and less, or by pointing out that the industry is unable to detect them in materials properly:

> *"/…/ let's take the example of the PFAS. That is a big topic that is discussed, a big restriction happening, when you take the example of PFAS, it consists of about 10,000 compounds. We know how to test 50 of them, at the level that is being enforced in the regulations, which is like, 25 ppb [parts per billion]. So, how would you know? I mean, let's say, okay, I'm not putting in PFAS. It's forbidden. And let's say most of the private sector, the producers, not the waste sector, but the producers will be fair even if not very fast. But then, we don't even know about imports, what will be in them. And as recyclers we have a question, how do we compare? Because, of course, we are not like producers. We don't have a formula. We're accepting waste, most of it from products that were not produced in Europe. So how do we make sure our recyclates are safe if we don't even know if the imports are safe, and then what is put on the market is safe? So, for us, the stakes are really high, because … we need to make sure that the things that arrive at our inputs are safe. Because, as I said, some monitoring technologies and screening technologies are not yet on point for some of the pollutants. How to get rid of them, from the PFAS?" (ITA3)*

versus

> *"They will use some other PPA processing additives. They won't go over the fuss. Of course, everybody knows that PFAS is not good. So why would you use it? And what they use it for is then in the plastic industry for mould release agents and such. But we are all the time focusing on getting away from PFAS. So, it's not a problem that cannot be easily tackled and nowadays the problem is so small that you can make a big story about it, but it's not a real problem." (R1)*

Similar discrepancies apply when we look at the way recyclers might consider incoming plastic streams from other parts of the world (i.e. outside the EU). Are they an opportunity to be welcomed or a potential hazard that can threaten the market balance and material purity?

> *"We don't have, for sure, the same rules applied in Asia and in the Middle East. I'm giving this example, because for plastics, the biggest stream is coming from there. How then do we make sure that these plastics are complying with our rules? And that's all the question of the enforcement, /…/ and it's linked with competitiveness in the end, because it's, I mean, the narrative is about competitiveness for the next five years. So how do we make the recyclates, the European recyclates, competitive? It's also by making sure that the imported plastics and imported recyclates comply with the European rules, and that the same standards apply for everyone." (ITA3)*

versus

> *"The biggest global problem is that in the areas where most of the plastic littering is taking place, India just ranked number one this year, most of those people don't have access to the recycling infrastructure. And if you have a million people in the slum, everybody's producing 20 kilos of plastic. It can stay there. They have to do something about it, so now they are either burning it on a bonfire or just throwing it away. But now if we can make it so efficient that we can pay 510 cents per kilo for Indians, who have a million kilos of plastic that they need to burn outside just to get rid of it. I say that's going to be a big business. So that's the opportunity." (R1)*

These differences aside, recyclers see the economy as a whole and consider the mobilisation of other parts of the loop and constant collaboration with producers and end users as vital for the creation of an efficient, successful and sustainable economic model. Recycling is not seen as a means to an end strategy, solely dependent on economic gain. It is seen as a vital component of any modern economy, helping to fill its unavoidable requirements. The role of legislative bodies and governments is perceived as vital to help to regulate the rights and obligations of each of these parties, including the recyclers themselves. According to one of the recyclers interviewed, it might be worth asking whether it is feasible to create a system that prioritizes increased recycling, reduced production, and consuming only what is necessary:

> *"The European Union could move towards ensuring that the things we use last longer. And somehow, this needs to be controlled or communicated in such a way that when something is more expensive, it doesn't necessarily mean it's of better quality. What we need to achieve is that when I pay more, it's because the TV will last ten years, not two. Less junk, more durable things. This applies to tools, home appliances – everything! In some cases, home appliances have parts that are so weak and fragile now that they're simply not designed to last. But that's not sustainable! A good and durable product might contain 20% or 30% more materials, but it will last maybe five times longer. Because that's actually the right way! We should avoid situations where a company simply says, "We reduced the material weight in our product by 10%". They put it on the ESG [Environmental, Social and Governance] wall, everything looks good. But in reality, their product now breaks twice as fast, which isn't environmentally friendly. A plastic bag, a shopping bag. "We made a thinner bag, saving several tons of plastic per year." I can't even get home with this bag! It falls apart on the way! /…/ Buy one thing and use it for a long time! Behavioural scientists can deal with this: why do people buy fast fashion? What are they comforting themselves with, what problem are they solving by purchasing fast fashion or quickly consumable items? It's actually a psychological issue. It's not a real need. It's not a material need." (R4)*

In order to pursue an economic model where recycling becomes an intrinsic part of manufacturing, further steps could be taken to both manage and balance the needs of different stakeholders, including the general public.

4 CITIZEN AND CONSUMER STUDY

The public opinion survey "Citizen and consumer awareness and acceptance of recycled plastics in Europe" was carried out in 2023 in four countries, focusing on the perception and acceptance of recyclates in consumer products. The survey of general population was intended to explore ***views*** about and ***experiences*** with products containing recycled plastics (RP), to reveal consumption patterns and attitudes towards plastics and circular economy. Our survey study focuses on ***attitudinal acceptance*** of recyclates and ***behavioural commitment*** to using recyclates in consumer products. Different aspects of plastic literacy and environmental awareness, as well as contextual factors are considered as necessary conditions for the recyclate acceptance and behavioural commitment to use products containing RP.

4.1 Conceptual framework

We depart from integrative multi-layered framework that takes into consideration drivers and barriers to recyclate acceptance on different levels of the analysis: a) individuals with their unique characteristics (micro-level), b) groups, organizations, and immediate living environment to which the person belongs, and which also shape their perceptions and behaviour by either limiting or enabling actions (meso-level), and finally, c) the broader country context (macro-level), including respective regulations, institutions, and wider cultural environment. Various theoretical models are adequate on different levels of analysis, explaining psychological processes on the individual level, socio-psychological processes on the level of groups and communities, and socio-cultural processes on the level of society/culture, for instance, the theory of social practices (Shove *et al*., 2012), and various models of environmental awareness (e.g. Stern, 2000).

At the *macro-level*, to explain differences between countries, the development of environmental awareness and plastic literacy can be influenced by the socio-cultural environment, shaped by historical developments; the welfare regime, which may commodify people to a greater or lesser extent; the type of capitalism, whether it is more or less oriented toward cooperation; existing infrastructure e.g. waste management systems, which may also vary by region, public transport availability, etc.; policies/regulations, especially those related to environmental protection; and the education system, for example how much attention is given to environmental issues within it.

Social scientists have described the "social life of plastics" in different socio-cultural contexts (Steger *et al*., 2021). Sustainable consumer behaviour is affected by political, economic, technological, legal and social factors (Ertz *et al*., 2023). In particular, different visions of circular economy and sustainability (Friant *et al*., 2020, 2022; Vermeulen *et al*., 2024), reflecting general worldviews, values and beliefs about human-environment relations contribute to the formation of environmental awareness and plastic literacy. Public discourses on recyclates and plastics in general (Colijin *et al.*, 2022) also influence customers' attitudes and behavioural choices.

At the community or *meso-level*, environmental awareness and plastic literacy can be viewed as a system, with following elements: a) shared norms and meanings, b)

habitual practices, and c) material resources and infrastructure. According to a practice-based approach, these should be the focus of interventions when changes are sought. For group members, phenomena at the group level constitutes either a support system or barriers to expressing environmental awareness. For example, environmental awareness is supported when consuming green products is prestigious within the community, when green products are easily available and have a positive symbolic meaning, and when environmentally friendly behaviour is common and widespread in that community. On the other hand, barriers can arise if green behaviour is ridiculed for some reason, if the necessary infrastructure is lacking, or if established traditions are environmentally harmful. The theory of social practices focuses on people's everyday behavioural habits and group-level processes. A practice emerges from the interaction between three interconnected elements: a) shared meanings, such as common ideas, symbols, aspirations, b) skills and competences, e.g. know-how, ability to follow rules, and c) the physical environment like objects, products, things, infrastructure, technology (Shove *et al.*, 2012). The focus of influence is not on acquiring new knowledge, but on developing new practices, new habitual actions (which may not be consciously realised), that can be changed or created through the transformation of the social and physical environment.

Environmental awareness at the individual *micro-level* is understood as a psychological system, consisting of cognitive, affective, motivational, and behavioural components. Various psychological theories (e.g. theories of reasoned action (Fishbein and Ajzen, 2009), values-attitude-behaviour theory (Stern, 2000) highlight different intra-psychic drivers of pro-environmental behaviour and examine the relationships between them (see, for example, the overviews by Goldman *et al*., 2022). For instance, according to Stern (2000), the causal chain inside the attitudinal domain moves from relatively stable elements of personality and belief structure (general worldview, values and beliefs about human-environment relations) to more specific beliefs about the environmental issues, to beliefs about the consequences of an action, personal responsibility and personal norm to take pro-environmental action. Different types of causal factors may interact (e.g. contextual or personality factors may promote or constrain the attitude-behaviour associations). This approach regards environmental awareness as a joint product of social-structural, socialization and social psychological processes. An important motivational component of environmental awareness is the belief in personal efficacy, which refers to the extent to which an individual believes they have the power to influence desired outcomes (Bandura, 2000a). In the context of the environment, this can also be referred to as "sense of environmental agency." If a person does not believe they can impact environmental or climate conditions through their actions, it doesn't matter how thorough their knowledge is – their motivation for environmentally friendly behaviour will be low.

A person's environmental awareness is also influenced by one’s socio-demographic and economic position (age, gender, level of education, occupation, economic means, etc.). These are social-structural factors, i.e. variables that reflect position in the social structure, amount of material and social resources, as well as institutional constraints and early socialisation experiences.

According to our multi-layered and integrated conceptual model, factors that encourage or discourage the acceptance of recyclates and environmental competences can be found on different levels of analysis. On ***macro-level*** we can observe structural or institutional drivers and barriers, e.g. laws, regulations, public discourses. On ***meso-level*** various situational factors may operate, e.g. adequate infrastructure, social norms and reference groups. ***Micro-level*** comprises individual drivers and barriers that can be dispositional (person's perceptions, attitudes, preferences), informational (existence or lack of information and knowledge), motivational (strong or weak sense of environmental agency), etc. It can be assumed that different groups face specific barriers that prevent them from acquiring or implementing green competences, e.g. accepting recycled plastic in various products.[3]

4.1.1 Earlier research on sustainable consumption behaviour

Empirical studies may be focused on specific levels of analysis. For example, a qualitative study (Roy *et al.*, 2022) revealed following subjective barriers to plastic waste disposal behaviour: confusion and uncertainty about which plastic materials can be recycled, perceiving plastic recycling to be less of a personal priority in daily life and perceiving that local government and manufacturers have a responsibility to make plastic recycling easier. The results highlight the knowledge gaps and inadequate infrastructure as the main barriers.

An extensive international survey study (van Oosterhout *et al*., 2023) found personal responsibility and self-proclaimed knowledge to be critical variables affecting all stages of sustainable plastics consumption behaviour (i.e. purchasing, using and disposing), as well as a factor differentiating consumer profiles. Concern and perceived consequences, on the other hand, were not found to be strong predictors of sustainable plastics consumption behaviour. Four distinct clusters of respondents were identified and labelled as "Waste Warriors", "Waste Conscious", "Waste Moderate" and "Waste Laggards". The results of the cluster analysis confirmed that the citizen profiles are heterogeneous with large differences in behaviour, attitudes, and perceptions related to plastics, indicating a need for differentiated engagement strategies. In this study there was only one item focused on the preference of recycled plastics in purchasing behaviour – "I choose products that use bioplastic or recycled plastic, even if they cost more".

A survey study in Finland (Ruokamo *et al*., 2022) investigated consumer experiences and perceptions of products and packaging made of recycled plastics and examined factors that are linked to the attractiveness of such applications. The results imply that females, younger people, those who recycle, and those who are environmentally conscious are likelier to think that the use of recycled plastics increases product attractiveness. Income or living environment do not have statistical power in

[3] Similar classifications of drivers and barriers have been used in overviews on the determinants of green purchasing behaviour (Joshia and Rahman, 2015; Sharma *et al*., 2022); plastic packaging waste avoidance and recycling (Jakobsen *et al*., 2022), acceptance of products made of recycled materials (Polyportis *et al*., 2022), consumer plastic recycling behaviour (Ertz *et al*., 2023).

explaining this view. Furthermore, consumers do not seem to find recycled plastic products unsafe. Regarding product labelling, a clear indication that the product is made of recycled plastic was appreciated.

Based on reviews about the drivers and barriers for the acceptance of recycled materials (Polyportis *et al*., 2022), several guidelines have been designed to foster consumer acceptance of products made from recycled plastics (Polyportis *et al.*, 2023). For example, offering additional information (trustful ecolabels, reflecting true environmental impact; focusing on environmental impact for a given region; describing product recycling content history), tackling perceived quality and performance risks, reducing perceived contamination risks, highlighting the innovativeness of the material and its long-term development. Recyclate content in products used in public should be recognizable, enabling to express person's environmental identity and functioning as a status symbol that contributes to social reputation.

Effective behaviour-change interventions (Michie *et al*., 2011, White *et al*., 2019; Borg *et al*., 2022) and communication strategies towards environmental sustainability (Kidd *et al*., 2019, Grunig & Hunt, 1984) draw on certain theoretical models of human behaviour and audience segmentation principles. In the overview of factors affecting sustainable consumer behaviour White *et al*. (2019) identify five broad routes to encouraging sustainable behaviours, encompassing micro- and meso-level processes. Although Borg *et al*. (2022) focused on individual-level behaviour change (reducing consumption of single-use plastics), they highlighted that behaviour is often limited and enabled by other stakeholders, including businesses and governments. The authors conclude that practitioners and policymakers designing future plastic reduction initiatives are advised to consider the bigger picture, engage with a variety of stakeholders, and utilise a combination of techniques which target multiple audiences within the system.

4.2 The research questions

To clarify different aspects and conditions of the acceptance of recyclates in consumer products by end users we formulated the following research questions:

1. ***Descriptive questions***
   - 1.1. What are the levels of acceptance for recyclates in consumer products across the studied four countries?
   - 1.2. How do pro-environmental attitudes (environmental concern, sense of environmental agency) manifest among the study participants in four countries?
2. ***Analytical questions***
   - 2.1. What are the main barriers and drivers to the purchase and use of products made of recycled plastics?
   - 2.2. How do these barriers and drivers differ across various country contexts?
3. ***Segmentation and intervention questions***
   - 3.1. What distinct population/consumer segments can be identified based on attitudes towards recyclates?

3.2. What are the specific barriers and drivers for recyclate acceptance within each identified segment?
3.3. Based on the segments analysis, what personas can be constructed to represent different consumer types?

4.3 Sample

Four countries were chosen as sites for the quantitative questionnaire study: Estonia, Finland, Germany and Spain, with the total sample of 6 011 respondents aged 15-90 and with about equal gender distribution (52% women, 48% men). In each country, a professional opinion polling company was subcontracted for the data collection. In Estonia, data collection took place 23.10.2023–21.11.2023, data were collected from 1 506 online panel respondents, in Finland 01.11.2023–22.11.2023 (n=1 503), in Germany 20.10.2023–27.10.2023 (n=1 500), in Spain 24.11.2023–7.12.2023 (n=1 502). The data were weighted only in the case of Spain as this was deemed necessary by the polling company. These countries represent different welfare regimes and geographical locations, large and small countries in Europe. They differ in the cultural and historical developments, but also in the implemented policies that regulate plastic waste and recycling, location of their business in the production cycle of first use, single use and recycled plastics. For more detail, see country context in Annex 3[4].

4.4 The instrument and methods of analysis

4.4.1 The instrument – questionnaire

To construct a survey questionnaire concerning general public recyclate acceptance and engagement we follow models of ***environmental awareness*** and ***responsible consumption***, as well as theory of ***social practice*** (see Chapter 4.1). These models integrate relevant psychological and social factors that potentially affect the acceptance of recyclates, thus functioning as drivers or barriers to the use of recycled plastics. Models of environmental awareness use various indicators of cognitive, affective, motivational, behavioural and situational aspects related to ecologically sound practices and responsible consumer choices. Models of social practice highlight contextual factors that affect individual choices: the existence or lack of adequate infrastructure, shared meanings (norms and representations), and skills and competencies. Our survey instrument covers conceptual elements summarised in Table 4 (p. 40). For structure of the questionnaire see Appendix 4 and for detailed wording of questions Annex 5.

4.4.2 Methods of analysis

The statistical software package SPSS version 26 was employed for quantitative data analysis. Descriptive statistics (cross-tabulations and means) were generated to describe the respondents' environmental concerns and behaviour habits, as well as attitudes and behavioural intentions towards recycled plastics.

[4] Additionally, detailed sample description available upon request.

Based on our earlier desktop and secondary data analysis (Eurobarometer), we formed respondent/consumer segments according to the level of their environmental concern and sense of agency or responsibility. These consumer segments can be taken as a basis for further data-based persona constructions.

Personas are imaginary characters that are constructed to represent specific segments of target groups. Personas can be differently designed, depending on the specific aims. The persona method is widely used in marketing and IT development (e.g. Nielsen, 2012). By now, this tool has also reached many other fields, including social sciences and sociological research. The goal of the persona method is to create imaginary characters based on survey data that represent specific segments of target groups (both typical and extreme), making them more relatable and understandable to product developers or marketers. Personas help to understand the interests, perspectives, and practices of stakeholder/consumer segments and to target influence activities aimed at them. The steps of persona creation are following: 1) collecting data about the target group through surveys, interviews, and other studies; 2) analysing the data to identify patterns and common characteristics within the target group, constructing segments; 3) creating a detailed profile for each persona, which includes demographic information, the person's goals, pain points, behaviour, etc.; 4) reviewing the personas with members of the target group to ensure they are accurate and useful. For illustrative purpose, we constructed some personas with the help of LLM (large language model) based on the consumer segment characteristics.

Table 4. Elements of the conceptual models and thematic questionnaire questions

Elements of the conceptual models	***Thematic questions in the questionnaire (literature references)***
Psychological (individual) level – based on models of environmental awareness and responsible consumption	
Sensorial aspect	Sensorial experiences with objects containing RP (e.g. Zwicker *et al*., 2020; Polyportis *et al*., 2024)
Cognitive aspect	Knowledge about the RP content in products. Knowledge and worries/concern about environmental and health effects of RP (Ruokamo *et al*., 2022; Barbir *et al*., 2021; Filho *et al*., 2022). Knowledge about environmental impact of certain practices (e.g. Cologna *et al*., 2022). General view on circular economy (e.g. Friant *et al*., 2020)
Affective aspect	Emotional attitudes and feelings towards RP. Positive and negative experiences with RP. Sense of accomplishment related to ecologically sound behaviour (Meng *et al*., 2019; Calvo-Porral and Lévy-Mangin, 2020; Polyportis *et al*., 2022)
Motivational aspect	Sense of agency (self-efficacy) related to the environment (Miller *et al*., 2022)
Behavioural aspect	Actual environmentally friendly habits (sorting, disposing plastic waste, habits of using domestic appliances (maintenance, repairing) (e.g. Roy *et al*., 2022). Sustainable consumption patterns (e.g. durability of products, sufficiency orientation, boycotting, renting vs purchasing, supporting companies that prioritize environmental sustainability and social responsibility) (e.g. Bleidorn *et al*., 2021; Nuñez-Cacho *et al*., 2020). Paying attention to ecolabels when buying (Ruokamo *et al*., 2022)
Consumer relations to particular objects containing RP: automotive, refrigerator, washing machine	Attitudes and buying intentions in relation to products containing RP, incl. views on the quality, durability, and safety of such products. Product characteristics (Bigliardi *et al*.,2020; Calvo-Porral and Lévy-Mangin, 2020; Ruokamo *et al*., 2022). Willingness to pay more for products containing RP (e.g. Barber *et al*., 2021)
Sociological level – based on models of social practice	
Material infrastructure: things, technology, availability, price	Availability and accessibility of products containing RP. Available infrastructure for recycling and disposal of plastics.
Shared meanings: collective norms; reference groups	Attitudes to laws and regulations concerning plastics. Social norms, social approval the influence of family, friends, and peers (e.g. Uren, *et al*., 2021). Trust in public information on environmental soundness of RP (Cologna *et al*., 2022)
Competencies, skills, know-how, habits, traditions	Knowing how to dispose plastic waste in the neighbourhood (Spaargaren, 2003)

4.5 Citizen and consumer study results

This chapter introduces PRIMUS citizen and consumer study results focusing on environmental concern and general attitudes towards plastics, behavioural commitment (e.g. purchase intentions) to and experience with recycled plastics and drivers and barriers to recycled plastics acceptance. The results are presented as a comparison of four countries.

4.5.1 Environmental concern and attitudes towards plastics

The 2023 PRIMUS survey data (see Summary table A6.1, Annex 6) reveal substantial differences in environmental concern across countries (Q1). Survey participants in Germany and especially in Spain stand out by exhibiting the highest concern about environmental issues in general with the majority answering "concerned" or "very concerned". In Estonia and Finland environmental concern is expressed by about half of the respondents. This could partly reflect the fact that Estonia and Finland have witnessed fewer changes in the environment and climate (e.g. considerable floods or heat and drought periods) compared to Spain and Germany. Additionally, Germany has worked for decades to build public support and provide political direction for environmental issues, for example with a transition to renewable energy (the "Energiewende") which has shaped the environmental awareness but is also transitioning into pro-environmental behaviour (Hommerich and Kitsnik, 2024). This question was also asked in ISSP 2010 and 2020 (see Roosmaa *et al*., 2023) and the order of four countries according to environmental concern is the same, although the rate of concerned people in Finland and Estonia is now, in 2023 more similar, meaning that in Finland concern has somewhat decreased. In case of Germany concern for environment has also slightly dropped, but it remains higher than in Finland and Estonia. Thus overall, it seems that in recent years, the levels of environmental concern have remained rather stable in the countries observed. However, it is important to note that there are some variations to the sample and population of the ISSP and PRIMUS surveys and therefore these surveys are not entirely comparable. Yet as the rank order of countries is the same, we can assume a reliability of this question in the two surveys.

Public perception of the severity of the plastic pollution problem (Q2) in the world in general is high in all four countries – more than 90% regard this problem "important" or "very important" (see Figure 1). In Spain and Germany people perceive plastic pollution problem in their own country to be almost as important as in the world in general, but in Estonia and Finland the urgency in the country is lower (about 75%). Respondents in all countries rate plastic pollution to be somewhat less important in their local area, but still, Spain and Germany rank this as a more pressing issue compared to Finland and Estonia.

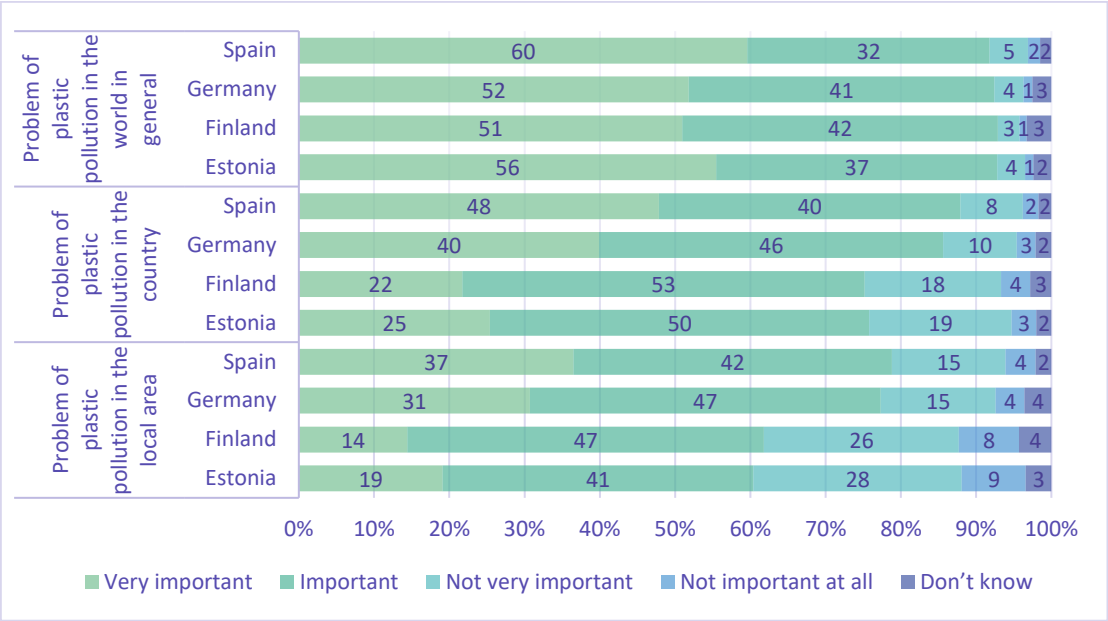

Figure 1. Importance of the plastic pollution problem

Source: PRIMUS Citizen and consumer study, 2023

Furthermore, we were interested in how worried consumers are about the environmental impact of everyday products made of plastic (Q8). It appears that in Spain majority (almost 90%) are worried about the impact of plastic products on the environment (see Figure 2). This concern is somewhat lower in Finland and Estonia (ca 80%) and lowest in Germany (below 70%). Results suggest that in Germany about third of consumers perceive everyday products made of plastic rather safe for the environment.

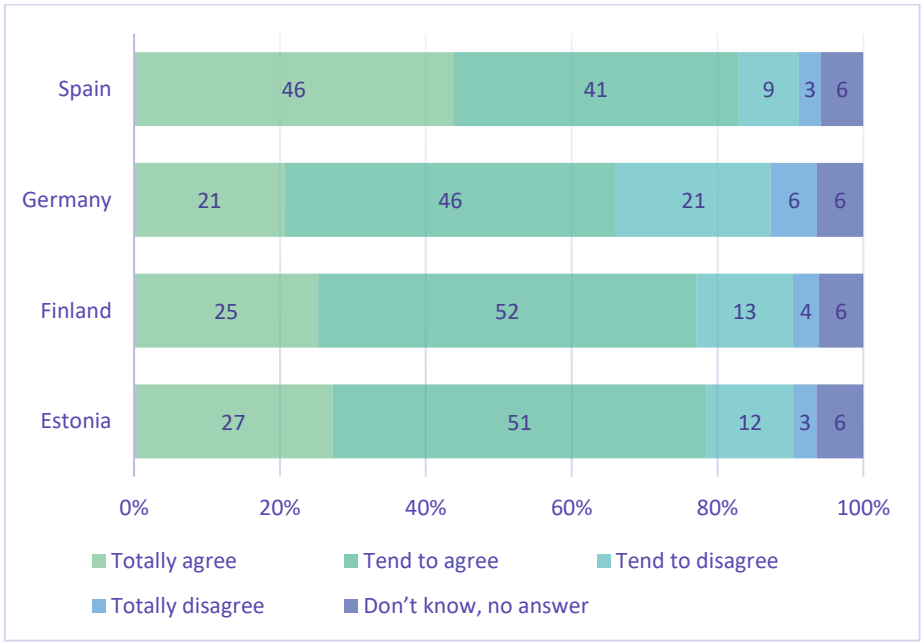

Figure 2. Worry about the environmental impact of everyday products made of plastic

Additionally, most respondents find choosing products made of recycled plastics (RP) instead of conventional plastics "very" or "rather" environmentally friendly act, especially so in Finland and Germany (almost 90%) (Q7a). Indeed, in Spain and Estonia also the majority of people regard RP products (rather) environmentally friendly, but the respective share of answers is about ten percentage points lower. Additionally, in Estonia there are more respondents than in other countries who do not know how to reply to this question (12% vs about 5%) which could indicate lower familiarity with products made of recycled plastics.

Governments can implement effective environmental policies, such as those related to the use of RP and therefore control or limit the amount of plastic that ends up in the environment or limit/facilitate the use of certain types of plastics. However, individual action is still crucial in two ways: first, to elect leaders who prioritise environmental issues, and second, to ensure these policies have maximum impact by adhering to and complying with them. Thus, we were interested in public attitudes towards the regulation of plastic use (Q11). More than half of the survey participants in Spain and Germany expect their government to do more to regulate the use of plastics. Respective rates are somewhat below 50% in Finland and Estonia. However, in Finland compared to other countries there is the largest proportion (approx. 30%) of respondents already satisfied with their government actions. In Estonia and Spain about one tenth feel that government goes too far with implementing policies to promote the use of recycled plastics. Additionally, in Estonia and Finland rather significant proportion (around 20%) answered "don't know", indicating that it is not easy to grasp the role of the government in plastics use regulation. These country differences reflect varying levels of knowledge about the topic, existing national policy approaches, and public expectations of government intervention in the area of environmental protection.

4.5.2 Behavioural commitment to and experience with recycled plastics

Citizens, through their consumer behaviour, can significantly influence the wider adoption and hence the use of recycled materials in everyday products by choosing them over those made with more carbon-intensive materials, e.g. conventional (primary) plastics. This section starts with the sense of environmental agency as it could be assumed that if a person believes they can impact environmental conditions via their actions, they are more motivated to adopt environmentally friendly behaviour. Belief in one's individual agency (Q3) shows that respondents in Finland and Germany mostly agree (almost 90%) that they can play a role in protecting the environment in their country (see Summary table A6.2, Annex 6). In Estonia and Spain perception of agency is also rather high, but by about 10 percentage points lower compared to Finland and Germany. Therefore, in Estonia and Spain there are more of those who are sceptical of their ability to protect the environment (approx. 15%). Eurobarometer survey conducted in 2017, where the same question was asked, shows largely the same order of countries with the main difference being that back then results of Finland were more similar to Spain, but in PRIMUS 2023 survey they are closer to Germany.

Following analysis focuses on responsible consumer behaviour and pro-environmental habits. It appears that on average majority (70%) of survey respondents

regard buying products from companies that prioritise environmental responsibility and sustainability "extremely" or "rather important" (Q13). However, in Spain consumers consider environmental responsibility and sustainability of companies even more important (almost 80%), while in Estonia this is given less importance (about 60%). Therefore, in Estonia there are more than a third of respondents (35%) who find company commitment to sustainability not important for their purchase decisions.

Rather similar picture emerges when asked if it is important that companies inform the consumers about the use of recycled plastics in their products, using special labelling directly on products (Q14). In Spain, vast majority (80%) regards that for them personally it is "extremely" or "rather important" products to be labelled with information about the use of RP. In Finland and Germany labelling of products is given almost the same importance (about 75%). In Estonia more than half of consumers (59%) are interested in special labelling of the products. Therefore, more than third of Estonian consumers do not consider it important that companies inform about the use of RP in their product. Still, if products were to be consistently properly and reliably labelled it might gradually increase the trust in and acceptance of recycled plastics.

Additionally, respondents were asked about the ecolabels in the context of purchasing (Q17d). Results show that on average well over half (64%) of survey participants "totally agree" or "tend to agree" that ecolabels play an important part in their purchasing decisions. Respective rate is higher in Spain and Germany (about 70%) and lowest in Estonia (52%). Thus, in Estonia some 40% of respondents disagree with the statement about ecolabels influencing their purchasing decisions. Moreover, nearly a tenth of respondents both in Estonia and Finland do not know whether ecolabels would affect their purchasing decisions.

Going into further detail, we were interested in what people consider when purchasing household appliances (Q17c), because these relate to the PRIMUS project demo cases where the use of recycled plastics is tested. On average, three-quarters of consumers regard environmental friendliness an important factor of choice when buying a new household appliance such as washing machine or refrigerator. Consumers in Germany value environmental friendliness even more, while it is somewhat less significant for consumers in Estonia and Finland. For slightly less than a quarter of Estonian and Finnish consumers environmental friendliness is not an important factor in their purchase decision. However, it should be noted that answers to such questions rather reflect intentional and not so much actual purchase behaviour.

In 2023, general familiarity and acknowledged experience with products containing recycled plastics (Q20) is relatively low as in Finland, Spain and Germany on average less than half of respondents' state they have products in daily use containing RP (see Figure 3). In Estonia this experience is even smaller, because only one in five respondents use daily such products and majority (76%) do not know whether products they use contain RP. In Finland, Spain and Germany about half of the consumers are not sure about the RP contents of the products they daily use.

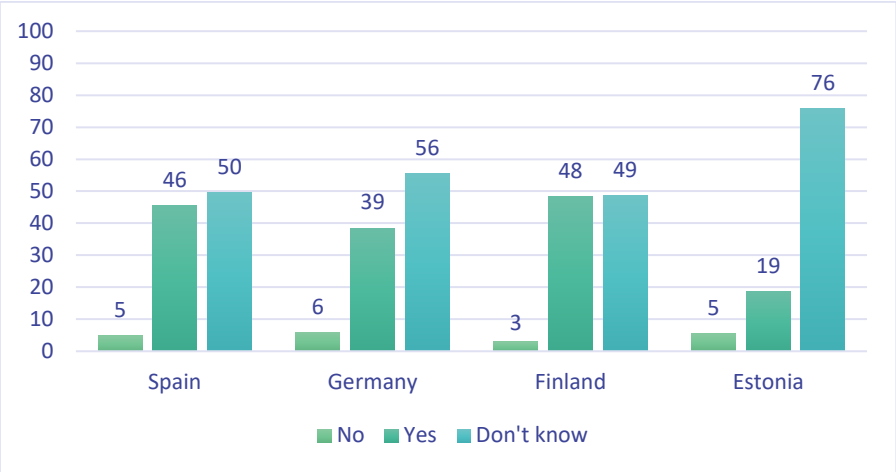

Figure 3. Whether daily used products contain recycled plastics

Continuing with the household appliances, we were interested to know how likely consumers are to purchase washing machine and refrigerator that contains parts where recycled plastic has been used to replace conventional plastic (Q22). Partly reflecting previous results, it appears that compared to Estonia, consumers in Finland, Germany and Spain are more prone to purchasing such washing machine if they would need a new one in the next 12 months (respectively 55% vs about 68% "rather" or "extremely" likely) (see Figure 4). Furthermore, in Estonia one in five survey participants do not care if a washing machine contains RP. In all countries, approximately one tenth is unlikely to purchase washing machine with RP content. Additionally, among Estonian consumers rather high percentage prefers not to answer or state that this question does not apply to them (14% vs 5-10% in other countries). Regarding refrigerators containing parts made with RP the pattern of answers is largely the same. Therefore, it seems that in case of refrigerators, respondents are not worried about the food coming into contact with RP or do not associate refrigerators containing RP with possible food contact[5]. Thus, about two thirds of respondents in Finland, Germany and Spain would prefer to by such a refrigerator, while in Estonia same preference is expressed by about half of respondents.

Another two PRIMUS project demo cases relate to cars and therefore we asked similar question about buying a car with some parts made of RP. According to our data, in all four countries the share of respondents who would be likely to purchase a car that contains parts made of recycled plastics is about 10 percentage points lower compared to purchasing similarly made home appliances. So, in Spain, Germany and Finland, slightly more than half of the respondents and in Estonia about two-fifths assume they would be willing to buy a car containing parts made of RP. Another difference compared to home appliances is that in case of a car more survey participants are not sure how the RP content of some car parts would affect their

[5] At a closer inspection, across all countries the share of those who would be "rather" or "extremely unlikely" to make such purchase is few percentage points lower (2%-4% depending on a country), which is within the margin of error.

purchase decision, especially in Estonia where one fifth have answered "don't know". Thus, it seems that in respect to cars, people are more hesitant about changes in materials, probably because of the safety reasons. However, it should be noted again that these data reflect expressed purchase intention rather than actual purchase decision, which might differ and depend on a variety of other factors.

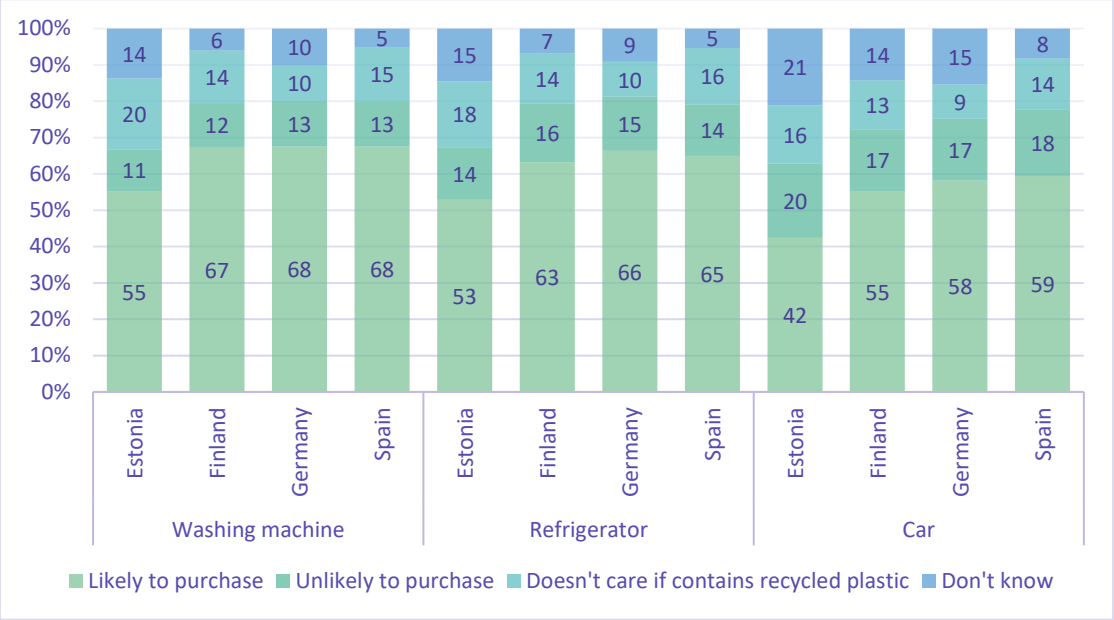

Figure 4. Willingness to purchase home appliances or a car containing parts made with recycled plastics

Next, respondents were asked to assess their willingness to buy home appliances such as a refrigerator or a washing machine where parts usually made of conventional plastic have been replaced with RP depending on the specific amount of RP these would contain (Q25). Firstly, this is one of the questions with the highest rate of "don't know" replies – 30% on average across all four countries, and in Estonia as much as 42%. Therefore, it should be acknowledged that for an average consumer it is difficult to decide or to know what exactly a certain content of RP in a home appliance mean (for example in terms of safety, quality, etc.). Interestingly, second most frequent answer (close to 30%) is that survey participants would consider buying these home appliances containing up to 100% of RP instead of conventional plastic. However, Estonia stands out with about 10 percentage points lower rate of respondents indicating that they would be willing to buy a washing machine or a refrigerator containing plastic parts entirely made of RP. Additionally, in Finland there is a larger share of consumers (15% compared to about 10% in other countries) willing to purchase such home appliances if they contain a moderate share of RP (up to 15%). In Germany and Spain, answers are more evenly distributed between different shares of RP in home appliances (from up to 15% to 50% RP). Despite high uncertainty among the respondents, results are still encouraging, because across all countries only about 5% reply that they would avoid buying such appliances containing any RP. These results suggest that more efforts are needed to raise awareness about recycled plastics (e.g. their properties) and products containing these.

Previous section showed that only small share of respondents would avoid buying home appliances containing recycled plastic. However, willingness to pay a premium for products made from recycled plastics is another matter (Q26). Across all four countries, there is a widespread reluctance to pay extra for these products, although less so in Germany and Spain (Figure 5). Accordingly, in Germany and Spain, 40% of the survey participants state that they are "not willing to pay more", while reluctance to pay extra is particularly high in Estonia, followed by Finland (around 60% and 50% respectively). On average, about a fifth of respondents are willing to pay up to 5% extra. In Germany and Spain, comparatively higher share is considering paying up to 15% extra (approx. 15% of respondents), while only few across all countries would pay significantly more.

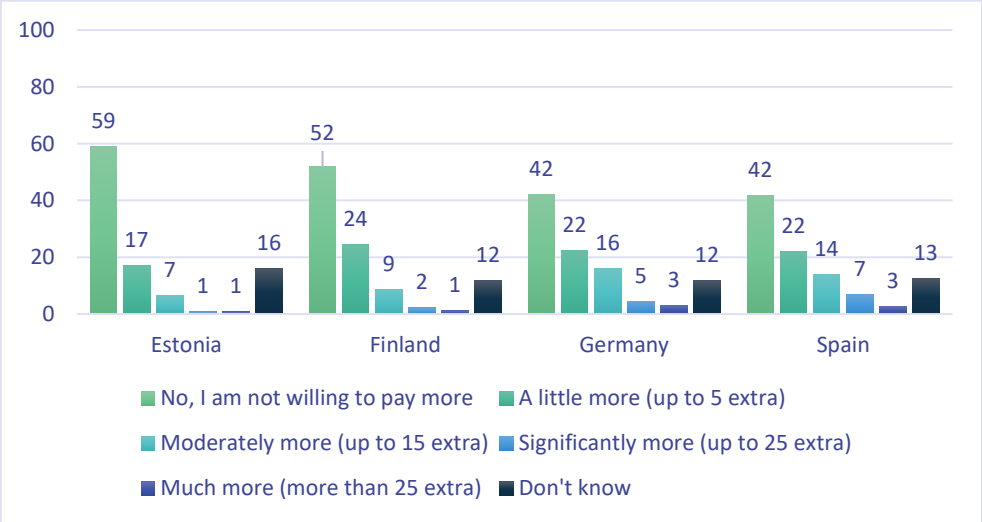

Figure 5. Willingness to pay more for home appliances containing parts made of recycled plastics

It should be added that the survey took place in time of rather high inflation rates in Europe, Estonia was hit especially hard with above the EU average rate (in 2023 9,4%; in 2022 19,4%)[6]. Moreover, GDP per capita and purchasing power in Estonia is lower than in other three countries which further explains the results[7].

Additionally, if asked about the willingness to pay more for a car that contains parts made of RP, reluctance is considerably higher with about half of respondents in Germany and Spain not willing to pay more (Q29). Again, this reluctance is higher in Estonia and Finland where approximately two thirds would not pay extra for a car containing parts from RP. Partly, this may indicate that buying a car is a big expense in any case so there is less room to raise the price. However, close to a fifth of survey participants in Germany and Spain are willing to pay a little more – 5% extra – for such a car, while in Estonia and Finland only around a tenth express similar readiness.

[6] See: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:HICP_all-items_%E2%80%94_annual_average_inflation_rates,_2014-2023_(%25)V2.png.
[7] See: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Purchasing_power_parities_and_GDP_per_capita_-_flash_estimate.

Furthermore, about every tenth of potential consumer in Germany and Spain would consider paying moderately more (15% extra) for a car partly made from sustainable materials. The positive trend is that rather few respondents (approx. 4%) across all countries would avoid buying or renting a car that contains parts made of RP, which partly also indicates trust in more sustainably made cars or recycled plastics as a material.

Concerns about product quality further shape any consumer behaviour but notably environmentally conscious consumer behaviour. Most respondents (about 70%) across all four countries (although somewhat fewer in Estonia and Spain) would purchase household appliances (a refrigerator or a washing machine) made from recycled plastics, provided that the quality matches that of the products made with conventionally sourced materials (Q27). Additionally, every tenth of respondent expresses the need for an electronic product made using RP to be of "a little bit better quality". In Estonia, however, where the overall purchasing power is the lowest, doubt about the quality is more pronounced, with about a tenth of respondents expecting products made from recycled materials to be of a "much better" quality before they would consider purchasing them. Whereas Spain stands out as the only country where comparatively more (7% versus 2% to 4% in other countries) are willing to accept lower-quality products made from RP, possibly reflecting a stronger environmental motivation or perhaps, less concern about the overall quality and safety of the consumer products. Around a tenth of survey participants are not sure how to respond to this question. Finally, only very few respondents would not consider buying a product containing RP, even if it is of better quality.

Social pressure and peer influence can also affect environmentally conscious consumer behaviour. In PRIMUS data we uncovered that encouraging family and friends to use recycled plastics varies across the compared countries, too (Q30). Well over half of respondents in Finland, Germany and Spain and slightly below half in Estonia state that they would be "extremely" or "rather likely" to encourage others to use products partly made with RP. Overall, about every fifth of respondents in Estonia, Finland and Germany would not commit to advocate for the use of such products, whereas in Spain, as many as a third would not do this. Rather significant proportion of respondents in Germany, Finland and Spain (18% on average) are undecided on the matter (i.e. answered "don't know"), and again Estonia stands out with even higher rate – one third are not sure how they would proceed regarding encouraging the use of products containing RP.

4.5.3 Drivers and barriers to recycled plastics acceptance

This chapter examines the drivers and barriers influencing wider consumer acceptance of recycled plastics. We define acceptance via attitudes, beliefs and experience related to RP. Firstly, it is important to understand the respondents' attitude towards environmental effects of recycled plastics, do they as consumers trust the plastics recycling system, which provides input for the more sustainable products made with RP materials (Q9). It is encouraging that majority of respondents "totally disagree" or "tend to disagree" with the statement that "all the talk about recycling plastics is just a hoax" (see Summary table A6.3, Annex 6). In further detail, reliability or trust in the environmental effects of recycling is strongest in Finland (81%), followed

by Germany (66%), and somewhat lower in Estonia and Spain (about 60%). Respectively, in Estonia and Spain about a third, and in Germany a quarter of respondents agree with this statement, and therefore problematise the (system of) recycling of plastics. Perhaps they feel that recycling in their country is not actually taking place properly or not in the amount that it should and therefore does not help fight plastic pollution or to combat climate change. As we saw before (Q7a), small proportion of people also do not consider choosing products made of RP instead of conventional plastics environmentally friendly. Therefore, it could be assumed that people doubtful of recycling are probably not ready or interested in introducing recycled plastic (more) into their lives.

Next, a significant barrier to recycled plastics acceptance could be negative experiences with products made from RP (Q21). According to PRIMUS data, consumers in all countries mostly (approx. 70% on average) state that they have never had any negative experiences with products made from RP (Figure 6). On average, only 4% of respondents acknowledge having negative experiences with such products. However, rather significant proportion of respondents – roughly a third – are not sure (answered "don't know"), perhaps because they are not aware if some products that they have used contain RP. There are also considerable country differences with almost 40% of consumers in Estonia admitting uncertainty about their experiences, while in Finland and Germany the level of uncertainty is about half as low. So not as much as negative experiences with RP products, but rather not having enough information about product content is one of the barriers to higher acceptance of RP. Hence, more efforts are needed to raise the awareness about RP and products containing them.

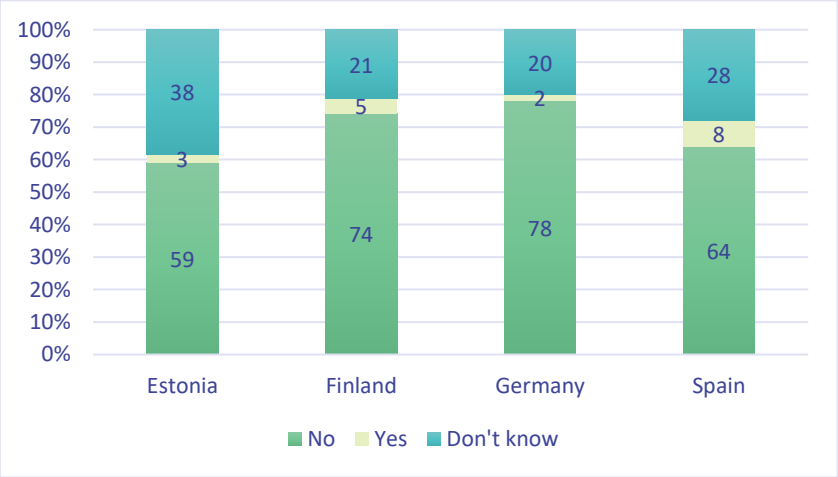

Figure 6. Whether one has ever had any negative experience with products made from recycled plastics

Further we were interested whether and what kind of concerns are there regarding the use of recycled plastics, compared to conventional plastics (Q16). For considerable proportion of respondents in Finland, Germany (about 50%) and Estonia (44%) there are no issues regarding the use of recycled plastics. However, in Spain only a third of respondents are of similar opinion. Roughly one in five respondents in Estonia, Germany and Spain are not sure whether the source of the recycled plastics

used in the products is safe for health. In Finland consumers are slightly less worried about the possible health-related issues (16%). Moreover, every fifth consumer in Estonia and Spain is concerned, because long term studies about the impact of RP are not available yet. In Finland and Germany this concern is felt by slightly more than a tenth of survey participants. Compared to other countries, consumers in Spain are also more often concerned about the lack of proper regulations or standards which would make sure recycled plastics are safe. Finally, in Estonia, Finland and Germany less than a tenth are expressing concern over RP components being more toxic compared to those in conventional plastics, but in Spain concern over toxicity is also somewhat higher. Thus overall, there are more different concerns expressed by respondents in Spain and fewer by respondents in Finland. This is interesting, because previous sections indicate that survey participants in Spain show similar recycled plastics behavioural commitment as those in Finland and Germany do (e.g. readiness to purchase products containing RP, owning such everyday products, etc.). However, respondents in Spain are also expecting their government to do more to regulate the use of plastics (Chapter 4.5.1) and therefore despite high RP commitment, they might be concerned that not all producers are providing proper and non-toxic material.

In the following two sections we explore recycled plastics acceptance through attitudes and associations via opposite adjectives or characteristics to uncover which of these evoke positive or negative associations compared to conventional plastics (Q6). Overall, respondents across all countries associate RP with positive rather than negative characteristics – about 10% versus 50% respectively – and just somewhat short of a third report neutral stance, which could also mean uncertainty. It appears that people in Germany and Finland have more positive associations regarding RP compared to Spain and especially Estonia (see Figure 7). Thus, in Germany and Finland rather high proportion of respondents (60% on average) find that compared to conventional plastics, RP is more "pleasant", "pure" and "safe". Also, about half of the respondents in Spain perceive RP as more "pleasant" and "safe", but 10 percentage points less as "pure". On average, RP is associated the least with being more "natural" than conventional plastics and here more positive are respondents in Finland and Spain (about half). Respondents in Estonia consistently perceive RP less positively compared to other countries – on average below 40% report positive associations. Additionally, every fifth survey participant in Estonia, compared to a tenth in other countries, did not know how they perceive RP in comparison to conventional plastics. Therefore, we can assume that for Estonian consumers recycled plastics is more unfamiliar than for those in other countries.

Furthermore, respondents were asked to rate on the scale of opposites which aspects they associate with electronic products such as home appliances that contain RP irrespective of whether they have experience with such products or not (Q15). This question proved to be more difficult than the previous one, because depending on the aspect describing electronic products containing RP, in Finland, Germany and Spain about 10%-20% and in Estonia as much as 40%-50% opted to answer "don't know".

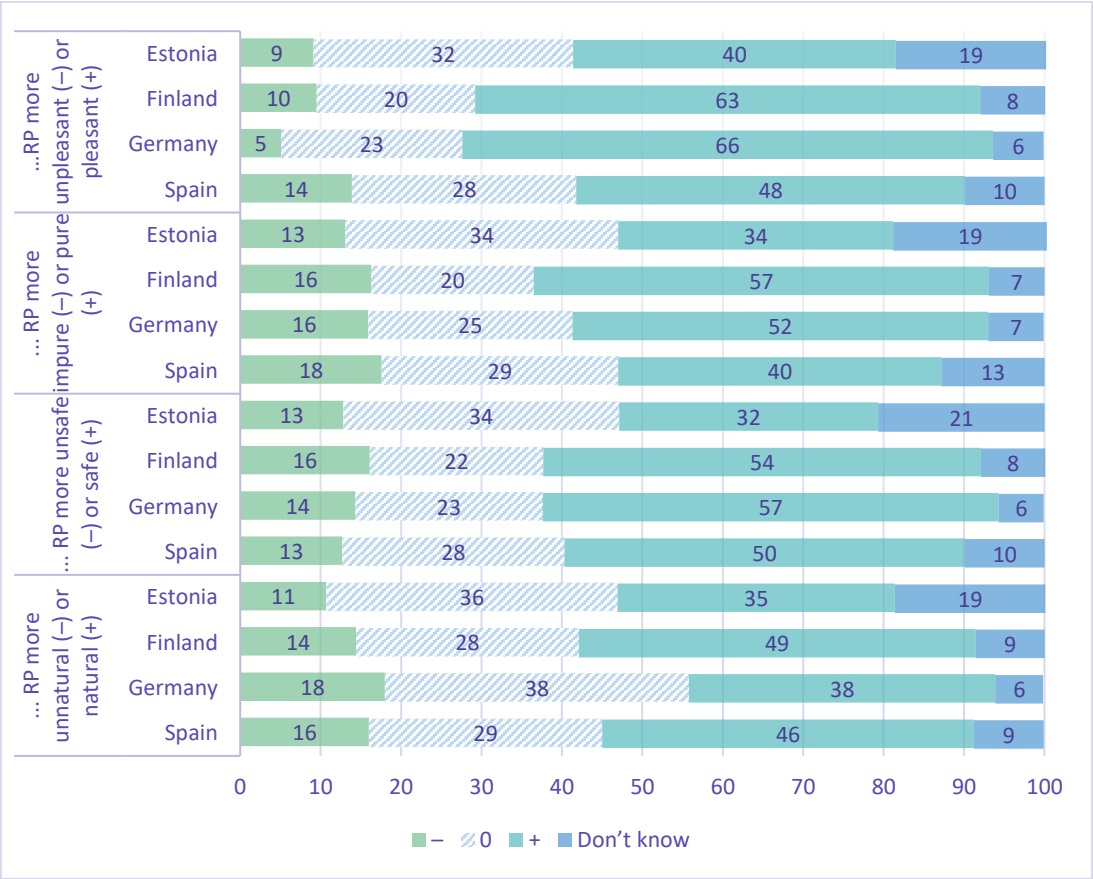

Figure 7. Perceptions of recycled plastics compared to conventional plastics

Additionally, roughly a quarter of respondents chose the neutral stance on the ranking scale. According to the highest rating, about half across all countries find home appliances made with RP to have a positive image. However, only above a third of respondents in Estonia associate such electronic products with positive image, and they give consistently more reserved assessment to other product aspects as well. Whereas respondents in Germany, Finland and Spain tend to associate RP products more with positive characteristics, which in turn might incline them to prefer such products over conventional ones. Next, on average 40% of respondents in all countries find home appliances containing RP to be of impeccable appearance, high quality, durable and to a somewhat lesser degree with even texture. About a third of respondents perceive electronic products made with RP available, innovative and with no particular smell. However, in Estonia only about one fifth of respondents acknowledge such electronic products as available and innovative. While respondents both in Estonia and Germany are more hesitant about the particular odour of products made with RP. Lastly, approximately a quarter of respondents regard electronic products containing RP affordable and easy to distinguish from conventional products. Therefore, expensiveness and difficulty to distinguish may prove to be biggest barriers for preferring home appliances containing RP over conventional ones. Whereas positive image, impeccable appearance, high quality and durability might serve as drivers to wider preference of home appliances made with RP.

4.6 Segments and personas

Analysis of Eurobarometer and the International Social Survey Programme (ISSP) surveys that explore the structure of environmental beliefs and attitudes, led to a consumer-typology across six European countries representing PRIMUS project consortium (Roosmaa *et al.*, 2023). This typology was refined in the original survey that innovatively also includes specific question related to recycled plastics carried out in Estonia, Finland, Germany and Spain.

We distinguish four basic respondent/consumer segments by combining the answers to two following survey questions:

a) general sense of environmental agency, responsibility – "*As an individual, you can play a role in protecting the environment*", and
b) concern about the environmental impact of plastics – "*You are worried about the impact on the environment of everyday products made of plastic*"

All answers were considered, including those expressing uncertainty, unfamiliarity or non-involvement (don't know, prefer not to answer), so that all respondents could be classified into the segments (see the exact distribution of answers in Annex 7).

The following segments have been differentiated into four broad categories (see Figure 8): **A Very responsible and concerned**, i.e., ***Ecologically Committed*** who totally agree with both questions; **B Fairly concerned and responsible**, tend to agree with both questions; **C Ambivalent and hesitant**, totally/tend to agree with one of the questions and totally/tend to disagree, don't know prefer not to answer with the other question; **D Neither concerned nor responsible**, i.e., ***Unconcerned and sceptical***, totally/tend to disagree, don't know prefer not to answer with both questions.

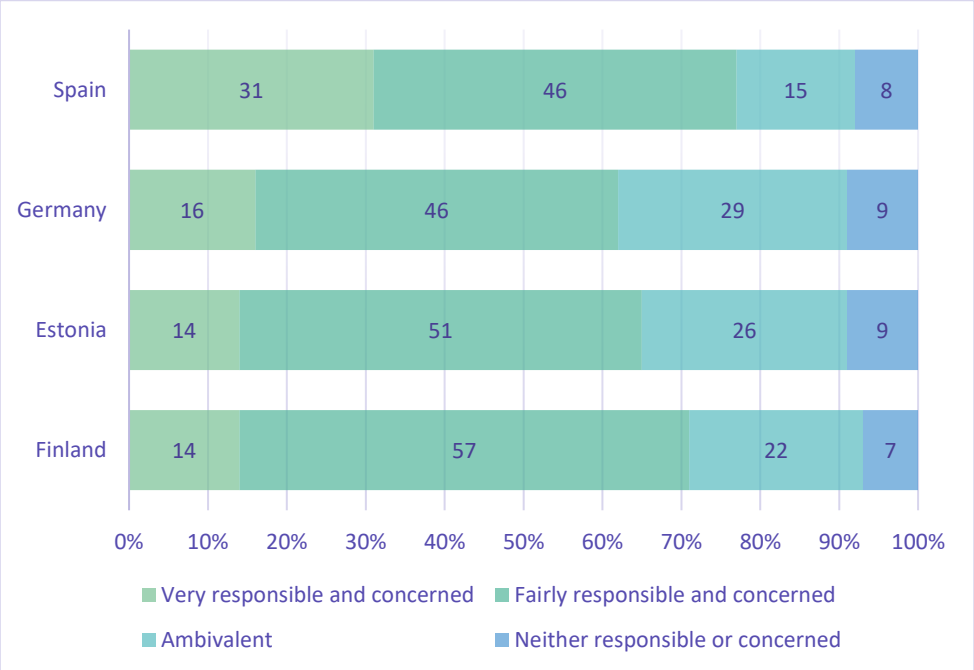

Figure 8. Distribution of the consumer segments in the studies countries

Although members of all four segments are present in all countries, their proportions vary. For example, while Fairly concerned and responsible are the dominant segment in all countries, Spain stands out as a country with considerably higher proportion of those who are Ecologically Committed (almost one third) than other three countries, and Unconcerned and sceptical make up only 15% of Spanish people (in contrast to Germany, where the proportion of sceptics is much higher, 29%). This suggests that different country contexts, legal systems, political realities and economic situation shape the popular support to the transition to circular economy and use of secondary plastics.

4.6.1 Sociodemographic profile of consumer segments

Sociodemographic profile of the consumer segments enables to understand characteristic of consumers with different set of attitudes (see details in Annex 8). These characteristics are important also for the persona construction to follow.

Segment **A Very concerned and responsible** (oldest and most established) is characterized by highest mean age (52 years) with 49% over the age of 55; most gender-imbalanced toward women (56% women vs 44% men); smallest household size (2.5 members); most urban (35% living in big cities, lowest village/farm percentage at 15%); one of the highest educational attainments (37% lower and upper tertiary levels combined); highest subjective social standing (5.0 on 1–10 scale where 1 represents the highest score)

Segment **B Fairly concerned and responsible** (middle-aged and stable): second-highest mean age (49 years); relatively balanced gender distribution (46% men, 54% women); high educational attainment (39% tertiary education); high employment rate (58% currently working); most likely to report "fairly happy" (62%); generally stable economically (24% find it "fairly easy" to make ends meet).

Segment **C Ambivalent and hesitant** (young-middle aged): mean age of 46 years; more balanced gender ratio (53% men, 47% women); high employment rate (60% currently working); moderate levels of education and economic stability; higher proportion living in villages/farms (22%).

Segment **D Unconcerned and sceptical** (youngest and with fewer resources): lowest mean age (42 years) with only 26% over 55; most male-dominated (60% men vs 40% women); highest proportion living with relatives (14%); largest households (2.7 members); lowest educational attainment (only 22% with tertiary education); most likely to be unemployed and not looking for work (4%); lowest subjective social standing (5.5 on 1-10 scale where 1 represents the highest score).

The progression across segments shows a clear age gradient, with corresponding shifts in social stability, economic security, and life satisfaction. Segment A represents the most established and traditionally successful segment, while Segment D represents a younger, more diverse, and less settled population. Regarding the main job, segment A generally represents more professional/specialized roles requiring higher education, while Segment D tends toward more technical, industrial, and operational roles focused on practical skills and vocational training.

4.6.2 Characteristics of the segments along their relation to (recycled) plastics

A Very concerned and responsible form the ecologically committed segment who is aware of environmental problems and is very concerned about them. At the same time, they feel that they themselves can do something to mitigate environmental issues. They are aware also of the problems related to plastic production and plastic pollution (i.e. plastic literacy). Concerning recyclates they are most enthusiastic and positive – probably early adopters of innovations. They express highest environmental concern, and they are most active in sustainable behaviours (buying second-hand, repairing, considering eco-labels), feeling accomplishment from eco-friendly behaviour. They view plastic pollution as a very important issue at all levels (global, national, local), they strongly support more government regulation of plastics, and they believe that recycling helps to fight pollution (disagree with the statement that recycling is just a hoax). They have the most positive perception of recycled plastics compared to conventional plastics, they are most interested in recycled plastic labelling on products and most confident about identifying recycled plastic products (49% say they use products containing RP). They are least concerned about recycled plastics safety (40% have no concerns) and they are strongest advocates of recycled plastics (77% likely/extremely likely to encourage others to use recycled plastics). Additionally, they are most willing to buy appliances with high recycled plastic content (4.8/6 mean) and most willing to pay price premiums for recycled plastic products. Ecologically committed are strong believers in a circular economy (20%) and reduced consumption (15%), but overall, they are also most pessimistic about the future (34% believe the environmental situation will worsen).

B Fairly concerned and responsible represent the mainstream moderate ecological awareness in the western societies. This segment is similar to the very concerned segment but with more moderate values. They express fairly high environmental concern (3.8/5) and generally feel accomplishment from eco-friendly choices. They take plastic pollution seriously but less compared to ecologically committed segment. They have positive but more moderate views on recycled plastics, and they too disagree with recycling being just a hoax. They support more government regulation and value corporate environmental responsibility but less strongly than very concerned segment. They are generally unconcerned about using recycled plastic compared to conventional plastics (42% not concerned).

They are willing to buy home appliances containing recycled plastics but are more price-sensitive than segment A. They have a practical approach to quality (71% want the same quality of products containing RP as those containing conventional plastics) and demonstrate moderate RP advocacy (60% likely/extremely likely to recommend using products containing RP to others). They have a balanced view of future solutions regarding circular economy, and they focus on practical environmental actions.

C Ambivalent and hesitant have moderate environmental concern (3.3/5), they are less engaged in ecologically sustainable behaviours and are less likely to feel accomplishment from eco-friendly choices. They view plastic pollution as less important than other segments, show moderate support for government regulation and have limited interest in corporate environmental responsibility. They have neutral to slightly negative views on recycled plastics and they are more sceptical about

recycling benefits. They are less certain about recycled plastic products and express more safety concerns. They are more hesitant about recycled content in home appliances and are rather price-sensitive (56% unwilling to pay more). They show limited advocacy for RP (40% likely/extremely likely to recommend products with RP to others). Concerning the visions of a circular economy, they have mixed outlook on future solutions.

D Unconcerned and sceptical segment has the lowest environmental concern (2.5/5) and considers plastic pollution less important than other segments at all levels. They are least engaged in sustainable behaviour and least likely to feel accomplishment from eco-friendly choices. They are most resistant to government regulation and least interested in corporate environmental responsibility and product labelling. They have the most negative perception of recycled plastics, and they are most likely to view recycling just as a hoax (17% agree). They are least aware of recycled plastic products (65% don't know if they use products containing RP) and they have highest safety concerns and scepticism concerning recyclates. Moreover, they are most resistant to recycled plastics in home appliances (3.6/6 mean) and most price-sensitive (56% unwilling to pay more for products containing RP). They are least likely to advocate for recycled plastics (13% likely/extremely likely to recommend). However, concerning the future outlook, they are most optimistic about technological solutions to alleviate most pressing global environmental problems (19%), yet have the highest uncertainty about the future, too (28% replay don't know). The unconcerned segment has the greatest share of don’t know answers to all the questions, reflecting either lack of interest (indifference), lack of information to form an opinion or general scepticism towards the topics touched upon in the survey.

There is a sequence from highly engaged environmental advocates (Segment A) to environmental sceptics (Segment D), with Segments B and C representing intermediate positions with decreasing levels of environmental engagement. Answers to these questions differentiate segments of respondents with different level of acceptance of recyclates: those who are committed to environment protection tend also to accept recyclates, whereas environmental sceptics and unconcerned are least aware or hesitant about recycled plastics.

4.6.3 Drivers and barriers to recyclate acceptance by segments

Based on the PRIMUS survey data, we can highlight several **drivers** and **barriers** influencing the acceptance of recycled plastics in each of the four respondent/consumer segments. The results are based on quantitative analysis of survey questions Q6, Q9, Q15, Q16 and Q21 (see also Annex 9), and qualitative analysis of open-ended responses (Q16, Q21) (for more detail, see Annex 10).

Table 5 summarises the results of drivers and barriers to recyclate acceptance by consumer segments. Each segment's drivers and barriers reflect their distinct levels of environmental concern, trust in the recycling process, and practical considerations, which influence their acceptance of recyclates. It appears that all segments encounter some barriers to recyclate acceptance. Thus, Very concerned and responsible segment highlights need for systemic change in consumption patterns, not just recycling or circular economy. At the other extreme, paradoxically, the deep scepticism of Unconcerned and sceptical segment, could be a driver if concerns about

recycling's effectiveness are addressed. If proven wrong, this segment's acceptance could increase once they feel reassured about the impact and benefits of recyclates.

Table 5. Summary of drivers and barriers to recyclate acceptance by consumer segments

	A Environmentally committed/Very concerned and responsible	B Fairly concerned and responsible	C Ambivalent and hesitant	D Unconcerned and sceptical
Drivers	Strong environmental concern, willingness to pay more, trust in recycling	Moderate environmental concern, balanced view on recycling, pragmatic approach	Practical focus on product quality, moderate support for recycling	Potential to shift views if scepticism is addressed
Barriers	Toxicity concerns, preference for systemic change not just recycling/circular economy. Inadequate recycling infrastructure	Uncertainty and lack of information, government regulation concerns, greenwashing scepticism	Quality concerns, detachment from environmental issues	Strong scepticism about recycling, negative product experiences, pessimism about environmental solutions, reluctance to pay more

The analysis of open-ended responses further suggests that all segments have encountered negative experiences with recycled plastic products. However, the specific nature of these experiences differed between the segments. While all segments reported concerns about durability and quality, segment A and C expressed more concerns about safety and health, while segment B and D focused more on product performance and aesthetics.

4.6.4 From segments to Personas

We distinguished consumer segments according to the level of concern for plastics environmental impact and sense of agency across four studied countries (see the details p. 52). Based on the survey data, it is possible to construct more or less detailed personas who represent specific segments in a certain context (country, location) in a vivid personalised way. Knowing the profile of attitudes and behaviour intentions of particular segments, we can choose the most relevant ones for persona construction.

For illustrative purposes we created several personas in different country contexts and the tailored communication strategies with the help of Chat GPT[8]. Personas presented here reflect the practical, hesitant, and price-conscious attitude of segment C and also illustrate various demographics who might fit under this segment (more detailed persona descriptions and tailored communication strategies by each country are provided in Annex 11). This segment is hesitant about recycled plastics, yet compared

[8] The following prompt was used: "Based on the added data on segments, please construct personas that represent each segment in the context of Spain, focusing on their relation to recyclates. Please propose best communication strategies for the promotion of recyclate use for each persona".

to the segment D, they are more likely to overcome barriers to RP acceptance if their concerns are properly addressed.

Peeter Tamm (56) is a **small business owner** from Tartu (Estonian second-largest, university town) where he has a family-run auto repair shop. He is married, his children have moved out and he owns a house in the suburbs. Peeter is practical and **cost-conscious**, and **values durability over eco-friendliness**. He regularly uses plastic-based car parts and tools but doesn't actively seek recycled alternatives. One of the main barriers of this is his **scepticism about recycled plastic's durability** for professional use. Namely, Peeter doubts whether auto parts made of recycled plastic are as strong as conventional ones. He generally believes recycling is necessary and **sorts waste when convenient** but doesn't feel strongly about it, as he believes recycling should be industry-led, not a personal responsibility. Peeter also feels that recycling consumes a lot of energy and isn't always effective. He supports government regulations on recycling but won't be willing to pay extra for sustainability.

Emmi Virtanen (40) is a **working mother** of two young children (6 and 8 years old) living in a suburb of Helsinki (Finland). She works as a HR manager in a tech company. Emmi prefers **convenience and practicality** over actively seeking sustainable choices. Although she uses plastics in daily life (kids' toys, packaging, household goods), she prefers trusted brands and is **hesitant about the safety of recycled plastics** in food packaging and children's products (being worried about toxins). Nevertheless, Emmi would buy recycled plastic products if they are **clearly labelled as safe and high-quality**. She thinks companies should be transparent about their use of recycled plastics. Emmi is also **price-sensitive** and wouldn't pay extra just for recycled materials or eco-friendly choices. She believes government regulations should ensure recyclability of materials and **due to the well-functioning recycling system** in Finland she **sorts waste regularly**.

Michael Wagner (52) lives with his wife in a rural village in Bavaria (Germany), where he **owns a small farm** primarily involved in dairy production. He has two adult children who do not need his financial support. He has a stable income but is mindful of expenses. Michael is a **practical and hands-on** guy who prefers **durable and cost-effective products** over environmentally friendly labelled ones. Although he uses plastic containers and equipment on his farm, he doesn't actively seek the ones made of recycled plastics. He is **sceptical about their durability** and sees little benefit in paying more for them. He worries that recycled plastic products may not be as sturdy and long-lasting and thus prefers traditional products that he trusts. He **sorts waste if convenient** but does not go out of his way to do so, as he believes that the effectiveness of recycling is overstated.

Alejandro Fernández (29) is a single tech enthusiast living in Barcelona (Spain). He works as a **software developer** at a technology firm. He **values innovation and efficiency** and favours cutting-edge design and functionality over sustainability messaging when choosing products. Alejandro uses plastic-intensive electronic devices, including smartphones, laptops, and home gadgets, but is indifferent to whether plastics in his products are recycled, as long as they maintain **high performance and durability**. Is also has some doubts of the durability of recycled plastics in electronics. He is more interested in circular economy innovations if they

align with technological advancements, and he supports sustainable technology if it offers tangible performance benefits. Alejandro **sorts waste inconsistently**, as he finds recycling rules complex and is sceptical about the real impact of recycling on sustainability. He also believes that corporations and policymakers, not individuals, should lead sustainability efforts.

5 CONCLUSIONS AND DISCUSSION

5.1 Stakeholder perspectives on the use of recycled plastics

Stakeholder perspectives on the wider adoption of recycled plastics were investigated through 28 in-depth interviews representing automotive and home appliance industry, recyclers, other plastics industry and research institutes covering ten countries. The survey explored challenges and perspectives on using recycled materials, particularly plastics, in new products. The focus was on industrial manufacturers using recycled components and recyclers, aiming to identify barriers to recycled plastics adoption and strategies to overcome them.

Recycled plastics are crucial for sustainable production but require strong infrastructure and legislative support. Manufacturers, especially from larger countries, support clearer and stricter EU regulations to balance market forces and sustainability goals, while smaller manufacturers report challenges in meeting regulations designed with larger players in mind, leading to competitiveness issues. In the home appliance sector, EU eco-design and waste directives were the key, though producers stressed the need for economically feasible regulations. The automotive sector expressed concerns over rapid regulatory changes, which can overwhelm industries needing time to adapt. Recyclers called for better collaboration with producers, financial incentives for waste sorting, and advances in recycling technologies to strengthen the circular economy.

Home appliance and automotive producers recognised the need to balance economic, environmental, and social sustainability, though these goals often conflict. Strict regulations can increase costs and inefficiencies, such as overlapping reporting requirements. Effective monitoring is needed to address greenwashing and social dumping. Both groups advocated for better waste management, such as improved e-waste tracking and household sorting. Recyclers pushed for product content regulations to enable more efficient recycling (and closing the loop).

Producers and recyclers emphasised the need for consistent, science-based EU regulations to avoid fragmented local rules. They supported financial incentives for recycled materials and innovation in recycling technologies. Despite challenges from political and economic uncertainties, stakeholders recognised the urgency of transitioning to sustainable production. Collaboration among legislative bodies, waste collectors, recyclers, and manufacturers were seen as essential to creating a circular economy.

Barriers to adopting recycled plastics include costly waste collection systems and plastic segregation. The recycling industry faces challenges with mechanical recycling quality and scalability, while chemical recycling can be expensive and not environmentally sustainable. Despite these obstacles, home appliances manufacturers and recyclers are collaborating on innovative recycled materials. The market for recycled plastics remains niche, with insufficient supply to meet the demand, especially in smaller countries due to limited waste volumes. Recyclers see opportunities to enhance recycling technologies but stress the need for better cooperation.

Commitment to sustainability, innovation, and dedicated sustainability teams were key drivers for adopting recycled plastics. Collaboration in less price-sensitive markets also supported recycled materials. However, mixed-material designs and safety concerns hinder circularity. In sum, sustainability was seen as a broader concept than just material use, including energy efficiency, emissions reduction, and waste minimization.

Consumer behaviour significantly impacts sustainability, though affordability often outweighs sustainability concerns. While sustainability ranks highly in surveys, it does not always translate into purchases. Producers view consumers as unreliable allies unless regulations or incentives guide the behaviour. Some acknowledged that consumer demand influenced sustainability in the household appliances and automotive sectors. Consumers were seen as economically rational actors, choosing sustainable products when economically feasible.

5.2 General public, consumer perspectives on plastics

To address societal concerns and promote the use of products with recycled content, it is crucial to understand the diverse attitudes and decision-making behaviours of the general public, consumers. These were investigated in an original PRIMUS "Citizen and consumer awareness and acceptance of recycled plastics in Europe" representative survey (2023) conducted in Spain, Germany, Finland, and Estonia, countries representing different welfare regimes, regulatory policies, and cultural contexts.

The findings reveal overall public environmental concern and behavioural commitment to recycled plastics, although with country variations. Respondents in all four countries generally prefer products made with recycled plastics due to their perceived environmental benefits. However, respondents in Estonia and Spain exhibit slightly greater uncertainty regarding these environmental advantages. Furthermore, a sense of agency (belief that one can play a role in protecting the environment) is rather high across all countries, but somewhat higher in Spain and Germany. While in Finland, for example, there is comparatively stronger belief that plastics recycling system works properly and is a way to combat plastic pollution and climate change.

While consumers indicate intentions to purchase home appliances containing recycled plastics, price sensitivity remains a barrier. The majority are unwilling to pay more for recycled plastics products, particularly in Finland, and even more so in Estonia where the overall purchasing power is lower and recent inflation rates one of the highest in Europe. Reluctance to pay more is even higher in case of possible purchase of a car, probably because this is a big expense and so there is less room to raise the price.

Drivers to acceptance of recycled plastics include rather positive perceptions of general safety (according to about half of the respondents) in comparison to conventional plastics and environmental friendliness, while barriers vary by country. Finland and Germany express higher confidence in recycled products, whereas Estonia and Spain show greater uncertainty about their experiences with recycled plastics that in turn might hinder acceptance. Overall, less than half of the survey

participants (and even fewer in Spain) have no issues of concern regarding the use of recycled plastics compared to conventional plastics. Concerns relate mainly to health safety, followed by the lack of long-term studies on recycled plastics (somewhat more so in Estonia and Spain), and inadequate regulations or standards (particularly in case of Spain). Another barrier is relatively low awareness regarding recycled plastics, because considerable proportion of survey participants have difficulty to answer questions specifically about this material.

Analysis of open-ended responses indicate nuanced country-specific concerns. Consumers in Estonia and Finland show a need for increased awareness about recycled plastics, while consumers in Spain exhibits distrust in the recycling process, viewing it as potential greenwashing. Respondents in Germany and Spain also emphasise the environmental footprint of recycling, advocating for sustainable alternatives and a reduction of overall plastic consumption.

To explore within-country variations, respondents were categorised into groupings based on concern of environmental impact of plastic products and environmental agency, resulting in following consumer segments: Ecologically Committed, Fairly Concerned, Ambivalent/Hesitant, and Unconcerned/Sceptical. The Ecologically Committed consumer segment (constituting about a fifth of respondents across all countries) is characterised by a high level of environmental concern and willingness to invest in sustainable products. Whereas the Unconcerned/Sceptical segment (below a tenth of respondents), often younger and less educated consumers (although who might continue studies), shows distrust towards recycled materials. In all countries, many individuals with moderate or pragmatic views, such as expressed by Ambivalent/Hesitant segment (close to a quarter of respondents), still demonstrate significant engagement in recycling. Therefore, we created illustrative personas for the Ambivalent/Hesitant segment, as compared to the Unconcerned/Sceptical segment, they are more likely to overcome barriers to recycled plastics if concerns are properly addressed.

The study highlights drivers and barriers to recyclate acceptance across segments, emphasising the need for targeted strategies that resonate with the unique values and lifestyles of different consumer personas. Effective communication and regulatory measures are essential to address public concerns, which vary significantly by cultural and national context. Tailored awareness campaigns aimed at sceptical or indifferent consumers, particularly younger and less educated individuals, can enhance acceptance and commitment to recycled plastics. Additionally, investigating actual user experiences with recycled plastics products could identify barriers and drivers more accurately.

Overall, consumers lack sufficient information about plastic recycling, leading to some confusion and distrust, particularly in the context of contradictory discourses on plastic circulation. Raising awareness about regulations, the plastic lifecycle, innovative recycling technologies, and the ecological impacts of recycled materials is crucial for fostering acceptance and promoting sustainable practices.

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ANNEX 1 – METHODOLOGY FOR INDUSTRIAL STAKEHOLDER STUDY

Interview sample was based on the combination of purposeful and convenience sampling. First round of data collection took place in the beginning of the project in 2022-23 with the interviews conducted among PRIMUS consortium partners. The aim of the interviews was first, to map various stakeholder groups involved in plastics recycling (from general community to industrial stakeholders, but also policy makers, standards organisations, innovators etc.) and second, to further develop and refine the interview plan for the second stage of data collection.

In the second part of data collection throughout 2024, our aim was to conduct interviews with stakeholders in automotive and household appliance industries, and in plastics recycling industry focusing on the EU level (trade associations) and on four countries: Estonia, Finland, Germany and Spain. Initial criteria for choosing relevant companies were that the company would be headquartered and/or have production in one of the four countries. We aimed to involve both market leaders, sustainability innovators and those more sceptical towards green transition and both parts manufacturers and original equipment manufacturers (OEMs). Contacts for potential interviewees were found via web searches and through PRIMUS project network.

We had to revise our initial sampling strategy for two main reasons. First, in Estonia home appliance and automotive sectors are practically non-existent and we extended sample to companies producing plastics parts for other industries as well. Second, several stakeholders we contacted were not willing to give us an interview or just did not answer to our interview invitation. For example, none of the targeted automotive OEMs were willing to be interviewed. In the end we extended the geographical scope of the stakeholders under study, relying more heavily on project network contacts than initially planned. See Table A1 for the overview of interviews. All in all, we conducted 28 interviews with 33 individuals (occupying different managerial, technical or policy positions) representing organisations in 10 different countries.

Table A1: Overview of stakeholder study interviews

Interview code	Type of organisation	Number of interviews	Number of interviewees***
HAM	Home appliance manufacturer (OEM)	3	5
APM	Automotive parts manufacturer	5*	7
PPM	Plastic parts manufacturer outside home appliance and automotive sectors	5	5
ITA	Industry trade association	5	5
R	Recycling company	4	5
RCO	Research and consulting organisation, including university	6	6
	Interviews by country		
	Austria**	1	2
	Brussels	3	4
	Estonia	10	10
	Finland	3	4
	Germany	2	2
	Italy	1	1
	The Netherlands	2	2
	Spain	4	5
	Sweden	1	2
	Turkey	1	1

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

Interviews lasted between 17 to 86 minutes, on average lasting around one hour. Four were done face-to-face, and most by using video-conference software. Main topics covered were related to sustainable production, circular economy and EU's green deal; using recycled plastics in automotive and home appliance industries, focusing on experiences, new possibilities and barriers hindering this; and the impact of national and European regulations on the industry and organisations' involvement in the policy making processes.

Interviews were recorded and analysed using a slightly modified "What's the Problem Represented to Be?" (WPR) framework, originally developed and elaborated by Bacchi and Goodwin (2016) for policy analysis. Accordingly, we attempt to answer the following questions:

1. What are different stakeholders' definitions of the problem at hand?
2. What sort of assumptions and logics underlie these specific problem representations?
3. What has been left out from the problem representation?
4. How has this approach to the problem been defended and/or disrupted?; additionally, we were interested in
5. What are the potential solutions offered to the problem?

ANNEX 2 – STAKEHOLDER STUDY INTERVIEW PLAN

Short intro to the project and aims of the interview: The interview will be conducted within the framework of the project "Reforming secondary plastics to become the primary raw material choice for added-value products" (PRIMUS) financed by the European Union research and innovation framework program "European Horizon". We aim to analyse the perceptions and experiences of various stakeholders with the circular economy and more specifically with recycled plastics. During the interview, you will be asked various questions about these topics, and the collected information will only be used for scientific research.

Background

1. Firstly, please introduce yourself: your position and tasks in the company.
2. And briefly introduce the company as well…. (produces fridges, freezers?)…? Locations? Headquarter? Production sites? Markets? Competitive advantage?
    a. Do you also belong to some associations? Where? Why?
3. What would you say are the main developments in the xxx sector right now? And in your company regarding production?
4. What are the main challenges in your sector/business right now? What are the main strengths of the European xxx sector in the world?
    a. What kind of regional/ country differences are there (e.g. are there regions where production in your sector is clustered?; important production countries?)?

Now let's talk about sustainability:

1. How would you define sustainability in the context of your sector and economic activity?
    a. What would sustainable production look like?
    b. What kind of sustainability related initiatives and activities is your company focusing on?
        i. Why so? *[we would like to hear both about social and environmental sustainability, but first let's see how interviewee understands sustainability]*
2. In recent years a lot of discussion has been about greening the economy and the EU's green deal more specifically. How have these discussions and developments affected the activity of your company? How have these influenced the sector?
3. What do you think about the circular economy? How has it been implemented in your company? What are the barriers for implementing it more widely?

Part of the circular economy is recycling materials and using them in the production process. We are especially interested in recycled plastics:

1. In general, how widespread would you say is the use of recycled plastics in your sector? How has it changed over the years?
    a. What about in your company?
2. How does your company make decisions about what materials to use?

3. There is also a lot of subcontracting in the sector, where parts can be made by different companies (and in different countries). Whose responsibility would be the material choice then?
4. What do you even think of using recycled plastics instead of the conventional plastics in the production?
    a. What are your main motivations for using recycled plastics in your company? And what types do you use?
    b. What problems are there with using recycled plastics?
    c. Specific concerns for using recycled plastics in food-contact applications?
5. What would help to increase the uptake of recycled plastics in your sector?

Regulations also play an important part in organising economic activity, so a few questions regarding these…

1. What do you think about currently existing regulations in the EU that affect your business?
    a. How do they affect production in your sector? (specifically: the use of RP)
    b. How are country/regional regulations interacting with EU ones? How different are the country-level regulations from each other? How does it affect the functioning of the common market?
2. Has your company been involved in the policy making processes? Which kind of policy/process? How? (or why not?)
3. What do you think, how are EU policies that affect your sector made? Which actors have a strong influence in the process? What kind of alliances (e.g. country-based / sector-based) are there?
4. How about the role of environmental, social, and corporate governance (ESG) framework and corporate social responsibility initiatives in general? How do these affect your activities?

To finish up these topics:

1. What kind of changes and developments are you expecting in your sector? How are you trying to influence them? What do you think: what direction will the EU policies move? 2. Is there anything else you would like to add?

A little bit about you before we wrap up: It seems that because of your professional life, you have to be very involved in these topics. How did this happen that you got involved in the first place? What do you, as a person, think of sustainability issues? What is the relevance of following sustainable practices at the individual level?... compared to the level of changing industry standards?

> *((only?) If previous answer suggests they **DO** believe in the relevance of individual action:)* What practices do you implement in your personal life? Why so? How have your practices and views changed over time?
>
> *((only?) If previous answer suggests they **DO NOT** believe in the relevance of individual action:)* How do you feel about the social pressure to change individual practices in your community? What would be a good way to address the kind of pressures and direct these more towards institutional level actions?

Based on our research we have understood that it is important to bring different actors in the sector together, so they could share problems and solutions with each other. We try to contribute to this by inviting you to join our PRIMUS online stakeholder community. This community is designed to be a small hub for exchanging ideas between stakeholders from different sectors that are connected to plastics' recycling / using recycled plastics in their products. We organise networking events and workshops, hoping to get to the bottom of the specific problems that are faced in different countries and in different parts of the recycling chain. Your participation in those events would be invaluable!

In your sector there are probably companies with very different attitudes and practices when it comes to sustainability in general and using recycled plastics in particular. We would be very grateful if you could provide us information about what companies to interview to get as wide perspectives as possible. *[And if the person is especially friendly, maybe ask for concrete contacts/emails.]*

ANNEX 3 – COUNTRY CONTEXTS

Institutional differences, macro-level indicators

Chosen countries each represent different regions, capitalist varieties and welfare regimes/systems (e.g. Esping-Andersen, 1990; Ferrera, 1996; Hall and Soskice, 2001; Lauzadyte-Tutliene *et al*., 2018; Molina and Rhodes, 2007):

- Finland representing a *coordinated market economy* (CME), Nordic region and *social democratic welfare regime* (strong social security net by the state, low level of commodification), is a small country with small internal market;
- Estonia representing a *liberal market economy* (LME) and *Eastern European welfare regime* (generous family policies, but meagre policies in other areas like unemployment, sickness), and is a small post-socialist country without much industrial production (neither related to plastic production/recycling nor production of cars/home appliances);
- Spain representing a *mixed market economy* (MME), *Southern European welfare regime* (family as central solidarity provider, commodification level medium), with a large agriculture sector and urban-rural divide and is a large producer country;
- Germany represents a *coordinated market economy*, with a *conservative corporatist/continental European welfare regime* (status-based differences in commodification, role of the state and family, social dialogue: insiders-outsiders), and is a large producer country.

Infrastructure: recycling, public transport, green energy

Mikuła, Raczkowska and Utzig (2021), who analysed three indicators of pro-environmental behaviour at the macroeconomic level – namely renewable energy sources in heating and cooling, share of busses and trains in passenger transport and recycling rate of municipal waste – have grouped EU countries into four classes, with first class having best outcomes in these three criteria, especially regarding renewable energy share. In 2019 Finland occupied place in the first class. Next class included Germany and Estonia. Spain belonged to the lowest class. Mikuła, Raczkowska and Utzig (2021) highlight that there is a correlation between pro-environmental behaviour (as measured by abovementioned macroeconomic indicators) and the level of economic development (GDP per capita), proposing that "the higher the level of income, the greater the tendency to desire a better-quality environment. In contrast, lower income countries are more committed to solving economic problems and less concerned about the environment. Environmentally friendly behaviour is also frequently more financially demanding, which is possible with higher income levels." (p. 15).

When looking at the available indicators more concretely, in 2021 Germany's municipal waste recycling rate was 68%, that is the highest among the EU countries, while in Finland the rate was only 39%, in Spain 37% and Estonia lagging with 30% (Eurostat database 2023). Looking in more detail into the share of renewable energy in gross final energy consumption between countries, we see that amongst the four countries it is highest in Finland (43%), followed by Estonia (38%), then Spain (21%), and finally Germany (19%) (Eurostat database 2023).

Human Development Index (2022)[9]

1. Germany: 0.950 (7th place in the world; Gross National Income (GNI) per capita higher than in other 3 countries)
2. Finland: 0.942 (12th place in the world)
3. Spain: 0.911 (27th place; lower GNI than in Germany and Finland, a bit higher than in Estonia)
4. Estonia: 0.899 (31st place; has the lowest life expectancy amongst the four countries, GNI bit lower than in Spain)

The size of the industry

The EU's industrial economy is covered by four activities: mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; and water supply, sewerage, waste management and remediation activities. In 2019, Germany had the highest share of EU value added for the manufacturing sector (33.0 %), for water supply, sewerage, waste management and remediation activities (30.6 %) and for electricity, gas, steam and air conditioning supply (26.2 %). Spain is also one of the EU top countries when it comes to these three fields, although share is much smaller than in Germany[10]:

Value added by industry[11] as a percent of GDP, 2022:

- Germany: 27%
- Finland: 25%
- Estonia: 24%
- Spain: 21%

Value added by the manufacturing[12] sector as a percent of GDP, 2022:

- Germany: 18%
- Finland: 16%
- Estonia: 13%
- Spain: 12%

Environmental regulations, policies

All OECD countries have increased their environmental policy stringency (measured by the index taking into account various areas related to environmental protection) between 2000 and 2020. In 2020, the countries with the most stringent environmental policies were France, Switzerland, Luxembourg and Finland. Germany lags somewhat

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[9] The Human Development Index (HDI), published by the United Nations Development Programme, is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The index is geometric mean of normalized indices for each of the three dimensions (https://hdr.undp.org/data-center/human-development-index#/indicies/HDI).

[10] https://ec.europa.eu/eurostat/cache/htmlpub/key-figures-on-european-business-2022/industry.html

[11] Definition: Industry (including construction) corresponds to ISIC divisions 05-43 and includes manufacturing (ISIC divisions 10-33). It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas.

[12] https://www.theglobaleconomy.com/rankings/Share_of_manufacturing/. Manufacturing refers to industries belonging to ISIC divisions 15-37.

behind, and Estonia is quite close to Germany. Spain has considerably lower policy stringency than Estonia, Germany and Finland (see Kruse *et al*., 2022).

Political situation, public opinion

In 18 Western countries Humprecht, Esser, and Van Aelst (2020) and Fletcher, Alessio, and Kleis Nielsen (2020), found that the spread of fake news within both online and offline news is less evident in countries like Finland, Germany and the Netherlands that have large and widely used public media services, than in the UK or Southern European countries (France, Spain, Italy) in which media outlets tend to be more polarised (e.g. countries here tend to have at least one large conservative and left-leaning news provider, rather than one strong centrist outlet). Although Estonia was left out of these comparative groupings, based on the latest Estonian Integration Monitoring (Voog *et al.*, 2023) it is evident that in Estonia among native Estonian population the most important and trusted information sources are still public media services, thus Estonia seems to belong rather to the former group (although among other nationalities news sources seem to be more polarised).

Pro-environmental values, attitudes, agency and behaviour

Although within each country people have a variety of environmental beliefs, values, attitudes and behaviours, we can also see that on an aggregate level these differ between regions/regimes. Based on our initial analysis of ISSP and Eurobarometer surveys we concluded the following:

- In Germany there is a rather large proportion of people who are concerned about the environment and also feel strong individual agency/efficacy towards protecting the environment, measured by agreement with the statement that as an individual they can play a role in protecting the environment in their country. In Estonia both of these dimensions – concern and personal environmental agency – are comparatively lower. Spanish and Finnish people are very worried about the environment, but don't feel such strong agency/efficacy as Germans do.
- While Germans are not concerned about their domestic waste disposal systems, in Estonia ¼ of population is concerned about this. In Finland and Spain, a smaller number is concerned than in Estonia.
- Willingness to pay much higher prices to protect the environment is rather high in Germany, somewhat lower in Finland and Spain, and much lower in Estonia. Willingness to pay a bit more is higher in Finland and Germany, but a somewhat lower in Spain and Estonia.
- In Germany close to 40% of people have replaced their older energy-intensive equipment with a new one, in Finland ca 35%, in Spain about 30%, and in Estonia 25%.

Tuitjer and Dirksmeier (2021) show that on average climate change efficacy – referring to the belief that one is able to make a difference in the fight against climate change – is somewhat higher in Finland (mean value 5.21) than in Spain (5.09) and Germany (4.88). Estonia was not included into the analysis.

Aral and Lopez-Sintas (2020; 2023) have grouped European countries into two clusters based on citizens responsible environmental behaviour (REB) score. While

Germany and Finland belong to the higher citizen REB cluster, Estonia and Spain belong to the group with lower scores. Authors propose to explain these differences with countries' different policies, macro-economic uncertainties and cultures, values, and institutional factors. They conclude that the pattern with higher environmental scores is overrepresented in countries with higher socioeconomic, educational and individualism levels and respectively lower income inequality levels.

ANNEX 4 – STRUCTURE OF THE SURVEY QUESTIONNAIRE

The questionnaire was constructed based on the conceptual framework containing the thematic blocks introduces on the schema below:

Schema A1. Structure of the questionnaire by thematic blocks

In the following we introduce thematic blocks of the public opinion survey with respective questionnaire question codes. For detailed wording of questions, please see Annex 5 – List of survey questions.

I. Questions on ***pro-environmental mindset and habits***:
   a) General environmental concern – Q1, Q8
   b) Sense of environmental agency – Q3, Q10
   c) Knowledge about the environmental impact of different practices – Q4, Q5, Q7
   d) Responsible consumer behaviour and pro-environmental habits – Q12, Q13, Q14, Q17
   e) Recycling infrastructure in the community – Q18, Q19
   f) General beliefs about circular economy – Q31

II. Questions on ***attitudes*** and ***practices*** towards ***plastic in general***:
   a) Concern over environmental impact of plastics – Q2, Q8
   b) Attitudes to regulation of plastic use – Q 11
   c) Knowledge and concern related to the use of plastics in consumer products
   d) Behavioural habits/practice of plastic use and disposal

III. ***Recycled plastics*** related views and practices measured by acceptance and commitment.
   Recyclate acceptance was defined as attitudes and beliefs related to recycled plastics. Recylate acceptance was operationalized as follows:
   a) Perception of recyclates – Q6, Q15
   b) Knowledge about positive environmental effects of recyclate use in products – Q7
   c) Scepticism towards propagation of RP – Q9
   d) Worries related to environmental and health effects of recyclates – Q16

Recycled plastics commitment was defined as behavioural intentions related to recyclate containing products. Recyclate commitment was operationalized as follows:

a) Intentions to purchase products containing RP – Q22, Q25, Q27
b) Willingness to pay extra for products containing RP – Q26, Q29
c) Importance of labels indicating RP in products – Q 14
d) Intention to encourage others to use RP – Q30

IV. Consumption patterns and intentions related to ***specific products that are relevant for the PRIMUS project*** (washing machines, refrigerators, cars):

a) Owning or renting and replacing household appliance – Q23, Q24
b) Owning or renting a car – Q28

V. Questions on ***socio-demographic profile*** of the respondents.

ANNEX 5 – SURVEY QUESTIONS AND CONCEPTUAL MEANING

Question	Conceptual meaning
Q1. Generally speaking, how concerned are you about environmental issues? Please tick one box below to indicate what you think, where 1 means you are not at all concerned and 5 means you are very concerned. 1. Not at all concerned 2. 3. 4. 5. Very concerned 99. Don't know	General environmental concern (Source: ISSP)
Q2. What is your **personal** opinion, how important is the problem of plastic pollution nowadays … Q2a. ...in the world in general Q2b. ... in [YOUR COUNTRY] Q2c. … in your community, your neighbourhood 1 – very important 4 – not important at all	Concern about plastic pollution
Q3. **To what extent you agree or disagree with the following statement?** As an individual, you can play a role in protecting the environment in [YOUR COUNTRY][3] 1. Totally agree 2. Tend to agree 3. Tend to disagree 4. Totally disagree 99. Don't know	Sense of environmental agency, environmental locus of control (Source: Eurobarometer)
Q4. **Out of this list below, what would you say is <u>the most effective</u> action that a person can take to protect the environment?** **Please choose one!** 1. Purchasing consumer goods that are made ethically, following principles of fair trade, social justice and environmental sustainability 2. Joining/supporting environmental organisations 3. Boycotting products by a producer that is likely unethical 4. Reducing waste (e.g. buying package free products, reusing/repurposing things) 5. Properly sorting waste 6. Overall, consuming less to decrease ecological footprint 7. Convincing others (e.g. friends and family, colleagues and neighbours) to protect the environment	Knowledge of the effectiveness of environmental actions

8. Voting for political parties who have pro-environmental agendas 9. Every one of these actions is almost equally effective on its own 10. None of the abovementioned individual action would be effective 11. Other (please clarify)	
Q5 **Let's now look at a few ways that some individuals claim to be environmentally conscious. Which of these two alternatives would you consider to be more environmentally friendly?** A. Using old home appliances/ machines until they no longer function (and cannot be repaired). B. Replacing old high-energy consuming home appliances with more efficient ones.	Knowledge of the effectiveness of environmental actions
Q6. Now think of two kinds of plastics: there is **conventional plastics,** directly sourced from fossil fuels, and then there is **recycled plastics** – sourced from plastic waste that has been properly collected, sorted, technologically processed and then used for manufacturing products in place of conventional plastics **Please think of recycled plastics in general. Compared to conventional plastics, do you perceive recycled plastics to be more…** Unpleasant – Pleasant Impure – Pure Unsafe – Safe Unnatural – Natural -5…+5	Perception of recyclates compared to conventional plastics (semantic differential)
Q7. **How environmentally friendly do you consider the following actions?** Q7a. Choosing products made of **recycled plastics** instead of conventional plastics Q7b. Correctly sorting and disposing of all plastic waste so that it could be recycled 1 – very environmentally friendly 4 – not at all environmentally friendly	Knowledge of effectiveness of environmental actions related to plastics and recyclates
Q8. **Some people are very worried about the impact that products made of plastic have on the environment. Others feel this is not a very serious issue. To what extent you agree or disagree with the following statements.** **You are worried about the impact on the environment of everyday products made of plastic.** 1. Totally agree 2. Tend to agree 3. Tend to disagree 4. Totally disagree 99. Don't know	Concern about environmental impact of plastics (Source: Eurobarometer)
Q9. **You feel that all the talk about recycling plastics is just a hoax: recycling plastics does not really help to fight plastic pollution or to combat climate change.** 1. Totally agree 2. Tend to agree	Sceptical attitude towards environmental effects of recycled plastics

3. Tend to disagree 4. Totally disagree 99. Don't know	
Q10. In general, would you feel some sense of accomplishment from choosing a more environmentally friendly behaviour? 1. Yes, most of the time 2. Yes, sometimes 3. No, never 4. I would not choose more environmentally friendly behaviour on purpose	Sense of accomplishment related to environmental behaviour
Q11. **Do you personally feel that [SURVEY COUNTRY] government does what is needed to regulate the use of plastics in [COUNTRY]? Please choose the answer that is closest to your opinion.** 1. I feel that [COUNTRY's] government should do more to regulate the **use of plastics**. 2. I feel that [COUNTRY's] government does enough to regulate the **use of plastics.** 3. I feel that [COUNTRY's] government goes too far with implementing policies to promote the use of **recycled** plastics. 99. Don't know	Attitude to government regulations of plastics use
Q12. In principle, how important is it for you to buy products from companies that prioritize fair trade principles and social justice towards their employees and suppliers? 1 – extremely important 4 – not at all important	Responsible consumer behaviour: awareness of corporate social responsibility
Q13. **In principle, how important is it for you to buy products from companies that prioritize environmental responsibility and sustainability?** 1 – extremely important 4 – not at all important	Responsible consumer behaviour: awareness of corporate environmental responsibility
Q14. How important is it for you personally that companies inform the consumers about the use of recycled plastics in their products, using special labelling directly on products? 1 – extremely important 4 -not at all important	Responsible consumer behaviour: importance of labels of recycled plastics
Q15. Electronic products with recycled plastics are: a. Unavailable – Available b. Expensive – Affordable c. Poor appearance – Impeccable appearance d. Of poor quality – Of high quality e. Difficult to distinguish – Easy to distinguish f. Innovative – Conventional/traditional g. With negative image – With positive image h. Not durable – Durable	Perception of electronic products with recycled plastics

i. With unfamiliar, artificial smell – With no particular smell j. With uneven texture – With even texture	
Q16. Do you personally have any concerns with regard to using recycled plastics, compared to conventional plastics? 1. I am concerned about the more toxic components[8] compared to those in conventional plastic products 2. I am concerned that there are no proper regulations or standards in place that would make sure recycled plastics are safe 3. I am concerned, because long term studies about the impact of recycled plastics are not available yet 4. I am not sure whether the source of the recycled plastics used in the products is really safe for my health 5. I do not think there are any issues to be concerned about with regard to use of recycled plastic 6. Other [please clarify]	Concerns related to recycled plastics in general
Q17. We will now consider your experiences. **People have different practices and preferences about purchasing and recycling. Please indicate if the following sentences would be applicable to characterise you.** Q17a. I buy second-hand products (e.g. electronics) rather than new ones Q17b. I buy household appliance that last as long as possible Q17c. When buying a new household appliance, e.g. washing machine or refrigerator, its' environmental friendliness is an important factor of my choice Q17d. Ecolabels play an important part in my purchasing decisions Q17e. I tend to repair a product instead of replacing it Q17f. To dispose old household appliances, I take them to waste station or donate them (for example give to friends, relatives, share on certain websites) Q17g. When I renew my household appliances, I sell the old household appliances Q17h. I am often confused about how I should dispose of different types of waste to benefit circular economy 1 – totally agree 4 – totally disagree	Responsible consumer behaviour, environmentally friendly practices
Q18. Suppose someone in your neighbourhood would like to dispose of electrical domestic appliance that contains plastic parts. How easy or difficult would it be? 1 – very easy 4 – very difficult	Infrastructure: Ease of disposal of appliances containing plastic parts
Q19. What challenges (if any) have you personally faced in disposing of your own plastic waste?	Infrastructure: experienced challenges with plastic waste
Q20. **Do any of the products you use daily contain recycled plastics?** 1. No 2. Yes 99. Don't know	Knowledge and personal experience with recyclates

Q21. **Have you ever had any negative experiences with products made from recycled plastics?** 1. No 2. Yes. Please describe your negative experience [open-ended] 99. Don't know	Personal experience with recyclates
Q22 How likely would you purchase the following items that contain parts where recycled plastic has been used to replace conventional plastic? Q22a Some would prefer to buy products using recycled plastics, others are hesitant. Washing machine. Q22b Some would prefer to buy products using recycled plastics, others are hesitant. Refrigerator. Q22c Some would prefer to buy products using recycled plastics, others are hesitant. Car. 1 – extremely likely 4 – extremely unlikely 5 – I do not care	Purchase intentions: household appliances containing recyclates
Q23. **Now think about your household. Which of the following statements characterises best the situation with a larger household appliance, such as the washing machine or refrigerator?** 1. You **own or rent** a washing machine and/or refrigerator where you live and you **are likely** to buy or rent a new one in next five years 2. You **own or rent** a washing machine and/or refrigerator where you live and you **are <u>not</u> likely** to buy or rent a new one in next five years 3. You **<u>do not</u> own or rent** a washing machine and/or refrigerator where you live now, but you **are likely** to buy or rent one in next five years 4. You **<u>do not</u> own or rent** a washing machine and/or refrigerator where you live now and you **are <u>not</u> likely** to buy or rent one in the next five years 99. Don't know	Ownership and intentions related to household appliances
Q24. What might be the reasons for replacing your household appliance, such as a washing machine or a refrigerator, with a new one? **Please choose all that apply** 1. Old household appliance is too energy consuming 2. New, innovative models of household appliances have emerged 3. Old household appliance is broken and it is too difficult or too costly to repair it 4. Old household appliance does not fit into my new/renovated home environment 5. When moving to a new residence, it does not make sense to take old household appliances along 6. Other. Please specify …	Possible reasons for replacing household appliances
Q25. **Would you be willing to buy home appliances such as a refrigerator or a washing machine where parts usually made of conventional, non-recycled plastic have been replaced with recycled plastic, if they contain…? Please choose one.**	Purchase intentions of home appliances with different share of recyclates

1. I would **avoid buying** appliances containing recycled plastic 2. … very little recycled plastic (up to 5%) 3. … a moderate share of recycled plastic (up to 15%) 4. … a significant share of recycled plastic (up to 25%) 5. … a large share of recycled plastic (up to 50%) 6. … up to 100% of recycled plastic 99. Don't know	
Q26. Would you be willing to pay more for a washing machine or a refrigerator that contains parts made of recycled plastic? 7. No, I am not willing to pay more 8. A little more (up to 5% extra) 9. Moderately more (up to 15% extra) 10. Significantly more (up to 25% extra) 11. Much more (more than 25% extra) 99. Don't know	Willingness to pay extra
Q27. To buy an electronic product such as a refrigerator or a washing machine that is made using recycled plastics, do you need this to be of higher quality? 1. I would always prefer a product that contains recycled plastics, even if it is less in quality 2. The product containing recycled plastics needs to be of the same quality 3. It needs to be of a little better quality 4. It needs to be of a much better quality	Purchase intention of home appliances containing recyclates: quality
Q28. Do you own a car or rent one on a regular basis?	Car ownership
Q29. Would you be willing to pay more for a car that contains parts made of recycled plastic? I would avoid buying or renting a car that contains recycled plastic 1. No, I am not willing to pay more 2. A little more (up to 5% extra) 3. Moderately more (up to 15% extra) 4. Significantly more (up to 25% extra) 5. Much more (more than 25% extra)	Willingness to pay extra
Q30. How likely would you be to encourage family and friends to use products containing recycled plastics? 1. Extremely likely 2. Rather likely 3. Rather unlikely 4. Extremely unlikely	Encouraging others to use of recyclates as a social practice
Q31. Think about the world in 15 years from now. Which of the following statements best describes your outlook for the future?	Global outlook on the effectiveness of different measures for mitigating

1. Technological innovations will alleviate most pressing global environmental problems with little change to our way of life 2. Circular economy and the reuse and recycling of materials will alleviate most pressing global environmental problems with little change to our way of life 3. Abandoning growth-based economic models and reducing consumption will alleviate most pressing environmental problems 4. Social policies aimed at rationed resource use and population controls will alleviate most pressing environmental problems 5. Social policies aimed at fair distribution of resource use between rich and poor countries will alleviate most pressing environmental problems 6. Global environmental situation **will aggravate** significantly despite technological innovations and reuse and recycling 99. Don't know	climate change and environmental problems

ANNEX 6 – SUMMARY TABLES FOR CHAPTER 4.5

Summary table A6.1: Chapter 4.5.1 Environmental concern and attitudes towards plastics (%)

	Estonia	Finland	Germany	Spain
Q1 Generally speaking, how concerned are you about environmental issues?				
1 Not at all concerned	5.0	5.1	4.5	2.3
2	10.4	10.4	7.5	3.5
3	31.7	30.9	27.0	14.8
4	32.4	38.3	34.9	34.4
5 Very concerned	17.4	13.4	24.7	43.7
99 Don't know	2.9	1.9	1.3	.9
999 Prefer not to answer	.3	.1	.2	.4
Q3 As an individual, you can play a role in protecting the environment in [YOUR COUNTRY]				
1 Totally agree	30,5	35,9	45,3	43,3
2 Tend to agree	48,5	51,6	41,8	38,5
3 Tend to disagree	13,1	7,8	8,2	10,4
4 Totally disagree	4,1	2,4	3,4	4,8
99 Don't know	3,7	2,3	1,3	3
Q7a Choosing products made of recycled plastics instead of conventional plastics				
1 Very environmentally friendly	19,0	27,2	23,8	26,3
2 Rather environmentally friendly	59,5	61,6	63,8	56,3
3 Rather not environmentally friendly	6,8	4,6	4,8	10,3
4 Not at all environmentally friendly	3,1	1,5	1,3	3,5
99 Don't know	11,6	5,1	6,3	3,5
Q11				
I feel that government should do more to regulate the use of plastics	45,1	43,5	61,4	70,5
I feel that government does enough to regulate the use of plastics	20,3	33,2	20,7	12,2
I feel that government goes too far with implementing policies to promote the use of recycled plastics	13,2	5,7	7	10
99 Don't know	21,4	17,6	10,9	7,3

Summary table A6.2: Chapter 4.5.2 Behavioural commitment to and experience with recycled plastics (%)

	Estonia	Finland	Germany	Spain
Q3 As an individual, you can play a role in protecting the environment in [YOUR COUNTRY]				
1 Totally agree	30,5	35,9	45,3	43,3
2 Tend to agree	48,5	51,6	41,8	38,5
3 Tend to disagree	13,1	7,8	8,2	10,4
4 Totally disagree	4,1	2,4	3,4	4,8
99 Don't know	3,7	2,3	1,3	3
Q13 In principle, how important is it for you to buy products from companies that prioritize environmental responsibility and sustainability?				
1 Extremely important	12,1	18,6	19,4	26,3
2 Rather important	44	51,6	50,7	50
3 Not very important	25,2	18,7	16,1	13,9
4 Not at all important	9,2	4,5	6,7	5,3
99 Don't know	8,7	5,7	6	3,7

	Estonia	Finland	Germany	Spain
999 Prefer not to answer	0,7	0,8	1,1	0,9
Q14 How important is it for you personally that companies inform the consumers about the use of recycled plastics in their products, using special labelling directly on products?				
1 Extremely important	15,4	25,7	23,7	31,5
2 Rather important	42,8	48,5	48,4	47,7
3 Not very important	25,2	16,6	16	12,8
4 Not at all important	9,6	4,1	6,2	4,8
99 Don't know	6,4	4,5	5	2,9
999 Prefer not to answer	0,6	0,5	0,7	0,3
Q17c When buying a new household appliance, e.g. washing machine or refrigerator, its environmental friendliness is an important factor of my choice				
1 Totally agree	21,2	17,4	35,9	32,9
2 Tend to agree	49,0	53,2	46,5	41,9
3 Tend to disagree	14,8	15,1	10,3	14,2
4 Totally disagree	6,9	6,3	3,5	5,1
99 Don't know	7,4	7,4	3,4	4,9
999 Prefer not to answer	0,6	0,5	0,4	1
Q17d Ecolabels play an important part in my purchasing decisions				
1 Totally agree	13,0	13,0	21,0	30,8
2 Tend to agree	38,3	46,5	48,0	42,9
3 Tend to disagree	25,2	22,2	17,9	13,6
4 Totally disagree	14,0	8,6	8,8	7,3
99 Don't know	8,8	9,2	4,1	4,5
999 Prefer not to answer	0,7	0,5	0,3	0,8
Q25 Would you be willing to buy home appliances such as a refrigerator or a washing machine if they contain recycled plastic...?				
I would avoid buying appliances containing recycled plastic	4,9	2,7	4,5	5,2
Very little recycled plastic (up to 5%)	6,0	3,9	6,2	6,3
A moderate share of recycled plastic (up to 15%)	11,4	14,8	10,9	8,8
A significant share of recycled plastic (up to 25%)	6,8	10,6	11,7	12,7
A large share of recycled plastic (up to 50%)	10,1	10,9	14,6	12,1
Up to 100% of recycled plastic	19,2	31,3	27,5	28,6
99 Don't know	40,7	24,8	24,8	24,8
999 Prefer not to answer	0,9	0,9	1,7	1,6
Q27 To buy an electronic product such as a refrigerator or a washing machine that is made using recycled plastics, do you need this to be of higher quality?				
I would always prefer a product that contains recycled plastics, even if it is less in quality	1,5	1,9	3,8	7,3
The product containing recycled plastics needs to be of the same quality	60,0	74,3	66,9	63,1
It needs to be of a little better quality	11,8	8,2	10,7	12,8
It needs to be of a much better quality	11,4	4,3	4,8	7,9
I would not consider buying a product that contains recycled plastics, even if it is of better quality	2,2	1,3	2,5	2,0
99 Don't know	12,5	9,4	9,9	6,2
999 Prefer not to answer	0,7	0,6	1,4	0,7
Q29 Would you be willing to pay more for a car that contains parts made of recycled plastic?				
I would avoid buying or renting a car that contains recycled plastic	4,8	2,8	4,6	4,0

	Estonia	Finland	Germany	Spain
No, I am not willing to pay more	68,6	69,3	50,6	50,9
A little more (up to 5 extra)	9,3	12,0	17,6	16,7
Moderately more (up to 15 extra)	2,0	3,2	7,9	10,8
Significantly more (up to 25 extra)	0,5	0,6	3,6	4,0
Much more (more than 25 extra)	0,3	1,5	4,0	2,5
99 Don't know	13,5	9,8	10,4	10,3
999 Prefer not to answer	1,0	0,6	1,2	0,8
Q30 How likely would you be to encourage family and friends to use products containing recycled plastics?				
1 Extremely likely	10,8	18,9	16,1	16,1
2 Rather likely	35,5	44,9	39,1	39,7
3 Rather unlikely	13,9	13,5	11,9	15,8
4 Extremely unlikely	7,6	6,0	10,4	13,2
99 Don't know	32,2	16,6	22,5	15,3

Summary table A6.3: Chapter 4.5.3 Drivers and barriers to recycled plastics acceptance (%)

	Estonia	Finland	Germany	Spain
Q9 You feel that all the talk about recycling plastics is just a hoax				
1 Totally agree	5,9	2,5	5,5	10,8
2 Tend to agree	21,7	9,3	19,0	20,7
3 Tend to disagree	35,6	32,4	31,4	25,5
4 Totally disagree	24,8	49,1	35,5	37,0
99 Don't know	12,0	6,7	8,5	6,0
Q16 Do you personally have any concerns with regard to using recycled plastics, compared to conventional plastics?				
I am concerned about the more toxic components compared to those in conventional plastic products	5,7	7,3	7,4	12,4
I am concerned that there are no proper regulations or standards in place that would make sure recycled plastics are safe	8,5	12,1	11,3	18,1
I am concerned, because long term studies about the impact of recycled plastics are not available yet	17,6	12,2	11,6	15,8
I am not sure whether the source of the recycled plastics used in the products is really safe for my health	19,6	16,3	18,8	18,7
I do not think there are any issues to be concerned about with regard to use of recycled plastic	44,0	48,7	46,9	31,9
999 Prefer not to answer	4,6	3,4	4,0	3,1
Q21 Have you ever had any negative experiences with products made from recycled plastics?				
No	59,0	74,2	78,1	63,8
Yes	2,7	4,5	1,8	8,3
99 Don't know	37,7	20,8	19,4	27,6
999 Prefer not to answer	0,6	0,5	0,7	0,3
Q15. Electronic products with recycled plastics are:				
Unavailable	12,4	22,0	18,1	20,6
Neutral	*20,3*	*18,6*	*22,4*	*24,5*
Available	17,3	36,2	43,7	37,8
Don't know	50,0	23,2	15,8	17,0
Expensive	14,9	26,7	26,6	32,6

	Estonia	Finland	Germany	Spain
Neutral	20,5	25,9	26,5	22,4
Affordable	19,1	27,5	31,7	25,5
Don't know	45,6	19,8	15,3	19,5
Of poor appearance	9,0	13,8	11,1	10,4
Neutral	25,6	21,6	24,1	25,6
Of impeccable appearance	27,0	48,3	53,6	47,8
Don't know	38,4	16,4	11,1	16,2
Of poor quality	8,6	14,2	9,7	13,4
Neutral	22,9	21,0	27,9	26,2
Of high quality	29,4	48,0	49,5	43,9
Don't know	39,0	16,8	12,9	16,4
Difficult to distinguish from conventional products	27,2	35,1	35,8	30,7
Neutral	20,5	22,6	27,4	22,4
Easy to distinguish from conventional products	18,9	26,3	24,5	31,1
Don't know	33,5	16,0	12,3	15,8
Innovative	19,9	31,9	42,1	35,4
Neutral	21,6	21,7	23,5	22,2
Conventional/traditional	24,7	30,1	24,8	30,4
Don't know	33,7	16,2	9,6	12,1
With negative image	9,3	10,9	11,8	10,9
Neutral	23,6	17,8	23,4	22,4
With positive image	34,9	60,3	56,1	55,1
Don't know	32,3	10,9	8,7	11,7
Not durable	10,5	15,5	13,7	14,3
Neutral	24,0	22,0	24,3	25,4
Durable	22,6	45,2	46,5	41,6
Don't know	42,9	17,4	15,6	18,7
With unfamiliar, artificial smell	10,0	12,4	12,6	10,3
Neutral	22,2	20,8	46,2	24,0
With no particular smell	23,2	45,0	22,3	44,5
Don't know	44,6	21,8	18,9	21,3
With uneven texture	11,6	14,2	14,4	15,7
Neutral	22,6	20,4	33,3	23,5
With even texture	22,9	45,4	34,7	40,3
Don't know	42,9	20,1	17,6	20,5

ANNEX 7 – THE METHOD OF SEGMENTATION

We formed segments of respondents by combining answers to the following PRIMUS citizen and consumer study questions:

- Q3. To what extent you agree or disagree with the following statement "As an individual, you can play a role in protecting the environment in [YOUR COUNTRY]"
- Q8. Some people are very worried about the impact that products made of plastic have on the environment. Others feel this is not a very serious issue. To what extent you agree or disagree with the following statements: "You are worried about the impact on the environment of everyday products made of plastic."

The distribution of combined answers is as follows:

You can play a role in protecting the environment (Q3)	**Worried about the impact on the environment of everyday products made of plastic** (Q8)					
	Totally agree	Tend to agree	Tend to disagree	Totally disagree	Don't know	Prefer not to answer
Totally agree	1134	520	77	29	22	0
Tend to agree	897	1591	247	48	55	6
Tend to disagree	183	377	189	57	21	0
Totally disagree	46	74	42	65	11	2
Don't know	60	136	28	15	46	1
Prefer not to answer	2	10	6	4	2	8

- Very responsible and concerned – totally agree with both statements
- Fairly responsible and concerned – tend to agree with both statements
- Ambivalent and hesitant – totally agree or tend agree with one of the statements and tend to disagree, totally disagree, don't know prefer not to answer the other statement
- Unconcerned and sceptical – tend to disagree, totally disagree, don't know prefer not to answer with both statements

Table A8.1. Proportion of the respondent/consumer segments in the sample

Very responsible and concerned	18,9%
Fairly responsible and concerned	50,0%
Ambivalent and hesitant	22,8%
Unconcerned and sceptical	8,3%

ANNEX 8 – SOCIODEMOGRAPHICS OF SEGMENTS

		A Very concerned and responsible	B Fairly concerned and responsible	C Ambivalent and hesitant	D Unconcerned and sceptical
Gender	Man	43.7%	46.2%	52.6%	59.8%
	Woman	55.8%	53.6%	47.4%	39.8%
Age	Mean age % over 55	51,8 49,2%	48,8 39,9%	46,2 34,1%	42,1 26,2%
Education	No formal education	2.2%	1.1%	0.9%	1.8%
	Elementary education	6.6%	5.6%	6.6%	8.7%
	Lower secondary	19.0%	18.1%	19.8%	25.2%
	Upper secondary	18.1%	17.5%	19.9%	22.3%
	Post secondary, non-tertiary	16.3%	18.2%	20.3%	17.7%
	Lower-level tertiary, first stage	21.2%	23.8%	16.3%	12.7%
	Upper-level tertiary, second stage (MA, Doctor)	15.6%	15.1%	15.1%	9.5%
Working situation	I have never worked	2.4%	3.7%	5.2%	5.8%
	I am currently working	56.5%	57.5%	59.5%	56.9%
	I am not working right now, but I have worked previously	39.0%	36.8%	33.1%	31.4%
Employment, labour market status	Employed full time	41,0%	43,4%	45,0%	40,0%
	Employed part time	10,0%	10,1%	9,3%	9,5%
	Self-employed	6,1%	5,2%	5,8%	6,4%
	Unemployed	6,1%	6,7%	7,2%	10,2%
	In education	7,4%	10,1%	10,9%	12,5%
	Retired	28,4%	25,0%	21,4%	14,5%
Where would you put yourself on the scale of social standing?	1 – highest, top 10 – lowest, bottom	5,0	5,2	5,3	5,5
How difficult or easy is it currently for your household to make ends meet?	Very difficult	8,9%	6,0%	6,6%	7,4%
	Fairly difficult	19,0%	19,4%	21,1%	19,9%
	Neither easy nor difficult	32,5%	36,3%	33,0%	34,0%
	Fairly easy	20,9%	23,9%	21,8%	18,3%
	Very easy	13,7%	9,4%	11,6%	7,0%
Current living arrangements	Alone	23,7%	26,0%	25,4%	23,5%
	With partner	37,7%	36,8%	34,3%	30,4%
	Single parent with children	3,7%	3,7%	3,6%	4,6%
	With a partner and with children	23,3%	21,7%	23,8%	21,3%
	In a community of relatives	8,2%	8,5%	8,5%	13,5%
	A big city	34,7%	31,2%	30,5%	28,8%

		A Very concerned and responsible	B Fairly concerned and responsible	C Ambivalent and hesitant	D Unconcerned and sceptical
Where do you live?	The suburbs or outskirts of a big city	14,4%	17,8%	17,9%	16,5%
	A town or a small city	35,4%	31,0%	28,8%	32,2%
	A country village	12,7%	15,3%	17,3%	16,5%
	A farm or home in the country	2,5%	4,7%	4,7%	4,4%
The way things are now, I find it hard to be hopeful about the future of the world	Agree strongly	24,0%	14,4%	18,0%	20,3%
	Agree	40,5%	44,2%	35,3%	28,6%
	Neither agree nor disagree	17,1%	25,0%	23,8%	22,7%
	Disagree	11,6%	10,6%	13,6%	11,1%
	Disagree strongly	4,5%	2,9%	3,9%	4,4%
	Don't know	1,9%	2,3%	3,8%	9,1%
How good is your health?	Excellent	10,8%	5,0%	6,0%	7,8%
	Very good	24,0%	25,2%	22,5%	22,3%
	Good	36,4%	35,5%	35,2%	30,8%
	Fair	19,8%	26,4%	25,9%	25,6%
	Poor	7,8%	6,9%	9,2%	9,1%
How happy or unhappy you are, on the whole?	Very happy	17,2%	8,1%	8,6%	7,6%
	Fairly happy	57,1%	62,2%	56,5%	46,3%
	Not very happy	18,1%	20,6%	21,6%	24,5%
	Not at all happy	4,0%	4,2%	6,4%	9,1%

ANNEX 9 – DRIVERS AND BARRIERS TO RECYCLATE ACCEPTANCE BY SEGMENTS

Segment A: Environmentally Committed (Engaged and Optimistic)

Drivers to Recyclate Acceptance:

High Environmental Concern: Segment A expresses a **strong concern for environmental issues** and places high importance on reducing plastic pollution. This makes them more receptive to using recycled plastics as a means to combat environmental degradation (Q1, Q2).

Willingness to Pay More: Segment A shows a **higher willingness to pay more** for products made from recycled plastics, including appliances and cars (Q25, Q29). Their environmental commitment likely motivates them to invest in sustainable products.

Trust in Recycling: Segment A is **less sceptical** about the effectiveness of recycling compared to other segments (Q9). They are also more likely to view recycled plastics as safe and environmentally friendly (Q6, Q7).

Encouraging Others: They are the most likely to **encourage family and friends** to use products containing recycled plastics (Q30). This social influence can facilitate broader acceptance of recyclates.

Barriers to Recyclate Acceptance:

Toxicity Concerns: Despite their support for recycling, some respondents in Segment A still express **concerns about toxic components** in recycled plastics (Q16). This indicates that worries about potential health risks could pose a barrier to full acceptance.

Desire for Systemic Change: Many in Segment A favour **reducing overall plastic use**, including recycled plastic, and advocate for alternatives such as reusable materials (Q16 "Other" responses). This anti-plastic sentiment may limit their enthusiasm for recyclates as a long-term solution.

Segment B: Fairly concerned (Cautious and Analytical)

Drivers to Recyclate Acceptance:

Moderate Environmental Concern: Segment B has a **moderate level of concern** about environmental issues (Q1, Q2), making them open to the idea of using recycled plastics as part of an overall environmental strategy.

Balanced View on Recycling: While some scepticism exists, Segment B appears to **acknowledge the potential benefits** of recycling, albeit cautiously. They are not as extreme in their opposition or support compared to Segment A or Segment D (Q9).

Practical Considerations: They are relatively pragmatic and **willing to pay a little more** for recycled plastic products (Q25, Q26). This willingness, combined with their technical focus on the quality and performance of recycled materials (Q16), could help increase acceptance if concerns are addressed.

Barriers to Recyclate Acceptance:

Uncertainty and Lack of Information: A significant number of respondents in Segment B express **uncertainty** about the safety, quality, and environmental impact of recycled plastics (Q16). This lack of confidence in the information available about recyclates is a major barrier.

Concerns About Regulation: Segment B is concerned about the **lack of proper regulations** ensuring the safety and quality of recycled plastics (Q16). Without clear standards and more transparency, they may remain hesitant about widespread use.

Greenwashing Scepticism: There is a degree of scepticism in this segment about the **marketing of recycled products**. Concerns about "greenwashing" (false or exaggerated environmental claims) could hinder their acceptance of products labelled as sustainable (Q16 "Other").

Segment C: Ambivalent and hesitant (Pragmatic and Less Engaged)

Drivers to Recyclate Acceptance:

Focus on Practicality: Segment C is more focused on **practical, daily concerns** and the **quality** of products. They are less emotionally invested in environmental issues, but this pragmatism could facilitate the acceptance of recyclates if the products meet their standards for **durability and performance** (Q16, Q21).

Moderate Support for Recycling: This segment shows **less resistance to recycled plastics** compared to Segment D and is willing to use them if they perceive the quality to be satisfactory. Their concerns are more technical (e.g., durability, texture of products) than environmental or ethical (Q21, Q25).

Barriers to Recyclate Acceptance:

Quality Concerns: One of the major barriers in Segment C is a **concern about the quality** of products made from recycled plastics. They express doubts about the durability and general performance of such products (Q16 "Other" responses), which could hinder their widespread acceptance of recyclates.

Detachment from Environmental Issues: This segment is **less concerned** about environmental issues overall (Q1, Q2), and their lack of strong motivation to prioritize eco-friendly behaviours could act as a barrier to recyclate adoption, especially if they perceive conventional products as superior in quality.

Segment D: Unconcerned and sceptical

Drivers for Recyclate Acceptance:

Low Trust in Recycling: Paradoxically, the **deep scepticism** in Segment D could be a facilitator if concerns about recycling's effectiveness are addressed. If proven wrong, this segment's acceptance could increase once they feel reassured about the impact and benefits of recyclates (Q9).

Barriers to Recyclate Acceptance:

Pessimism About Recycling: Segment D expresses **significant scepticism** about the effectiveness of recycling to combat environmental issues (Q9). Many respondents believe that recycled plastics do not offer a real solution to plastic pollution or climate change. This makes them the least likely to accept recyclates.

Negative Experiences: This segment reports the **highest number of negative experiences** with recycled plastics, particularly in terms of **product quality** (Q21 open ended answers). Such experiences likely reinforce their resistance to using recycled products.

Environmental Pessimism: Segment D has a **pessimistic outlook** on the future of environmental problems, believing that the global situation will worsen despite innovations and recycling efforts (Q31). This overarching pessimism dampens their enthusiasm for using recycled plastics as part of a solution.

Reluctance to Pay More: Segment D is the least willing to **pay extra** for products made with recycled plastics, and they show a preference for conventional products. Their lack of willingness to invest in eco-friendly options creates a significant barrier to recyclate adoption (Q25, Q29).

ANNEX 10 – WORRIES AND NEGATIVE EXPERIENCES RELATED TO RECYCLED PLASTICS

Q16 Do you personally have any concerns with regard to using recycled plastics, compared to conventional plastics?

The qualitative open ended responses to this question ("Other") provide rich insights into how different segments perceive the use of recycled plastics. Here's a breakdown of the key themes and differences in attitudes across the segments based on the qualitative "Other" responses:

Segment A: Action-Oriented and Definitive Statements

Focus: This segment demonstrates strong, definitive opinions on plastic use and tends to emphasize **systemic changes**.

- **Anti-plastic Sentiment**: Many respondents are critical of plastic use in general, regardless of whether it's recycled. Statements like "We must eliminate the use of plastic" and "I don't want plastic, they can be replaced with reusable products like glass" show this segment's tendency toward advocating for plastic alternatives.
- **Energy Consumption Concerns**: Some express that recycling may consume more energy than producing new plastic, stating concerns like "manufacturing recycled plastics consumes more energy."
- **Scepticism of Recycling**: This segment includes respondents who question the overall effectiveness of recycling, calling it a "small patch" on a bigger problem and noting that recycled plastics still end up in the sea.
- **Emotional Responses**: Some responses are emotionally charged, evident in the use of **all-caps** ("NO MATTER HOW RECYCLED, IT DOESN'T HELP MUCH IF PEOPLE ARE NOT CONSCIOUS") and a focus on urgent action.
- **Alternatives to Plastics**: Several respondents advocate for replacing plastic entirely, emphasizing alternatives like glass and other reusable products.

Segment B: Uncertainty and Tentative Responses

Focus: This segment is characterized by **uncertainty** and **self-reflection**, with many responses reflecting a lack of deep engagement or knowledge on the topic.

- **Knowledge Gaps**: Many respondents in Segment B admit to not knowing enough about recycled plastics to form an opinion. Responses such as "I can't say" or "I don't know much about this" were common.
- **Scepticism of Greenwashing**: A notable theme in this segment is scepticism about how green products, including recycled plastics, are marketed. Several mention "greenwashing" and express a sense of distrust toward the recycling industry's claims.
- **Practical Concerns**: Some respondents focus on practical considerations like cost and performance, with comments like "how much more expensive is it to use recycled plastic?" and "I hope recycled plastic pollutes less and requires less energy to produce."
- **Long-Term Studies**: Concerns about the lack of long-term studies on recycled plastics emerge here, though these respondents are generally more tentative in their concerns.

Segment C: Technical Concerns and Shorter Responses

Focus: This segment seems less emotionally invested but focuses more on specific **technical concerns** regarding the quality and safety of recycled plastics.

- **Manufacturing Process**: Several respondents in Segment C mention that they are not familiar with the manufacturing process and express concerns about potential harmful substances being used. For example, a response stated, "You do not know what toxic substances or harmful technologies may be used."
- **Durability and Quality Issues**: Concerns about the durability of recycled plastics are common, with statements like "They are usually less durable" and "Is not of high quality."

- **Environmental Impact**: Some respondents are focused on practical barriers to recycling, such as the distance to recycling points or the belief that "recycling consumes too much energy and pollutes the air."
- **Brief and Pragmatic Responses**: Segment C responses tend to be short and pragmatic, without much elaboration or emotional intensity.

Segment D: Environmental Impact and Brief Responses
Focus: This segment is the least engaged in terms of response length but focuses on **environmental impacts**, particularly the **resource consumption** involved in recycling plastics.

- **Energy and Water Usage**: Some respondents express concerns that the recycling process requires too many resources, specifically water and energy. Statements like "Recycling plastic extremely harms the environment since recycling requires a huge amount of energy" illustrate this view.
- **Unfamiliarity with the Topic**: Like Segment B, some respondents express unfamiliarity with the topic, with comments like "I haven't thought about it" and "Not familiar enough with the topic to answer."
- **Reduction of Plastic Use**: A few respondents also echo the sentiment from Segment A about reducing plastic use altogether, whether recycled or not.
- **Brief Responses**: Segment D's responses tend to be short and to the point, with less detailed explanations. Some even state directly that they don't feel worried about recycled plastics.

Overall, the qualitative responses reflect varied levels of knowledge, engagement, and concern across the segments. Segment A is more emotionally charged and focused on broad systemic changes, while Segments 2 and 4 exhibit more uncertainty and brief answers, focusing on knowledge gaps and environmental impacts, respectively. Segment C is more technically focused but less emotionally invested.

Q21: Have you ever had any negative experiences with products made from recycled plastics?

Several key themes emerged from the negative experiences reported by respondents

- **Durability and Quality:** All segments frequently mentioned issues with the durability and quality of recycled plastic products, including breakage, tearing, and poor performance.
- **Smell and Appearance:** Many respondents complained about unpleasant smell and poor appearance, particularly in products like bags and containers.
- **Safety Concerns:** Some participants expressed concerns about the safety of recycled plastics, citing potential health hazards and chemical release.

Segment-Specific Differences

- **Segment A:** Respondents in Segment A seemed to have more diverse experiences, mentioning issues with a wider range of products. They also expressed more concerns about the safety and health implications of recycled plastics.
- **Segment B:** Members of Segment B primarily focused on the durability and quality of recycled plastic products, particularly bags and containers. They also frequently mentioned issues with smell and appearance.
- **Segment C:** Respondents in Segment C seemed to have more diverse experiences, mentioning issues with a wider range of products. They also expressed more concerns about the safety and health implications of recycled plastics.
- **Segment D:** Members of Segment D primarily focused on the durability and quality of recycled plastic products, particularly bags and containers. They also frequently mentioned issues with smell and appearance.

ANNEX 11 – PERSONAS REPRESENTING SEGMENT C

Estonian personas representing segment C Ambivalent and hesitant

Persona description	Tailored communication strategies
Peeter Tamm (56) – Small Business Owner from Tartu, second largest, university city **Practical and cost-conscious** **Background:** • Owns a **family-run auto repair shop** in **Tartu**. • Married, children have moved out, owns a house in the suburbs. • **Practical and cost-conscious**, values durability over eco-friendliness. **Relation to Plastics:** • Regularly uses **plastic-based car parts and tools** but doesn't actively seek recycled alternatives. • **Sceptical about recycled plastic's durability** for professional use. • Believes **recycling is necessary** but thinks **corporations should take the lead**. **Recycling Attitude:** • Sorts waste **when convenient** but doesn't feel strongly about it. • Supports **government regulations on recycling** but **won't pay extra for sustainability**. **Concerns:** • Doubts whether **recycled plastic auto parts** are as strong as conventional ones. • Feels that **recycling consumes a lot of energy** and isn't always effective.	**Peeter Tamm (56)** **Main Barriers:** • **Sceptical about durability** of recycled plastics for professional use. • **Believes recycling should be industry-led**, not a personal responsibility. • **Cost-conscious**—not willing to pay more for sustainability. **Strategy:** **Prove Recycled Plastics' Strength and Cost-Efficiency** • Showcase **durability tests** comparing **recycled vs. conventional plastic auto parts** in real-world conditions. • Work with **Estonian automotive suppliers** to offer **trial products** (e.g., recycled plastic bumpers, dashboards, under-the-hood components). • Use **local mechanics and workshop influencers** to endorse **recycled plastic materials** as "workshop-approved." **Leverage Financial Incentives and Regulations** • Introduce **government tax benefits** or **subsidized pricing** for businesses using recycled plastic components. • Show how **global car maker brands** are adopting recycled plastics to **future-proof Estonian businesses**. **Make it Practical and Hassle-Free** • Ensure **recycled plastic auto parts are available in major Estonian distributors**. Offer **bulk discounts** for workshops that transition to recycled plastic components
Katrin Lepp (42) – Working Mother from Tallinn, the capital **Safety and brand trust-driven** **Background:** • Lives in **Tallinn**, works as an **accountant** in a logistics company. • Married, **mother of two children (ages 5** and **10)**.	**Katrin Lepp (42)** **Main Barriers:** • **Worried about safety and toxins** in recycled plastic products, especially for children. • **Price-sensitive**—won't pay significantly more for sustainability. • Prefers **trusted brands** over new eco-friendly alternatives.

• Seeks **practical and affordable** solutions but **isn't strongly committed to sustainability**.
Relation to Plastics:
• Buys **plastic-packaged food and household products** for convenience.
• Would consider **recycled plastic products** if they are **safe and from trusted brands**.
• Worries about **toxic substances in recycled plastics**, especially for children's items.
Recycling Attitude:
• **Sorts household waste consistently**, as required in Estonia.
• Thinks **companies should be more transparent** about their use of recycled plastics.
• Unwilling to pay significantly more for **eco-friendly alternatives**.
Concerns:
• Unsure if **recycled plastic toys and food containers** are completely **safe**.
Believes **most recycling efforts are ineffective** without **better corporate responsibility**
	Strategy:
	Guarantee Safety and Trust Through Certifications
	• Use **trusted EU safety labels** for recycled plastic consumer goods.
	• Partner with **Estonian baby product brands** to **launch safe recycled plastic toys and children's products**.
	• Develop **"Safe for Families" campaigns**, featuring **lab tests and paediatrician endorsements**.
	Make It a Brand-Backed, Effortless Choice
	• Ensure **recycled plastic alternatives** are available in **Estonian supermarkets** next to familiar brands.
	• Work with **Tallinn-based retail chains** to provide **discounts on family-friendly recycled plastic products** (e.g., baby bottles, food containers).
	Use Practical Savings Messaging
	• Market **recycled plastic household items** as **cost-effective, high-quality alternatives**:
	  ○ "Same trusted brand, now even better—**Safer, Stronger, Smarter**."
	  ○ "Better for your family, better for your wallet."
	• Offer **"Buy 2, Get 1 Free" deals** on recycled plastic home products to encourage trial.

Marko Saar (29) – Tech Enthusiast from Pärnu
Tech-focused and sceptical
Background:
• Lives in **Pärnu**, works as a **software developer** for a startup.
• Single, enjoys **gadgets, gaming, and modern technology**.
• Interested in **innovation and performance** rather than sustainability.
Relation to Plastics:
• Uses **plastic-heavy electronics** (laptops, smartphones, gaming accessories).
• **Doesn't actively seek products with recycled plastics** but is open to them **if performance remains unchanged**.
	Marko Saar (29) – Tech Enthusiast from Pärnu
	Main Barriers:
	• **Sceptical about performance** of recycled plastics in tech products.
	• **Indifferent to sustainability** unless it aligns with **innovation and quality**.
	• **Finds recycling complex and inconvenient**.
	Strategy:
	Position Recycled Plastics as Cutting-Edge Tech
	• Market recyclates as **"next-gen materials" used in aerospace and gaming gear**:
	  ○ "NASA-grade recycled plastics—designed for performance."
	  ○ "Your gaming mouse, now **50% lighter and just as durable**, thanks to recycled tech."

• Would consider recycled plastic tech if it's marketed as **high-tech and innovative**. **Recycling Attitude:** • **Sorts waste inconsistently**—sees it as a hassle. • Supports **circular economy ideas** but believes **tech companies should lead the change**. • Thinks **recycling must be convenient** to be widely accepted. **Concerns:** • Worries that **recycled plastic components in electronics may reduce performance**. Questions whether **recycling actually helps** the environment	• Partner with **Estonian tech brands** to develop **innovative products from recycled plastics**. **Gamify and Simplify the Circular Economy** • Introduce **tech gadget trade-in programs**: "Turn your old phone into a high-performance **recycled plastic device**." • Work with **YouTube and Twitch influencers** to feature recycled plastic gadgets in **performance stress tests**. **Use Digital-First Marketing for Impact** • Leverage **targeted social media ads** on Reddit, Instagram, and YouTube: o "Recycled plastic? More like re-engineered for peak performance." o "Upgrade your gear and help reduce waste—no extra cost." • Develop **limited-edition tech products** (e.g., **recycled plastic smartphone cases, keyboards, gaming accessories**) with **premium branding**.

Finnish personas representing segment C Ambivalent and hesitant

Persona description	Tailored communication strategies
Matti Korhonen (54) – Rural Carpenter from Northern Finland **Background:** • Lives in a **small village near Rovaniemi**, married, children have moved out. • Owns a small **carpentry and renovation business**. • Traditional, **prefers quality and durability** in materials over eco-friendly choices. **Relation to Plastics:** • Uses **plastic-based materials** (coatings, packaging) but doesn't actively look for recycled alternatives. • **Skeptical** about recycled plastics—worries about **durability** and **moisture resistance** in Finland's harsh climate.	**Matti Korhonen (54)** **Main Barriers:** • **Sceptical about durability** of recycled plastics. • Believes **recycling should be industry-led**, not a personal responsibility. • Prefers **high-quality, long-lasting materials** over "eco-friendly" alternatives. **Strategy:** **Demonstrate Recycled Plastics' Strength & Durability** • Create **case studies showcasing recycled plastic materials in construction** (e.g., "Recycled plastic panels withstand Finnish winters as well as conventional ones"). • Provide **hands-on demonstrations at hardware stores**—show him that recyclates perform equally or better than traditional plastics.

• Feels **recycling is necessary** but believes **it should be handled by industry, not individuals**. **Recycling Attitude:** • Sorts household waste (as required by local regulations) but **doesn't feel personally accomplished** doing so. • **Believes Finland already handles recycling well**–sees no need for extra effort. **Concerns:** • **Doesn't trust** that recycled plastic products **meet professional-grade quality**. • Worries about **hidden chemicals or reduced lifespan** of recycled materials.	• Partner with **Finnish professional carpenter associations** to distribute recyclate-based product samples. **Highlight Cost and Efficiency Benefits** • Emphasize **long-term savings**: "Recycled plastic construction materials require **less maintenance and last longer**." • Introduce **government incentives** (e.g., tax reductions or grants for using sustainable materials in renovations). **Make Recyclates a Logical Choice, Not a Moral One** • Position recyclate-based materials as **technologically advanced** rather than just "green" (e.g., "Next-gen materials for modern carpentry").
Emmi Virtanen (40) – Working Mother in Helsinki **Background:** • Lives in **a Helsinki suburb**, works as a **HR manager** in a tech company. • Married, **two young children** (6 and 8 years old). • Prefers **convenience and practicality** over actively seeking sustainable choices. **Relation to Plastics:** • Uses plastic in daily life (kids' toys, packaging, household goods). • Prefers **trusted brands** and is **hesitant about safety** of recycled plastics in food packaging and children's products. • Would **buy recycled plastic products if they are clearly labelled as safe and high-quality**. **Recycling Attitude:** • **Sorts waste regularly** because it's easy in Finland. • Believes **government regulations should ensure recyclability**–not an individual responsibility.	**Emmi Virtanen (40)** **Main Barriers:** • **Safety concerns** about recycled plastics, especially for children's products. • **Prefers trusted brands**–hesitant to try unfamiliar products. • **Price-sensitive**–not willing to pay extra just for eco-friendliness. **Strategy:** **Emphasize Certified Safety and Health Benefits** • Use **trusted Finnish certification labels** to ensure product safety. • Launch **"Safe for Families" campaigns** with a focus on tested, toxin-free recycled plastics. • Partner with **Finnish child product brands** to create premium baby/kids' items from recycled plastics. **Leverage Convenience and Trusted Brands** • Introduce **recycled plastic household products via familiar brands** (e.g., "Your trusted kitchenware brand now uses 50% recycled plastic–same quality, lower waste!"). • Make recyclate-based options **widely available in major supermarkets**. **Keep Pricing Competitive** • Offer **price-matching guarantees**: "Recycled plastic products at the **same cost as conventional ones**."

• Thinks **companies should be transparent** about their use of recycled plastics. **Concerns:** • **Worried about toxins** in recycled plastic items (especially for children). • **Price-sensitive**–won't pay extra just for recycled materials.	• Introduce **bulk discounts or promotions** for everyday household recyclate-based products.
Aleksi Laine (29) – Tech Enthusiast in Tampere **Background:** • Single, lives in **Tampere**, works as an **electronics engineer** in a startup. • Passionate about **innovation, design, and functionality**. • Likes high-tech, modern solutions but isn't emotionally invested in sustainability. **Relation to Plastics:** • Buys **plastic-based electronics** but doesn't actively think about **whether they contain recycled plastics**. • Open to **recycled plastic in tech products** if performance is the same or better. • Finds **sustainability important, but only if it aligns with product innovation**. **Recycling Attitude:** • **Sorts waste but doesn't see it as a major personal contribution**. • Believes **circular economy is the future**, but **expects companies** to lead the way. **Concerns:** • **Sceptical about durability**–doesn't want devices with lower-quality plastic parts. • **Prefers high-tech innovations over traditional sustainability narratives**.	**Aleksi Laine (29)** **Main Barriers:** • Concerned about **performance and durability** of recycled plastic in electronics. • Indifferent to sustainability unless it aligns with **innovation and high-tech design**. **Strategy:** **Position Recycled Plastics as a Cutting-Edge Innovation** • Market recyclates as **"next-gen materials" used in aerospace and automotive industries**. • Collaborate with **tech brands like Nokia, Suunto, and Polar** to launch **limited-edition, high-tech gadgets** made from recycled plastics. **Leverage Tech and Innovation Messaging** • Highlight performance aspects: o "Our new smartphone case is made from **recycled ocean plastics**–lightweight, impact-resistant, and stylish." o "This laptop shell is made from **recycled industrial plastics**–just as strong, but with 50% lower emissions." • Use **AI-driven marketing** to target tech-savvy buyers on **Reddit, YouTube, and tech forums**. **Encourage Circular Economy Thinking** • Introduce **trade-in programs**: "Return your old gadgets–we'll turn them into the next generation of recycled tech!" Offer **tech influencer collaborations**–showing recycled plastic devices being **stress-tested and proven as durable**

German personas representing segment C Ambivalent and hesitant

Persona description	Tailored communication strategies
Michael Wagner (52) – Practical Farmer from Bavaria • **Background:** Lives in a rural village in Bavaria, owns a small farm, married with two adult children. He has a stable income but is mindful of expenses. • **Profession:** Farmer, primarily involved in dairy production. • **Lifestyle:** Practical and hands-on, prefers durable and cost-effective products over environmentally labelled ones. • **Relation to Plastics:** Uses plastic containers and equipment on his farm but doesn't actively seek recycled plastics. He is sceptical about their durability and sees little benefit in paying more for them. • **Recycling Attitude:** He sorts waste if convenient but does not go out of his way to do so. He believes that the effectiveness of recycling is overstated. • **Concerns:** Worries that recycled plastic products may not be as sturdy and long-lasting. Prefers traditional products that he trusts.	**Michael Wagner (52)** **Main Barriers:** • Sceptical about recyclates' **durability** and **quality** • Prefers tried-and-true conventional materials • Cost-conscious, avoids unnecessary spending **Strategy:** **Prove Long-Term Durability and Cost-Savings** • **Showcase real-life case studies** of recycled plastic equipment used in agriculture (e.g., durable recycled plastic fencing, storage bins). • Offer **side-by-side comparisons** of recyclates vs. conventional plastics in terms of strength, weather resistance, and maintenance needs. • Highlight **cost efficiency over time** (e.g., "Recycled plastic crates last 30% longer than conventional ones"). **Leverage Local Farming Networks** • Partner with **agricultural cooperatives** to distribute **subsidized trial samples** of farm equipment made with recyclates. • Get **trusted farmers** to endorse recycled plastic solutions via testimonial-based marketing. **Make it Easily Accessible** • Ensure that recycled plastic alternatives are stocked in **regional farm supply stores**. • Offer **discounts for bulk purchases** to appeal to cost-conscious farmers.
Laura Hoffmann (38) – Busy Working Mother in Berlin • **Background:** Lives in an apartment in Berlin, mother of two young children, dual-income household with a moderate lifestyle. • **Profession:** Administrative assistant in a logistics company. • **Lifestyle:** Balances work and family, convenience is key in her purchasing decisions. • **Relation to Plastics:** Buys packaged foods and plastic household items for their	**Laura Hoffmann (38)** **Main Barriers:** • Concerned about **safety and health** for children • Prefers **trusted brands** and **convenience** • Not motivated by sustainability alone **Strategy:** **Emphasize Certified Safety and Health Benefits** • Use **certifications** to prove recycled plastic products **meet high safety standards**. • Launch **"Safe for Your Family"** campaigns showing that recycled plastic

practicality. She doesn't go out of her way to buy recycled plastic products unless they are clearly labelled as safe and high quality. • **Recycling Attitude:** Sorts waste out of habit but doesn't feel strongly about it. She believes more regulations should exist but is not an advocate. • **Concerns:** Worries about safety aspects of recycled plastics, especially for products used by her children. She is open to them if they come from a trusted brand and meet quality standards.	products (like kids' toys, kitchenware) undergo rigorous testing. **Leverage Trust in Established Brands** • Collaborate with **major household brands** to introduce premium recycled plastic product lines. • **Highlight recyclate use in everyday products** that families already buy (e.g., "Your child's favourite chair is made from 50% recycled plastic!"). **Make Recyclates the Smart, Modern Choice** • Market **recycled plastic packaging** as a **premium, smart choice** (e.g., "Same quality, less waste!"). • Create a **"Recycling Made Simple"** educational campaign via **mom influencers, parenting blogs, and supermarkets** to show how choosing recycled plastic products can be **effortless and beneficial**.

Tobias Richter (28) – Tech-Savvy Engineer in Hamburg
• **Background:** Young professional living in Hamburg, single, enjoys technology and modern gadgets.
• **Profession:** Mechanical engineer at a manufacturing company.
• **Lifestyle:** Values innovation and efficiency, prefers products that offer high performance.
• **Relation to Plastics:** Uses plastic in everyday life, from electronics to home appliances. He is indifferent to whether they contain recycled materials as long as they perform well.
• **Recycling Attitude:** Has a neutral stance on recycling. He finds it important but is not actively engaged. He believes that recycling alone won't solve environmental issues.
• **Concerns:** Questions whether recycled plastics can maintain the same durability and technological performance as conventional materials. He would consider recycled plastic
	Tobias Richter (28)
	Main Barriers:
	• Concerned about **performance** and **innovative value**
	• Doesn't actively seek sustainable products
	• Open to recyclates if they match or surpass conventional materials
	Strategy:
	Position Recycled Plastics as High-Tech and Innovative
	• Market recyclate-based products as **next-gen technology**:
	  ○ "Futuristic materials"
	  ○ "High-performance recycled plastics used in cutting-edge aerospace & automotive industries"
	• Show **premium examples** (e.g., "This smartphone case is made from aerospace-grade recycled plastics").
	Appeal to Engineering Mindset & Performance Standards
	• **Technical data sheets & comparisons**: Clearly display recyclates' material properties (heat resistance, strength, flexibility).
	• Work with **tech influencers, engineers, and product reviewers** to test and endorse recycled plastic products.
	Incentivize Smart Purchases

products only if they are of equal or better quality.	• Offer **trade-in programs** for old gadgets and appliances, ensuring they're recycled into new high-quality products. Promote **limited-edition "Eco Tech" product lines** with exclusive colours or features made from recycled plastics

Spanish personas representing segment C Ambivalent and hesitant

Persona description	Tailored communication strategies
José Manuel Gutiérrez (55) – Small Business Owner in Seville **Background:** • Resides in **Seville**, where he owns a **small hardware store**. • Married, with adult children who have moved out. • **Traditional consumer habits**, prioritizing reliability over sustainability. **Relation to Plastics:** • Uses **plastic-based products** in his business, particularly in packaging and DIY materials. • Sceptical about **recycled plastic alternatives**, perceiving them as **less durable and potentially unreliable**. • **Not actively engaged in sustainability** but acknowledges its importance from a regulatory and business perspective. **Recycling Attitude:** • **Sorts waste** as per municipal guidelines but does not derive personal satisfaction from it. • Believes that **recycling should be industry-driven** rather than dependent on individual efforts. • Concerned about the **cost-effectiveness of recycled plastic** in professional applications. **Concerns:** • Questions **whether recycled plastic products meet industrial-grade quality standards**.	**José Manuel Gutiérrez (55)** **Main Barriers:** • **Sceptical about durability and reliability** of recycled plastic materials. • **Cost-conscious**—sees sustainability as a business regulation rather than a personal concern. • **Prefers traditional, well-tested materials** in his hardware store. **Strategy:** **Highlight Business Benefits of Recycled Plastics** • Offer **financial incentives**: Discounts, tax benefits, or bulk pricing for recycled plastic materials. • Showcase **real-life case studies** where hardware businesses successfully transitioned to recycled plastic alternatives. • Introduce **supplier partnerships** where manufacturers offer **free samples** of durable recycled plastic products. **Prove Durability with Demonstrations** • Organize **live product tests** at trade fairs and business expos: "See how our recycled plastic materials match traditional ones in strength." • Partner with **construction and industrial associations** to conduct **comparative durability studies**. **Regulatory and Competitive Framing** • Present **future-proofing arguments**: "Spain is increasing green regulations—get ahead by integrating sustainable alternatives now." • Show that **big competitors are already making the shift**, positioning recyclates as a **smart business move**.

• Uncertain about the **availability and pricing of recycled plastic materials in bulk**.	
Marta López (42) – Middle-Class Professional in Madrid **Background:** • Lives in a **Madrid suburb**, working as a **marketing manager** for a retail company. • Married, **mother of two children (ages 5 and 9)**. • Values **practicality and affordability** over strong environmental commitments. **Relation to Plastics:** • Regularly purchases **plastic-packaged consumer goods** and **household items**. • Open to **recycled plastic products**, provided they are **safe, well-designed, and competitively priced**. • Prefers to buy from **trusted brands** that guarantee product safety, especially for **children's products and kitchenware**. **Recycling Attitude:** • **Sorts household waste consistently**, following city regulations. • Supports **corporate environmental responsibility** but does not proactively seek sustainable products. • **Price-sensitive**—will not pay significantly more for products made from recycled materials. **Concerns:** • **Health and safety risks**, particularly for **plastic items used by children**. • Perceived **lack of transparency** in labelling recycled content in consumer goods.	**Marta López (42)** **Main Barriers:** • **Concerned about safety** of recycled plastics, especially for **children's products**. • **Price-sensitive**—will not pay extra for sustainability alone. • **Prefers well-known brands** and convenience when shopping. **Strategy:** **Guarantee Safety and Quality Through Certifications** • Use **trusted European certifications** to validate **recycled plastics in children's products and kitchenware**. • Introduce **brand labelling campaigns**: "This product is made with **certified non-toxic recycled plastic**." • Partner with **popular Spanish brands for baby products** and **kitchenware** to integrate recycled plastics in everyday household items. **Make Sustainable Shopping Effortless** • Ensure **recycled plastic alternatives are easy to find** in major Spanish supermarkets. • Work with e-commerce platforms like **Amazon Spain** to create a **"Recycled and Safe" product filter**, allowing customers to choose recyclate-based products easily. **Maintain Competitive Pricing** • Partner with **brands to absorb costs**, ensuring recycled products **cost the same as traditional ones**. • Offer **discounts or loyalty rewards** for buying products with recycled plastics.
Alejandro Fernández (29) – Tech Enthusiast in Barcelona **Background:**	**Alejandro Fernández (29)** **Main Barriers:** • **Sceptical about performance** of recycled plastics in electronics.

• Resides in **Barcelona**, working as a **software developer** at a technology firm. • **Single, urban lifestyle**, values **innovation and efficiency** in product choices. • Favors **cutting-edge design and functionality** over sustainability messaging. **Relation to Plastics:** • Uses **plastic-intensive electronic devices**, including smartphones, laptops, and home gadgets. • Indifferent to **whether plastics in his products are recycled**, as long as they maintain **high performance and durability**. • More interested in **circular economy innovations** if they align with technological advancements. **Recycling Attitude:** • **Sorts waste inconsistently**, as he finds recycling rules complex. • Believes that **corporations and policymakers should lead sustainability efforts**. • Supports **sustainable technology** if it offers tangible **performance benefits**. **Concerns:** • Doubts **the durability of recycled plastics** in electronics. • Sceptical about **the real impact of recycling on sustainability**.	• **Indifferent** to sustainability unless it **aligns with innovation**. • **Finds recycling complex** and **prefers companies to lead sustainability efforts**. **Strategy:** **Position Recycled Plastics as High-Tech & Premium** • Market **recyclate-based electronics as next-generation materials**: o "This laptop case is made from recycled ocean plastics—lightweight, impact-resistant, and stylish." o "Sustainable innovation: Our newest headphones are built with aerospace-grade recycled plastics." • Partner with **tech brands** to launch **limited-edition products made from recycled plastics**. **Use Performance-Based Messaging** • Highlight that **recycled plastics in tech products are tested for high durability and resilience**. • Offer **comparative stress tests** between recycled and traditional plastic components to prove performance. **Leverage Digital Marketing and Influencers** • Engage **Spanish tech influencers** on YouTube and TikTok to **test and review** recycled plastic electronics. • Create **interactive campaigns on Instagram and Twitter** showing how **recycled materials are used in cutting-edge tech**.

To **increase recyclate acceptance** among **Segment C personas**, strategies should focus on **practical benefits, quality assurance, convenience,** and **price sensitivity** rather than emotional or purely environmental appeals. **Messaging: Practicality Over Idealism:** "Recycled plastic isn't just good for the planet—it's better for you." **Quality and Performance First:** "Same durability, same price—just smarter." **Focus on Safety** – Address concerns with **proven data and certifications. Cost-Effectiveness** – Show **long-term savings and value** instead of framing it as an expensive eco-choice. **Trusted Brands Matter:** Leverage well-known companies to introduce recyclate-based products.